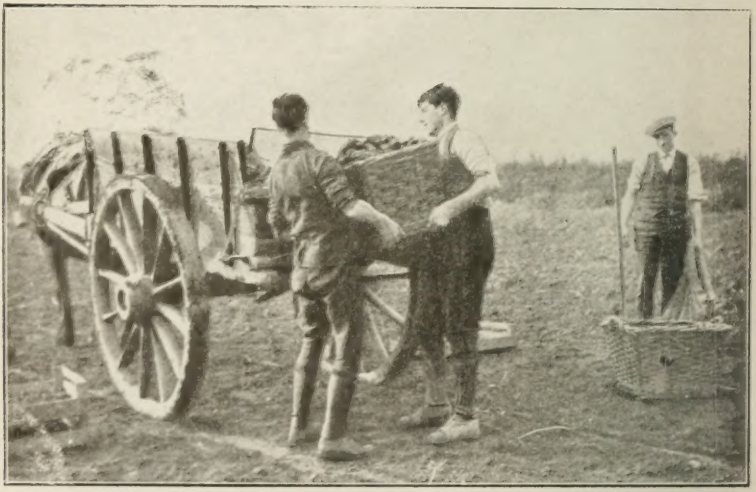
PHYSICAL REMEDIES FOR DISABLED SOLDIERS



DISCHARGED SOLDIERS AT WORK AT HOLMES CHAPEL AGRICULTURAL COLLEGE.

(1) Gathering potatoes. (2) The potato harvest.

PHYSICAL REMEDIES

FOR

DISABLED SOLDIERS

BY

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TO THE MEMORY

OF A

BRAVE SOLDIER

PREFACE

WITHIN the last year physical methods of treatment in military cases have attracted considerable attention, and in one form or another have been adopted in many places throughout the country. Much progress has been made in introducing them, or improving their administration, in the Army Medical Service, in the Auxiliary Military Hospitals, and also at the British Health Resorts.

Any writer may well hesitate in face of so large a subject, for, indeed, its adequate treatment would require the combined knowledge of many specialists,—in Hydrology, Electrotherapeutics, Radiology, Mechano-therapeutics, Remedial Exercises and Training, and Medical Climatology. All these sciences are now growing so rapidly that it is evident there must be for many years to come a corresponding development in medical practice.

Physical treatment is the convenient term which denotes the remedial use of these closely related physical forces. It may now claim to be a special department of Medicine, not in respect to the organs or diseases treated, but in respect to the remedies employed. The practitioner who at the present time chooses to devote himself to it will have a double reward, not only by making a sensible contribution to the vast problem of the restoration of the wounded soldier, but also by adding something of permanent value to medical science and art. I shall be satisfied if the present work may serve as a guide over rather unfamiliar ground, showing how certain valuable and closely allied methods of treatment may be utilized to the best advantage upon a basis of accurate observation and records.

I have to thank Major R. Tait McKenzie, of the University

of Pennsylvania, for kindly contributing a chapter on Mechanical Treatment and Remedial Exercises; also Dr. Hernaman-Johnson for one upon the Electrical Treatment of Military Cases, and Dr. J. B. Mennell for another on the Clinical Uses of Massage.

For permission to reproduce portions of papers, drawings, maps or illustrations, besides those specifically acknowledged in the text, I gladly express my obligation to the editors and publishers of the *Transactions of the Royal Society of Medicine*, the *Lancet*, *British Medical Journal*, *Practitioner*, *Clinical Journal*, *Journal of the Royal Army Medical Corps*, and *Paris Médical*; also to Sir Napier Shaw and H.M. Stationery Office, and to M. Léon de Paeuw, of the Belgian Government. An acknowledgment is also due to the well-known experts, Messrs. Shanks, for their skilful technical assistance.

For valued assistance and advice during the past two years, my grateful thanks are due to Drs. William Gordon, Septimus Sunderland and Campbell McClure, and the other members of the War Disablement Committee of the Section of Balneology and Climatology of the Royal Society of Medicine; and to Mr. Louis Allen and my other colleagues at the Red Cross Clinic for the Physical Treatment of Disabled Officers; also to my distinguished friends in the French and Belgian Army Medical Services, Drs. Camus, Quiserne, and de Marneffe; and, not least, to my daughter and constant helper in the preparation of this work.

R. F. F.

London,
May, 1917

CONTENTS

LIST OF ILLUSTRATIONS

PHYSICAL REMEDIES

INTRODUCTION

Physical Remedies in General.

THE object of these pages is a practical one. It is to collate and present in a convenient form the information which may be useful to those who are engaged in the treatment of soldiers and civilians—by heat and cold in baths, by electricity and radiation, by massage, mechanical apparatus, exercises and medical gymnastics, as well as by medicinal waters and climate in the British health-resorts.

The physiological action of the various agencies employed will therefore be only incidentally referred to. No time will be spent in the discussion of theories, however interesting; and where, here and there, principles are briefly stated, it is only with the object of making the actual practice intelligible and consistent. Only such conclusions are advanced in this work as have been attested by the experience of good observers. For a more complete account of these agencies the reader is referred to the standard works on hydrology and balneo-therapeutics, medical electricity, and physical exercise.

The care of vast numbers of wounded and invalid soldiers obliges the medical practitioner to explore and utilize many methods of treatment, some of which are unfamiliar, to find new remedies for new conditions, and often to apply old remedies in a new manner.

In particular, it has made it necessary to explore the group of remedies that are justly called "physical." The

experience of soldiers in camp or in the field has shown how swiftly both mind and body respond to physical conditions. Hard exercise and exposure to the weather in the course of military training have in a few months transformed delicate and languid youths into vigorous men, capable of withstanding the severest bodily or mental strain. Again, later on, in the field, these same men, reduced to an extremity of fatigue and exhaustion, have regained their elasticity and vigour in a few hours by the use of hot baths.

These are illuminating facts. They bring to mind some realization of the truth that the living organism exists in virtue of its continual contact with the energies supplied to it from without; that it is possible to live poverty-stricken in a *minimum* contact with this energy, and that there is an *optimum* contact in which the powers of life reach their fulness. The appeal to physical agencies is a primitive quality of life. And since life depends upon them for its well-being and proper development, so it is that to insure an ample and sufficient access to these sources of energy, by which they may be brought into vivifying contact with each individual, becomes the duty of those who are charged with the health of the community.

This dependence and this appeal seem to be at a maximum in the early years of life, in the period of development. They are well seen in what is called the " physical education " of children. But they are also the cardinal facts which underlie the laws of hygiene, and inspire the efforts of sanitation and preventive medicine. In adult age, and especially, perhaps, in the period of decline, it is necessary that civilized man should *retain touch* with the energies of the outside world; and the imperative need for daily " light and water and air " is now recognized in the case of populations crowded into cities, which too often bar their access to natural surroundings.

Passing across the hazy line that divides preventive from curative medicine, it must be admitted by all thoughtful persons that these same great and fundamental remedies are more employed and valued as their powerful action on the

body is understood. It is not too much to say that they now form a chief part in the recognized treatment of fevers and of tuberculosis, and of many chronic illnesses which respond to physical surroundings—to the influence of the fresh air and the rays of the sun, of heat, of cold, and of movement in wind and water. A little consideration will serve to make it plain that these physical agencies, so potent in their influence upon the human body in the period of development and in health, must have also an equally powerful operation and efficacy in the treatment of disease.

The physical forces are known to be closely correlated. It is questionable whether they ever act singly upon the human body. In the solar rays light is combined with heat and with other invisible radiation extending beyond the violet and the red. So it is in a lesser degree with all kinds of artificial radiation baths. The different kinds of rays are in process of being disentangled, and their medical value and uses determined. In the case of baths, also, the effects of heat and of cold upon the skin are combined with those of moisture and pressure, and sometimes of movement, and of the gases and salts contained in the water, besides those belonging to its physical qualities, such as electrical potential and radio-activity. Again, it is well known that frictions and movements are accompanied by heat and electric currents.

These examples show how closely physical forces are related to one another, and also how intimate and complex are the relations existing between them and the recipient human being. To bring those energies into effective operation upon the disordered tissues and organs of the body is the task of physical treatment. And it has for its foundation nothing less than a true and philosophical correspondence—dynamic remedies for a dynamic organism.

All this is more or less common ground, and it may seem unnecessary to emphasize admitted truths. The facts are obvious, but here as elsewhere it may be doubted whether the full *significance* of familiar facts is equally plain. The

more familiar the facts, the deeper and the more concealed is apt to be their meaning. The effect of cool fresh air in tuberculosis is one of a multitude of similar observations. Do these not unmistakably signify that there are *laws* governing the reaction of the human body to heat and cold, and that by virtue of these laws reactions may be produced in infective disease which increase the resistance of the tissues to invasion, and so check the extension of disease and favour the natural processes of cure? Do not such observations prove that there is in truth a complete body of doctrine, much of it still undefined, that will hereafter determine the actions and uses of physical remedies?

This is not the place to attempt to state or summarize, even in the briefest manner, the ascertained principles or laws which have been found to govern the action of physical remedies on the body. They relate to a department of medicine which is full of interest and but little explored, and presenting much opportunity for fruitful research. Although many facts are familiar, the *science* of physical treatment remains still in great part a *terra incognita* and a *doctrina indocta*.

Their proved effect upon the human body in health and disease marks out physical remedies as worthy of searching examination. No superficial study of this or that isolated method of treatment is of any permanent value. It avails nothing to proclaim *cold* as a remedy in the nineteenth century, or *heat* in the twentieth. What is needed is a critical study of physical remedies as a whole, and this goes best of all *pari passu* with their practical application. Here as elsewhere clinical study is the most accessible and the most fruitful field for research. Observation by the trained observer, aided by instruments of precision, will not only guide the course of treatment, but gradually build up the science upon which the art of treatment depends.

The treatment of soldiers is in one respect a new experience, because many of these patients are fit and healthy, were it not, perhaps, for the crippling of a limb or a disabling stiffness in one or more joints. Their trouble, therefore, is

entirely a local one, and it is obvious that only local remedies can be of service.

On the other hand, many men coming back from the field are seriously ill. Besides surgical and medical infections, they have wounds or disorders of the nerve centres. And the nervous injury is shown not only by many forms of paralysis and functional nervous disorder, but by disturbances of the circulation and nutrition. Among these invalids the trouble, whether infective or nervous, is partly general and partly local and both local and general treatment is applicable.

For both local injury and for infective or nervous disorders physical remedies may be brought to bear by the surgeon and by the physician, and often, as will be shown in subsequent chapters, from an early stage in the case.

Physical treatment has acquired a new value in two departments of practice which stand rather at the poles of medicine. Surgery is finding aid from many remedies of this kind, and these, instead of being reserved as a *dernier ressort* for convalescent homes and camps, are now employed from an early stage in surgical cases. And at the other medical pole the same class of remedies are powerfully assisting *psychological* treatment. It is a perfectly sound principle that one impression should be made to assist another. Persuasion, suggestion, the influence of one personality over another, which are everyday facts, sometimes depend for their efficacy upon associated physical treatment, which has a whole series of powerful impressions at its command, and can often act through the body upon the mind. How much of the way one walks by sight, and how far by faith, is after all a secondary matter, if the journey is accomplished.

PART I

HYDROLOGICAL REMEDIES AND THE INDICATIONS FOR THEIR USE

CHAPTER I

REMEDIAL BATHS

REMEDIAL baths are of two kinds, according to their degree of heat in relation to the human body. The division between them is the crucial point 93° F., which is the average temperature of the skin. Baths that are above this point of temperature increase the bodily heat, and those below 93° diminish it. It is important to recognize that baths of all descriptions are subject to this grand division into cooling baths and heating baths, and that to each of these two kinds belongs a separate group of actions and effects in disease. It must, however, be remembered that, while temperature is the chief property of a bath, its effect, cooling or heating, will sometimes depend upon the condition of the body or of portions of the body.

Classification by Temperature.

1. Cooling Baths.—Cooling baths have a range of temperature from 93° to 65° F. Immersion baths at a lower point of temperature are unsuitable to persons out of health. Baths of this kind are especially applicable to acute forms of disease, such as specific and other fevers. They may be applied in a great variety of ways, according to temperature and duration, and to the entire body or to portions of it. The application of water within a certain range of tempera-

ture below that of the skin ("cooling hydrotherapy") is a valuable form of *surface treatment*. It should generally be accompanied by frictions, particularly in conditions of weakness and where low temperatures are employed (see Chapter III.).

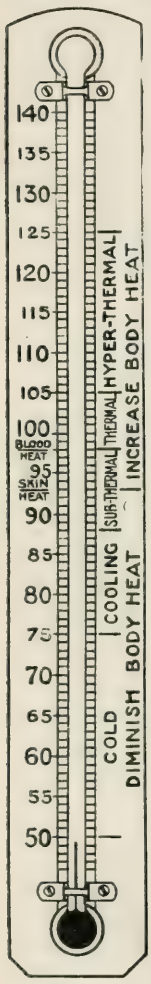


FIG. 1.
THE AUTHOR'S MEDICAL BATH THERMOMETER.

2. Subthermal Baths.—A particular group of effects belongs to baths having a temperature from 90° to 98° F. The skin heat in many parts of the body is often considerably below 93°, and therefore these baths very nearly correspond to the range of temperature between that of the skin and that of the blood. In all febrile states they are necessarily *cooling* in their character, but for persons of subnormal temperature they may be *heating* baths. It should be noticed that their degree of warmth corresponds closely to that of portions of the body, and that they tend especially to equalize the surface temperatures. Their effects (especially upon the nerve centres and circulation) are clearly marked off from those of baths at more extreme degrees of negative and positive heat.

The epithet "subthermal" serves to distinguish this important kind of medical bath. It is very necessary that this especial class of baths, with its limited range of heat in close relationship with the body, and with its definite group of physiological effects, should not be confused either by the medical man or by bath attendants with baths of any other kind; and therefore this name, although barbarous to the purist, has obvious advantages over its natural rival. "*Hypothermal*" might easily in practice be mistaken for *Hyperthermal* baths, which are totally different in their character and effects.

Cardiovascular Baths.—Two important forms of subthermal baths must be here mentioned: (*a*) *Cardiovascular*

Baths—that is, baths of a subthermal range, especially adapted for cardiac and vascular affections. There is a considerable variety of such baths, in all of which the temperature should be carefully adjusted to the individual reactions of the patient. The temperature is often lowered, and the reactive impression increased, by slow degrees during a course of such baths. Subthermal temperature in a watery medium may of itself serve to control a disordered cardiovascular action, both slowing and strengthening the action of the heart, and relieving spasm of the peripheral arterioles. But over and above this chief action of heat in the bath, a further action is produced by the addition of salines and gases. By such additions the effects of temperature may be considerably augmented and modified. The effervescent salt or muriated subthermal bath may be given in natural waters, or in water artificially prepared, with results that are similar, although not identical. There are no natural medicinal waters of this description in the British Islands, but cardiovascular baths are given at most of the British health-resorts. The salt waters of Droitwich and Woodhall Spa are well adapted for them, whilst sea-water is used for the same purpose at Sidmouth and Torquay. Such baths form a valuable arm in the treatment, not only of disorders of the heart and circulation (such as the familiar "D.A.H." of soldiers), but in neurasthenia and in the convalescent state.

(*b*) *Long-continued and "Pool" Baths.*—When baths are given at the temperature of the skin, no impression of heat or cold is produced, and the bath may be continued for long periods. In such a case the human body, like that of an amphibious animal, exchanges a gaseous for a watery atmosphere. An equable, uniform, and unchanging sensation of temperature is substituted for the multitude of changing impressions which ordinarily fall upon the body; and to this the influence of moisture and the gentle pressure of the water must be added. The total effect is sedative, which is shown in the action on the nerve centres and circulation.

In surgical practice such baths, local or general, are used for painful or unhealed and discharging wounds, and for septic poisoning. In medical practice they have a wide application, and at many spas having subthermal waters, like Loeche-les-Bains, long-continued baths have been in use for many years.

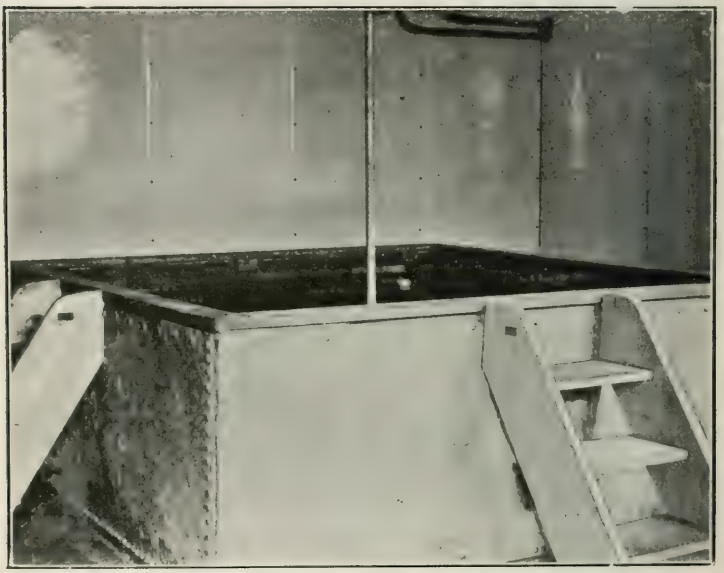


Fig. 2.—The Pool Bath.

Sedative Pool Bath.—A sedative pool bath has been recently devised * and introduced for the treatment of wounded and invalid soldiers. Fig. 2 represents the pool bath erected at the Heaton Park Command Depot. It can accommodate ten to twelve soldiers at once, who are seated in the water, which covers their shoulders. Water is constantly flowing through the pool, of which the temperature is fixed at 92° to 94° F. by a thermostatic valve. It is stated that the

* See "A Model Hydrotherapeutic Installation for Soldiers, with a Ground-Plan," and "Indications and Directions" for the use of the several treatments in military cases, prepared for the use of the Command Depot at Heaton Park in November, 1915, and published in the *Journal of the Royal Army Medical Corps* for May, 1916.

pool has been used with marked benefit in many cases of disordered action of the heart. After a month to six weeks' treatment, light physical training and light route marches have been undertaken without much discomfort. A pulse of 120 on admission, after a daily immersion of an hours' duration, soon slows down to 95 or 80* (see chart on p. 27).

A similar bath was installed in April, 1916, at the Command Depot at Tipperary. Referring to the installation at Tipperary, Professor Sims Woodhead writes:

"We have had as many as 155 bathers in a day, with an average of 130; and more than half of these are treated in the pool bath, though we also use the shower, douche, and needle baths pretty freely. We use the pool bath principally for shell-shock cases, many of them doing exceedingly well under this treatment; though a few, who seem to have got into a lethargic condition, do better under a hot douche, followed by an almost cold douche or spray. A few of the shell-shock cases do not appear to get any benefit from the pool bath, but I must say that they are the exception. Most of them contend that they feel tired and sleepy afterwards; but this is just the effect that I now wish to obtain, for every man is sent back to his bunk for an hour's rest. They gradually form a habit of sleeping, which becomes more and more marked as time goes on, and with this the dream becomes a less marked feature. I think that the blood is drawn away from the nerve centres, and that it gives the vessels a rest, and allows them gradually to 'tone up.'"

The following notes on the use of long-continued baths have been kindly furnished to the author by Captain Edward Ryan, C.A.M.C., of the Rockwood Hospital for the Insane at Kingston, Ontario:

"I have had upwards of ten years' experience with the long-continued baths at the Rockwood Hospital. Our installation was the first of its character in Canada. This form of treatment has been especially serviceable in soothing and calming excited patients. In all cases where there is

* See "Hydrotherapy as an Agent in the Treatment of Convalescents," by F. Radcliffe, M.B., *Brit. Med. Journ.*, October, 1916.

any manifestation of toxæmia, and in depressed cases, we have used the baths. In fact, we have found them very serviceable in the great majority of toxic cases. The temperature of the bath ranges from 92° to 96°, and the patients have been kept therein for five hours at a time, or even for ten hours a day for three or four days, after which the time would be somewhat reduced. The clinical effects noticed were slowing of the pulse, lowering of the temperature, equalizing of the circulation, lowering of the blood-pressure. It had a marked effect in calming excited patients. In maniacal depression with constipation, foul breath, loss of appetite, etc., the continued baths helped materially in clearing up the symptoms.

" At the Ontario Hospital at Orpington we have used these baths in cases of shell-shock. Two instances that I may mention will illustrate our work. One case admitted to the hospital deaf and mute was quite depressed. We gave him treatment in the continued bath covering a period of nearly two weeks. The patient recovered hearing and voice, gained in weight, and has left the hospital. Another case was admitted with marked excitement; this patient was also deaf and mute, was very irritable, and would jump at the lightest touch. He was placed in the continued bath daily, and made a very satisfactory recovery. The patients at Orpington now realize the value of the bath, and take very kindly to the treatment.

" It has also been used in surgical cases for septic wounds. To illustrate: One case, a gunshot wound in the knee, became very septic, abscesses forming freely, dissecting the muscles both above and below the knee. He was placed in the bath when his condition was at the worst, and when there were marked symptoms of constitutional toxæmia. The wounds cleared very satisfactorily, the temperature fell, the patient's appetite markedly improved, although, unfortunately, we found it necessary, on account of severe hæmorrhage, to amputate the limb."

Further references to the action of pool baths, and the indications for their use, will be found in subsequent chapters.

3. Thermal Baths.—These baths range in temperature from 98° to 105° F. Their action is to dilate the peripheral vessels and increase the frequency of the pulse, in proportion to their degree of thermality. They also stimulate tissue change (catabolism), and so in two ways increase the amount of heat in the body—that is to say, both by adding to heat production and by diminishing heat loss, since the body is immersed in a medium hotter than itself. It will be obvious that such baths—and this observation applies to all sorts of hot baths—open a wide door to possibly injurious effects. They have a clear and definite application and value in treatment; but their effects must always be watched with care, especially as in a " course of baths " these effects are cumulative and rather insidious, and are very apt to be manifested at a later stage, some time after the treatment is concluded. The nature and symptoms of " thermal debility " cannot be further dealt with in this place; but the subject is of great importance, and should always be kept in mind by those who prescribe and administer bath treatment.

Thermal baths are employed when it is proposed to stimulate the circulation and increase the bodily heat, especially in many chronic disorders (rheumatic and gouty)—where the tissue exchanges are sluggish, the circulation languid, and there is a tendency to morbid deposits and effusions, as in most forms of arthritis and fibrositis—and in uratic disorders. There are grounds for thinking that under thermal treatment the catabolism of morbid tissues is stimulated more than that of healthy tissues. In the chronic disorders just mentioned, there are often foci of congested and subinflammatory tissue, and thermal treatment frequently causes in these an increase of reaction, with pain, swelling, and tenderness, an example of a morbid process being temporarily intensified (intensive treatment) and made more acute, and amenable to the natural process of cure. By increasing the circulation in the muscles, thermal baths, which may be accompanied by movement and massage (*vide infra*), are often helpful in paralysis.

The later effects of heat developed after thermal baths, already alluded to as " thermal debility," are apt especially to fall upon the heart, producing sometimes serious forms of heart weakness, from atony and dilatation of the heart and bloodvessels. In order to minimize or prevent these late effects it is well to terminate all hot immersion baths with a brief application of cold. This tends to tone up the surface vessels, and stimulates and slows by reflex action the ventricular contractions. " Cold after heat " is a good axiom for the medical as well as for the hygienic use of baths.

4. Hyperthermal Baths.—The merit of these baths is founded upon the physiological fact that the impression of heat produces a brief and primary stimulant effect upon the body, and that, within limits, the hotter the application the stronger is the stimulant action. The value of brief hyperthermal baths in collapse and fevers is described elsewhere.

Their action in chronic disease is equally well marked. They rapidly stimulate the sluggish circulation and glandular activity of the skin. In Japan such baths have been used for many centuries, as a chief method of cure for sluggish cutaneous and other diseases. They have for their object to take advantage of the first stimulant effect of great heat, but to avoid the secondary " thermal debility." This is done by making the immersion very brief, and by a subsequent cold affusion. Their action upon the body is that already mentioned under Thermal Baths, but more intense, in proportion to the temperature.

Different Forms of Baths.

Douche Baths, Shower Baths, Needle Baths.—These methods have a great advantage over immersion baths in two respects. First, as a medium of heat they admit of gradual increase and diminution; and in the douche the usual sequence of gradually increasing heat abruptly followed by cold is an ideal use of heat. The prime rule, *minus after plus*, which should generally govern the ap-

plication of heat to the body, is thereby fulfilled. Secondly, in these baths the effects of percussion in the douche or some

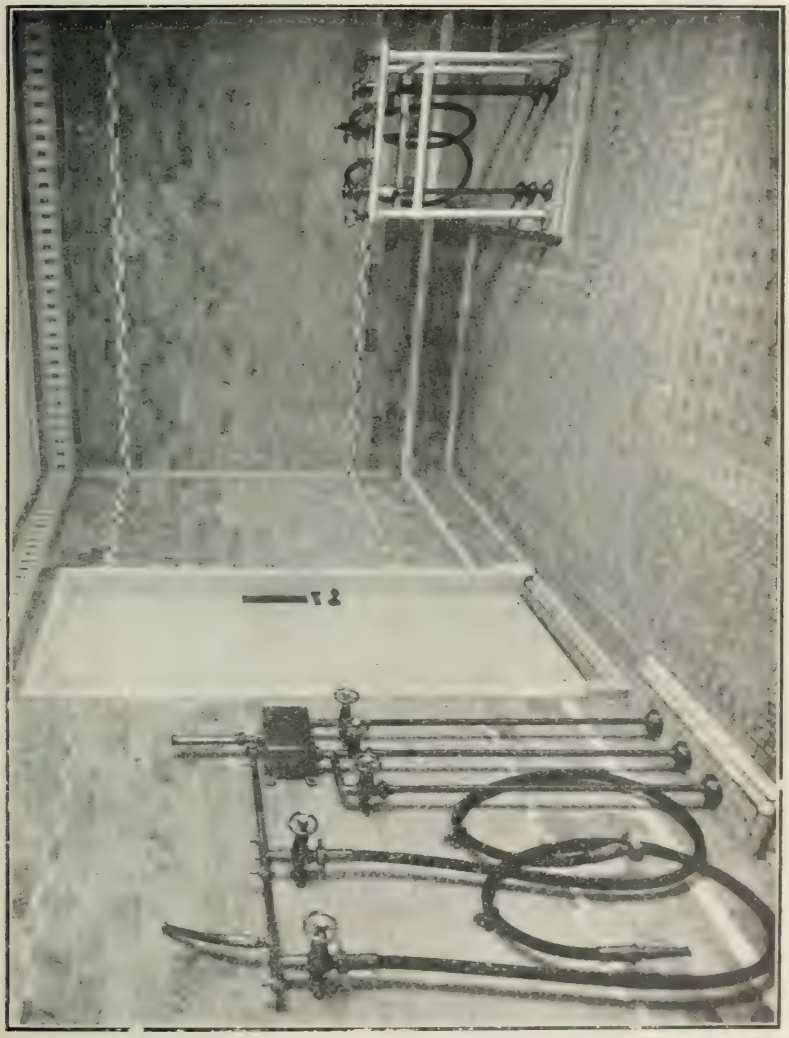


FIG. 3.—DOUCHE ROOM AT THE MEDICAL BATHS AT TORQUAY

gentler form of mechanical stimulation are added to those of temperature, and these stimuli, as is well known, may be made to reinforce the action of heat and cold.

On the other hand, when a gradual and more prolonged action is required, immersion baths have the advantage; for the douche is necessarily of brief duration, one to three minutes, whilst the immersion is usually ten or twenty times as long, and may be indefinitely prolonged.

It naturally follows that in general douches are stimulant baths, admirable for hygienic use and for vigorous persons, and having a wide range of application as a tonic treatment in the slighter forms of illness, particularly in atonic forms of dyspepsia, sluggish circulation, neurasthenia and neuralgia. But they are inapplicable, and should be avoided, when a sedative action is required. Their action and uses may be sharply contrasted with those of the sedative pool bath.

Douches and showers form an ideal school bath, whether for cleansing purposes or as a refresher after exercise, and are also most useful in hospitals, asylums, and convalescent camps—in short, wherever a routine daily tonic regimen is required.

Hot Air and Vapour Baths.—Very high temperatures may be applied to the body in the medium of dry air, rising in the Turkish bath to upwards of 200°. The effects of heat in hot air are quite different to those observed in baths. In the hot air bath there is no bar or hindrance to the cooling of the body. In a prolonged immersion bath heat is piled up in the tissues, and " thermal debility " frequently results. In the hot air bath, on the contrary, there is an increased loss of heat by copious perspiration and evaporation from the skin, and in health this abundant loss of heat compensates for the increase of heat communicated by the bath. The Turkish bath is therefore primarily a stimulant of the cutaneous functions, both glandular and circulatory. Like the douche, it is a stimulant unsuitable for very weakly, over-sensitive, or feverish persons, or those who cannot perspire freely.

Vapour Baths.—Vapour baths are usually more sedative in their action than hot air baths, and the range of temperature is lower—from 100° to 130°. These baths are of several kinds, according to their temperature and the

degree of saturation. In the Russian bath the air is very hot and saturated with moisture, and the action on the skin and circulation is very intense, surpassing that of the Turkish bath. Baths of this maximum intensity can only be borne by those well habituated to them, and have but a limited application in medicine. But baths of a lower heat, and not fully saturated with moisture, are of much value, and may be readily given with simple apparatus, either seated or in a recumbent position. At many thermal springs there are natural vapour baths or grottos, where the bather can spend several hours in moist air at a subthermal or thermal temperature. This is soothing to irritated mucous membranes, favours the action of the skin, restores the peripheral circulation, and is therefore often beneficial in rheumatic and catarrhal affections and in irritable neurasthenia.

Manipulation and Massage Baths.—Mechanical treatment by massage and manipulation is often more effectual in association with the bath. For example, joints stiff and painful as a result of injury or rheumatism can be generally moved and manipulated *under water*, and in a *reclining position* without discomfort, although the same movements would be impossible or very painful without the bath. This is partly because thermal baths relax muscular spasm and occupy the patient's attention. But the specific gravity of the body and its members is so nearly that of the watery medium that the apparent weight of the part immersed in the bath is balanced by that of the displaced water, and therefore painful limbs can often be moved either voluntarily or by the hands of the attendant, with comparative ease, when the patient is reclining in water.

Many natural thermal waters have been used in this way for manipulation baths; and physicians at Bath in the eighteenth century have recorded remarkable instances of the value of this practice.

Another useful form of manipulation bath is the *massage douche*, with which the name of Aix-les-Bains in Savoy has been generally associated. It is important to observe that this method is entirely different in both action and uses from

the douche proper. In the ordinary douche, water under considerable pressure is directed upon the patient, so as to produce a very powerful mechanical stimulation, and there

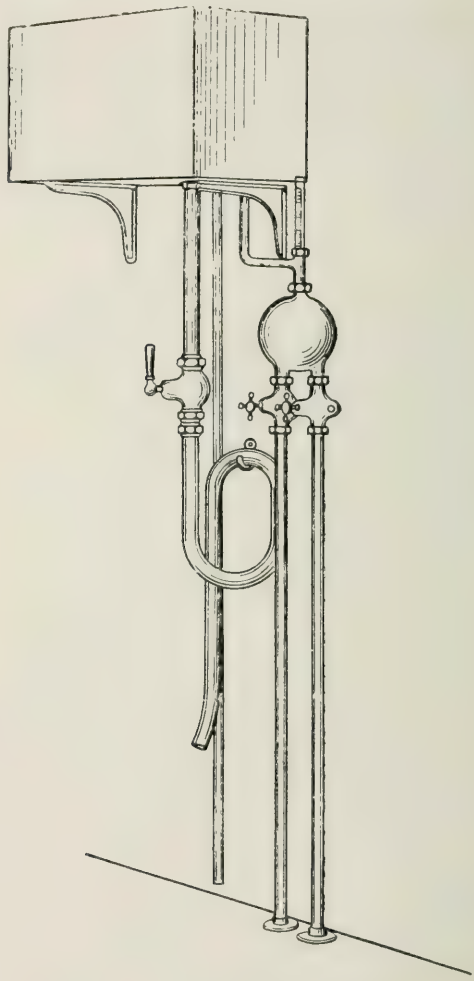


Fig. 4.—Low-Pressure Douche.

is a considerable range of temperatures, often with abrupt changes. In short the douche bath is above all a tonic procedure, and, indeed, *facile princeps* the most tonic and least sedative form of hydrological treatment (see Fig. 4).

But the massage douche, properly administered, is a soothing and gentle procedure, which may be given with advantage to weakly and delicate subjects, and often in cases of cardiac weakness and degeneration. The water at subthermal temperatures, at or about 95° F., pours, *without any pressure*, from an open mixing chamber (*boite de mélange*), and flows full bore in a copious stream over the patient, seated or reclining. The pervading sense of warmth and the gentle movement of the water are pleasurable and gently stimulating, and to this is added whatever form of massage is best suited to individual requirement. It should, however, like the flow of water, be gentle and continuous rather than intermittent or powerful (see Fig. 4).

It should be added that *water under pressure* (as in the ordinary douche) is entirely unsuitable for this form of treatment, and might easily cause serious ill effects in cases of nervous or cardiac weakness. For this reason the ordinary appliances of the douche room cannot be used for the massage douche, unless the necessary fittings for douches without pressure are also provided.

In addition to the cases already mentioned, the massage douche is applicable to neuritis and painful scars, fibrositis in many forms, and to gouty and other toxic disorders in debilitated subjects.

For an account of the natural British baths—thermal, salt, sulphur, etc.—the reader is referred to Chapter XV

Local Baths.

Local baths are of value first of all as thermal stimulants, according to their temperature, and secondly as affording special forms of local stimulation, either chemical or mechanical.

Local Vapour Baths.—These are given at comparatively low temperatures, with unsaturated vapour. The effects of moderate heat are therefore combined with those of moisture. The lower or upper limb can be readily enclosed in a vapour bath of this kind, and also parts of the body, like

the shoulder, that cannot be so easily immersed in other local baths. Many thermal spas have appliances for using the natural vapour in this manner, and at other health-resorts steam at low pressure is employed.

Hot Air.—A great variety of boxes, cylinders, or chambers, have been devised, served with dry hot air (150° to 250° F.) for local application to the upper or lower limb. One of the first was the " thermal air chamber " used at Strathpeffer for the treatment of rheumatoid arthritis (Fig. 5).* This

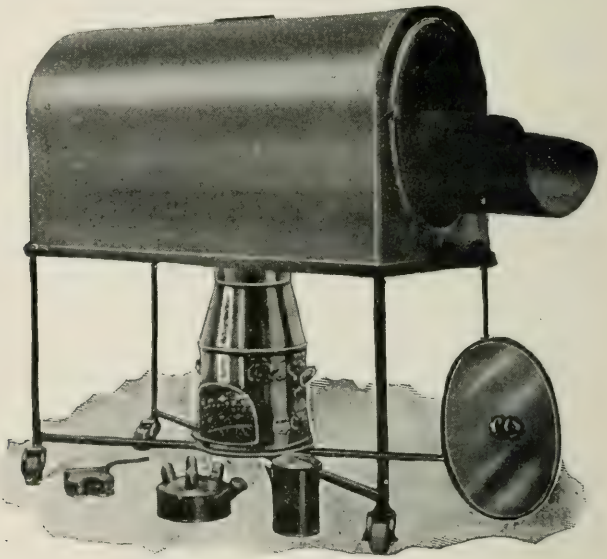


Fig. 5.—Thermal Air Chamber.

and later Bier's hot air chambers were first heated by spirit lamps, and subsequently by an electrical resistance. The appliance associated with the name of Dr. Tyrnauer of Carlsbad is similar in principle and construction, but not superior to those of British manufacture.

In one form or another, hyperthermal applications to injured or stiffened and painful limbs are of great value, and are generally very well borne. They often relieve pain

* See *Journal of British Balneological and Climatological Society*, July, 1899. The apparatus is manufactured by Mr. J. C. Stevens, Marylebone Lane, W.

and greatly increase the circulation and facilitate the movements both of muscles and joints. The limb and sometimes the patient perspire very freely; and it is necessary that the box should be ventilated, otherwise the heated perspiration may scald the skin. Unless the skin acts very freely, the hot air bath is badly borne, and moist heat should be employed. It is, indeed, questionable whether dry heat in this or any other form produces the same emollient effect as heat in a

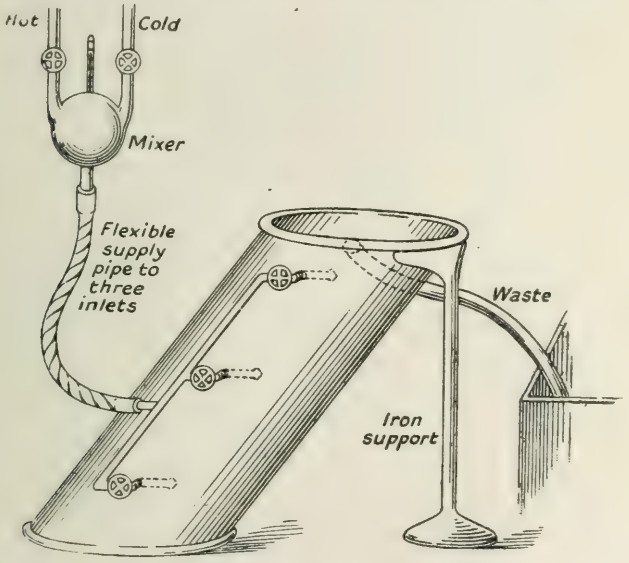


FIG. 6.—FRENCH "EAU COURANTE" BATH FOR THE LEG.

watery medium, although in the air bath the temperature is usually far higher than in water.

Hot Air Douches.—These are employed to convey heat to the shoulder and back or other parts to which a local bath cannot be conveniently applied. The jet of air, heated by an electrical resistance, is sometimes found soothing in neuritis and neuralgia.

Whirlpool Baths.—These are local baths in which a whirling movement or agitation has been communicated to the water by means of jets entering the bath, or by a turbine or other mechanical device, or by the injection of compressed

air. The use of local baths of this kind in the British Islands was first proposed by the author* when studying the method employed in France for dealing with the stiff and swollen limbs of wounded soldiers, under the name *balnéation à l'eau courante.* In the French bath the movement is supplied by the incoming water. A comparatively gentle and rotatory movement is thus produced, but at the expense of large quantities of water. Various types of the whirlpool

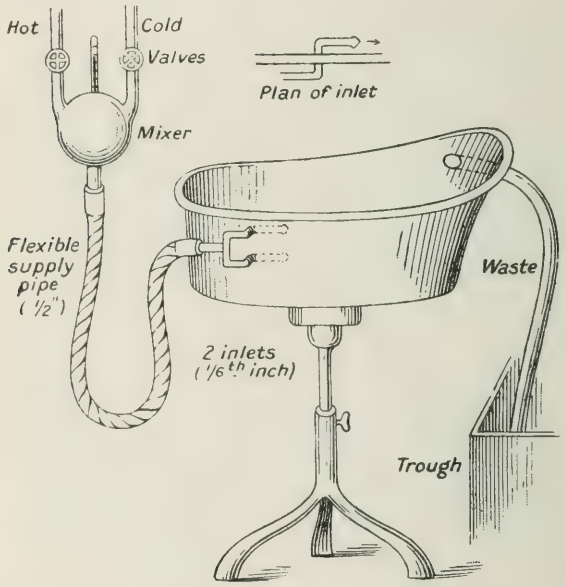


Fig. 7.—French "Eau Courante" Bath for the Arm.

bath have been designed and constructed in England and Scotland, applicable not only to the limbs, but also to the entire body, either in a sitting or a reclining position. In all of them the effect of heat is supplemented by that of more or less powerful movements of the water having an action which may be described as "hydro-massage."

For the *eau courante* bath a considerable pressure of water

* See Report of the War Service Special Committee of the Section of Balneology and Climatology of the Royal Society of Medicine, August, 1915; also *Journal of the Royal Army Medical Corps,* October, 1915.

is necessary, equivalent to not less than a 50-feet head; and, naturally, a large quantity of hot water is consumed. This is not the case with the British Whirlpool Baths.

In the electrically driven bath a turbine (protected by a grating) revolves rapidly in the bottom of the bath.

A very stimulating form of whirlpool bath is that which is operated by compressed air. This has been installed in the Red Cross Clinic for the Physical Treatment of Disabled Officers in London.*

Another excellent method in which a series of whirlpools are operated by a pump and automatically kept at a constant temperature, has been devised by Major H. S. Souttar, R.A.M.C., for the British Red Cross Hospital at Netley. This bath is very economical of heat and water, as when once the temperature is set the water can be circulated indefinitely with a gas burner to maintain the heat.

The limb baths are usually given at a thermal (100° to 105° F.) or hyperthermal (105° to 120° F.) temperature, and may be continued for fifteen to forty, or even ninety, minutes.

Whirlpool baths stimulate the arterial circulation in the most powerful manner. Their action in this respect is more striking than that of any other method with which the present writer is acquainted. That they also stimulate the lymphatic circulation, and accelerate the retrogression of inflammatory processes, seems clear from the rapid diminution of œdema and synovial and other effusions that sometimes attends their use. They have a marked sedative effect in relieving pain and muscular spasm, and often enable painful and sensitive limbs to be handled and moved with comparative ease. They are consequently used *inter alia* for trophic lesions resulting from prolonged suppuration, chronic œdemas, swellings of the periarticular tissues, fractures of the articular ends of the bone, and painful and adherent cicatrices. Hyperthermal whirlpool baths may be given with advantage as a preparation for massage and movement, which are by their use rendered easier and less

* A complete series of whirlpool and aëration baths, both for the limbs and for the entire body, has been manufactured and generously presented to the clinic by Messrs. Shanks and Co., of Barrhead, near Glasgow.

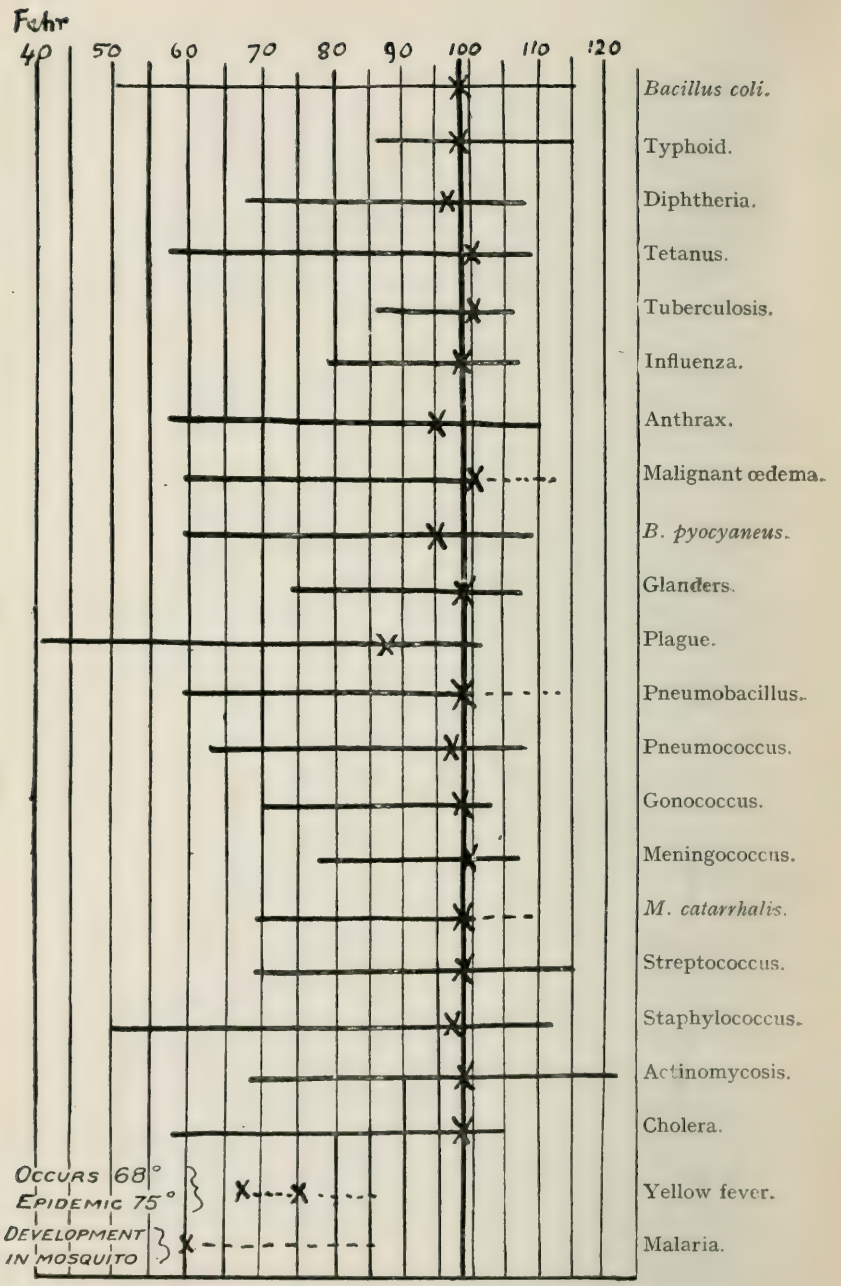


FIG. 8.—HEAT LIMITS FOR GROWTH OF PATHOGENIC ORGANISMS.
(X = optimum temperature.)

painful. Similar baths at a lower temperature promote the cleansing and healing of wounds and the separation of dead tissue. These baths have been extensively used at the London clinic just mentioned (see Chapter XIII.), especially as a preparation for, or in substitution of, massage and to assist the mechanical treatment of injured limbs.

Those who have had to treat a large number of injuries after the wounds have healed and inflammatory reactions have subsided will notice that the temperature of the limb is usually subnormal, no doubt in consequence of long disuse and immobility. The part is often blue and cold to the touch. This will be readily appreciated by observing the colour and temperature of the corresponding arm or leg. The whirlpool bath, repeated day by day, in many cases restores the normal warmth and colour. This alone, no doubt, assists the processes of nutrition and repair, whether of bone or of the softer tissues.

But it seems probable, also, that raising the temperature of the limb 12 or 15 degrees above blood heat hinders the activity of included pathogenic micro-organisms (see chart). It is remarkable that many of these microbes are limited, as respects their growth and activity, to a very narrow range of temperature. If they thrive best, as is usually the case, at about the temperature of the blood, it should be sometimes possible to deal effectively with localized pockets of microbes in the vicinity of scars and wounds simply by raising the temperature of the tissues. This may probably be part of the *rationale* of whirlpool and other local hyperthermal baths, as well as the "intention" of the pyrexial reaction in infective disease.

It has fallen to Dr. F. P. Nunneley, of Llandrindod Wells, to make the first connected series of observations* upon the action of whirlpool baths, and by his kind permission they are here appended. The record of these first experiences with an early type of whirlpool bath cannot fail to be of interest to medical men in many places, who are employing physical treatment for soldiers.

* See *Brit. Med. Journ.*, November 25, 1916.

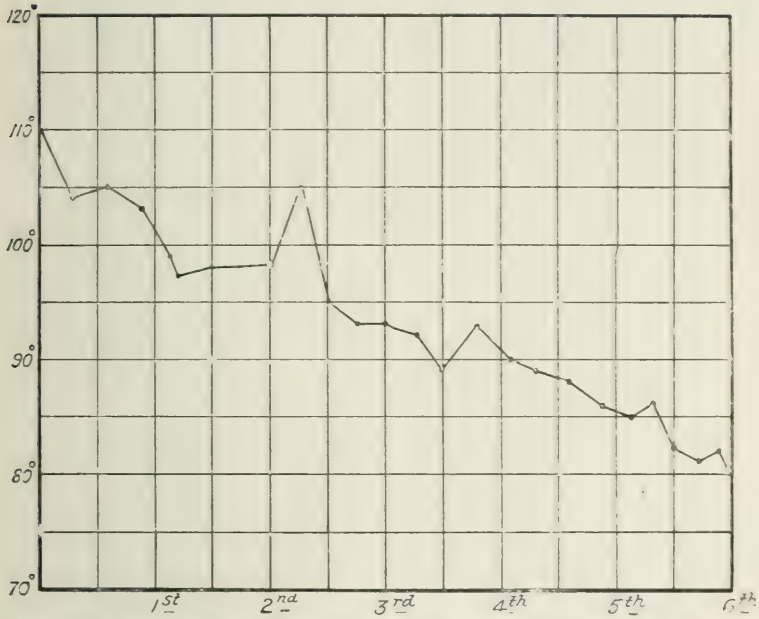
"The following notes are based upon experience gained in the Physical Treatment Department of the Red Cross Auxiliary Hospitals for Officers, Brighton.

"The baths are of the French type, and were presented by H.R.H. the Princess Royal. Within four months more than sixty cases have been treated.

"The period of immersion is usually of twenty minutes' duration; the temperature should be as high as can be comfortably borne—in most cases from 110° to 120° F. Before the limb is immersed, the bath is filled with water at a temperature of about 100° F., and the temperature is gradually raised to the limit of endurance. It will frequently be found that the higher ranges of temperature—110° to 120° F.—cannot be borne at first, but, as a rule, after one or two treatments tolerance is acquired. It is necessary to proceed very cautiously when treating cases in which nerves have been injured and there are areas of anæsthesia or partial anæsthesia. The skin supplied by the injured nerves is frequently in a very atrophic condition, and scalding of these areas may take place, without the patient having complained of any discomfort in the normal portions of the limb.

"Very shortly after the limb has been immersed in the bath, the skin becomes flushed, pain is relieved, and a feeling of comfort is experienced. The tissues become more supple, and movements can be made which previously were painful or impossible. After the bath the limb is found to be in a condition of considerable hyperæmia. The skin is red and feels hot, and it is probable that the internal temperature of the limb also is temporarily raised. There is usually a slight increase in bulk, varying in the case of the thigh from half to one-third of an inch in circumference. The tissues are soft and relaxed, and will bear manipulations which before the bath would have been too painful. In a large majority of cases the whirlpool bath is used as a preparation for subsequent massage and manipulation. In this hospital radiant heat was formerly used for this purpose, but when the whirlpool baths had been installed they were substituted for the radiant heat in every possible case,

so that the views of masseurs and patients who had had experience of both methods of treatment could be obtained. The opinions expressed were unanimously in favour of the baths. The masseurs said that the tissues and joints were more easily manipulated, and the patients that the manipulations were less painful. Subsequent experience has confirmed the correctness of these early observations. Adhe-



AVERAGE PULSE-RATES OF TEN CASES OF DISORDERED ACTION OF THE HEART DURING SIX WEEKS' TREATMENT BY THE POOL BATH AT HEATON PARK (DR. FRANK RADCLIFFE).

sions are frequently and almost painlessly broken down, and function seems to be restored more rapidly. Some members of my staff have found that, when there is great tenderness, they can employ deeper massage and obtain more movement while the limb is still in the bath than if they wait till afterwards. But the whirlpool is not only a thermal bath; in virtue of the lavage and elastic pressure produced by the rapidly moving water, it must be regarded as an efficient form of gentle massage. In cases where the use of hand

massage is contra-indicated by the danger of disturbing the barriers erected by Nature against the spread of infection, the whirlpool bath is of considerable value. An increased flow of blood is induced by its thermal qualities, whilst resolution and removal of inflammatory products is facilitated by the massage of the rapidly moving water.

" When nerves in the vicinity of a wound have been slightly injured, but not destroyed, treatment is apt to be extremely difficult. The application of heat frequently increases the pain, whilst massage—which may be urgently needed for the preservation of the utility of the limb—is rendered impossible by the pain which it causes. In these cases the whirlpool bath at a " neutral " temperature acts not only as a substitute for hand massage, but also relieves the pain to a remarkable extent.

" The pain in the missing hand or foot, so frequently felt after amputation, is rapidly allayed by the whirlpool bath. The effect of the bath seems to be increased if one of the jets is allowed to play directly on the tissues covering the nerve which is apparently at fault.

" In the light of the writer's very limited experience, the use of the whirlpool bath as a preliminary to the breaking down of adhesions under anæsthesia is of doubtful value. Owing to the hyperæmic condition of the tissues, the advantage gained by the decreased amount of force required seems to be more than counterbalanced by the increased bruising which ensues.

" So far as the writer's information goes, the whirlpool has not yet been employed in the treatment of recent wounds; but it seems probable that its use in this connection would be very valuable, especially when a large sloughing area could be exposed to the action of the water. Owing to the difficulty of cleansing the motor bath, it would be necessary to use an apparatus of the French type.

" The following cases may be of interest as illustrating the foregoing remarks. Except when otherwise noted, the angles are calculated from the position of full extension, the axis of the upper bone entering into the joint, and an imag-

inary line produced past the joint, in continuation of the axis, forming the diameter of a circle of which the joint is the centre. *E.g.*, 10° of flexion at the knee-joint means that the tibia, forming a radius of the imaginary half-circle, makes an angle of 10° with the imaginary line passing through the knee-joint.

" I. 22/12/15: Fracture of left femur, 2 inches below great trochanter. Admitted 4/7/16; much periarticular swelling of the knee-joint, a little fluid in joint, flexion 10°. Whirlpool bath and massage. 26/8/16: Very little periarticular swelling, still a little fluid in the joint, flexion 90°.

" II. G. S. W. Fracture right femur, upper third. Admitted 29/7/16; wound healed, flexion of knee 20°. Whirlpool bath and massage. 1/9/16: Flexion 113°.

" III. Shell wound left foot, very septic. Admitted 14/7/16; wounds healed, much swelling of foot and ankle, foot in toe-pointed position, range of movement at ankle 15°; no movement at interphalangeal or metatarsal-phalangeal joints. Whirlpool bath and massage. 1/9/16: Swelling much decreased, all interphalangeal and metatarsal-phalangeal joints move well, range of movement at ankle 23°.

" IV. G. S. W. of left elbow in neighbourhood of head of radius: comminuted fracture lower end of humerus. Admitted 9/8/16; wound healed, union firm, pronation and supination weak and incomplete, elbow can neither be fully extended nor fully flexed, range of movement 30°. Whirlpool bath and massage. 1/9/16: Pronation and supination complete and fairly strong, range of movement at elbow-joint 70°.

" V. Septic arthritis of the knee, incisions. Admitted 7/7/16; much periarticular thickening, fluid in joint, flexion 60°. 8/8/16: No fluid in joint, very little periarticular thickening, flexion 120°.

" VI. Traumatic arthritis of the right knee. Admitted 28/3/16; much periarticular swelling; X-ray, " lining " of cartilage, no bony change; can bear no weight on knee, walks with crutches, no movement of knee-joint. Radiant heat and massage. 25/5/16: Very little improvement, still on crutches. Whirlpool bath and massage. 15/7/16: No swelling of knee, walks well with stick, flexion at knee-joint 90°.

"VII. Amputation of right arm. Admitted 20/5/16; tenderness of stump, much pain in missing hand. Whirlpool bath. 14/6/16: No tenderness of stump, no pain in missing hand.

"VIII. Wound of axilla, bruising of brachial nerves. Admitted 13/6/16; much neuritic pain, referred chiefly to fingers; partial anæsthesia, dorsum of thumb and index finger and radial side of hand and wrist; no power of extension of fingers; elbow flexed at right angle, no power of extension beyond this point; paralysis supinator longus and extensors of wrists. Radiant heat followed by massage, or either alone, caused increased pain. 3/7/16: Whirlpool bath at temperature of 99° F.; immediate alleviation of pain, tolerance to gentle hand massage after six treatments. 8/8/16: Very little pain, sensation returning, some power of flexion of fingers, supinator longus recovering, extension of wrist weak but complete, extension of elbow to 50°."

Sand Baths.—The ancient practice of *arenation*, or covering the affected limb with heated sand, has a useful place in an institute for physical treatment. The hot sand greatly increases the arterial circulation and facilitates subsequent movement. A certain pressure is also exerted by the sand, and it is possible that the heat retained in the perspiration and crusted sand is more penetrating and acts more favourably in some cases than the heat in a flowing medium of air or water.

Local baths or poultices of *peat*, *fango*, or *mud*, sometimes impregnated with iron or salt or various acids, act in the same manner as regards pressure and the stationary contact of the medium, but in these baths a certain amount of chemical stimulation is superadded.

CHAPTER II

INDICATIONS IN SURGICAL PRACTICE

For a more particular account of the different forms of baths and their uses, the reader is referred to the previous chapter. There are certain definite indications for their use in surgical practice. The several kinds of baths that are employed, and the objects for which they are given, can be formulated as follows:

1. To cleanse deep wounds, by removing unhealthy matter as it is formed, and by making the discharge more copious. (Long-continued subthermal baths and hypertonic saline baths, both general and local.)

2. To promote the healing of wounds. (Isotonic saline baths and certain natural waters.)

3. To allay muscular spasm. (Subthermal and thermal baths.)

4. To relieve pain. (Subthermal and thermal baths.)

5. To promote the absorption of inflammatory exudations.

6. To increase the circulation where it is defective.

7. To facilitate the stretching of fibrous tissues.

(The last three objects are served by thermal and hyperthermal baths, and by natural waters like those of Bath, Droitwich, and Woodhall Spa.)

It may be well to recall the fact that three phases of heat are employed in baths for surgical cases:

1. *Cooling baths* (75° to 90° F.), which can be used for febrile cases in the same manner as for the specific fevers (see Chapter III.).

2. *Subthermal baths* (90° to 98° F.), which are used for con-

tinued immersion, prolonged if necessary for many hours or days.

3. *Thermal* and *hyperthermal baths* (98° to 105° F., and 105° to 120° F., respectively), which are brief or very brief stimulants. Moist heat is also employed in *local vapour baths*, and dry heat in the form of *hot air* and *radiation baths*.

To the bath or local bath may be added a varying proportion of salt. Water becomes *isotonic* with the body fluids when it contains about 0·9 per cent. of salts, and *hypertonic* when more than 1·0 per cent. is added.

It is not claimed that all the actions of these various baths are as yet understood. The following notes exemplify their use in common surgical conditions.

Inflamed and Septic Wounds, Burns, Gangrene.

Local baths to the wounded limb are often useful. They should be cool to subthermal (75° to 90° F.) when it is intended to *allay heat* and inflammatory reaction, but may be given warmer if it is desired to increase the circulation and *promote discharge*. The duration of the bath may extend to an hour, twice or three times daily. Still water in the ordinary leg or arm bath is useful, but flowing baths, in which the water is constantly renewed and remains at the same temperature, are much better. Like cooling drinks and cool enemata, local cooling baths applied for any length of time to an injured limb reduce the local circulation and bring down the temperature.

Whole-body baths may be used with advantage at subthermal temperatures (85° to 95° F.). In septicæmia, after incisions, immersion in a bath at 93°, prolonged for hours or days, keeps down the temperature, relieves pain and tension, and promotes discharge. Cases are on record in which limbs, and even life, have been saved by this procedure. Long-continued normal saline baths (chloride of sodium 0·9 per cent., or 2½ pounds to an ordinary bath of 30 gallons) have also been used with advantage in war practice, especially in septic wounds of the trunk. Care must be taken to keep

the temperature of the bath at approximately the same point throughout.

Warm *hypertonic* salt baths (5 per cent. chloride of sodium), of two or more hours' duration, and applied usually to the affected limb only, have been employed with success in military hospitals in the Rouen area. According to a report made in 1915, such baths were " practically always used in wounds of distal parts of the extremities, especially when these were multiple, where purulent discharge was very profuse, and where heat was found to relieve pain." There was a general consensus of opinion that hypertonic treatment (by " tablet and gauze packs " and by baths) was quite satisfactory in such conditions. The treatment was discontinued when the wound was clean and covered by healthy granulations.

" Hypertonic solutions stimulate a more or less profuse flow of lymph containing antibodies, and thus bring about what has been called ' lymph lavage ' of the tissues lining the wound.

" Isotonic or physiological salt solution stimulates diapedesis—that is to say, it brings about a concentration of leucocytes in these tissues. These phagocytes are in large measure shed into the wound cavity and form pus corpuscles."*

Contusions, Sprains, Fractures. Early Stages.—If local baths or gentle douches can be applied nearly cold *at an early stage*, with still or flowing water, congestion and swelling and local rise of temperature may be *prevented* or minimized. The same effect is often sought by evaporating lotions, but a douche or local bath in flowing water is more effectual.

At a later stage, when the limb is hot and swollen, the same measures are still indicated, combined with gentle or sedative massage in the direction of the circulation. When the surface temperature has fallen and the circulation is sluggish and impeded by exudations, cooling applications must be replaced by stimulating baths.

* See Colonel H. M. W. Gray, A.M.S. (T.), " Remarks on the General Treatment of Gunshot Wounds from a Clinical Point of View." *Brit. Med. Journ.*, January 1, 1916.

The early treatment of fractures by massage is described in another chapter. A combination of massage with bathing is often very grateful to the patient, from its effect in relieving tension and restoring the circulation. A case of fractured ulna, for example, may after the first week be submitted to a whirlpool bath at 105° F., accompanied by subaqueous massage. Such treatment effectually prevents the effusion, stiffness, defect of circulation, and muscular wasting, that are commonly met with after fractures.

Late Stages.—In most cases cooling and sedative baths should quickly be followed by stimulating applications of heat. But as a rule hot applications should not be used whilst there is any excess of heat or other signs of active congestion in the injured part. When this has subsided, thermal and hyperthermal local baths in still or flowing water may be given, and continued once or twice daily for fifteen to thirty minutes. Their normal effect is to diminish pain, stiffness, and swelling, and improve the colour and circulation in the limb. If these effects are not produced, such baths are premature and inappropriate. Very hot applications should be followed by a brief application of cold. Local baths of this description are a good preparation for movement and massage. The massage and movements (active and passive) may begin with advantage whilst the limb is in the bath. At a still later stage douches at alternating temperatures (110° to 60° F.) may be employed. Low-pressure douches should at first be used, and if no pain is caused the pressure may be raised.

Sprains or Strains of Joints (Ruptured Ligaments).—In an early stage, alternate hot and cold applications, if perseveringly employed, relieve pain and prevent stasis. When effusions, within and without the joint, persist, and inflammatory reaction has subsided, douches may be used, with increasing strength and alternating temperatures. To obviate contraction and immobility and relieve pain, local hyperthermal and whirlpool baths (110° to 120° F.) should be given. Massage and movements may often be given with good effect when the limb is immersed in the bath. Local

vapour baths are also valuable, especially in injuries to the shoulder-joint.

Articular Stiffness, Fractures near Joints.—In painful cases, prolonged subthermal (pool) baths (90° to 95° F.) reduce œdema, relieve pain, and restore the local circulation. In less acute cases thermal baths (95° to 105° F.) are useful. At a later stage, hyperthermal (110° to 120° F.) and whirlpool baths are indicated, accompanied by manipulation and mechanical treatment. In the case of fractures, the movement of neighbouring joints should be commenced as soon as osseous repair allows.

The physical treatment of articular stiffness was thus summarized in pre-war days by Dr. F. Sandoz, Medical Director of the Zander Institute in Paris.

" 1. The only logical treatment of articular stiffness of traumatic or infective origin is movement, preferably by mechanical means, and in certain cases the employment of heat.

" 2. Mechanical treatment is as a rule sufficient for stiffness due to traumatism, but in infective and rheumatic arthritis heat is often useful.

" 3. Mechanical is more advantageous than manual movement, because it is more precise, better regulated, more constant, and more easily prolonged.

" 4. In employing thermal energy, cold can be utilized as well as heat. Excessive temperatures, especially of heat, are dangerous, and too frequent applications of heat often lead to disastrous results."*

Fractures imperfectly United, Unresolved Effusions.—Here also the circulation and nutrition should be stimulated by hyperthermal and whirlpool baths, and by douches at alternating temperatures.

Unhealed Wounds.

Prolonged subthermal baths (90° to 95° F.) of gently flowing water are of advantage. The moist warmth, maintained for several hours within these limits of temperature, is seda-

* *Journal de Physiothérapie*, October, 1913.

tive to the cutaneous nervous system, increases the peripheral circulation, and promotes nutrition and the healing of wounds, especially in debilitated subjects. If it is desired to increase serous discharge, hypertonic salt solutions may be locally applied. Prolonged and nearly isotonic salt baths, by keeping the exposed tissues in an artificial serum, are very soothing to inflamed and irritable wounds. If at the same time they are kept a few degrees below blood-heat, they allay nervous and circulatory excitement.

Painful Scars.—Painful scars are often relieved by hyperthermal and whirlpool baths.

Cases where Arterial Circulation is locally Deficient: Effects of Pressure, Frost-Bite, Arterial Claudication.—After all serious wounds, with a prolonged period of immobility and disuse, the circulation in the limb will be found defective. The limb is colder than its fellow, and there is often swelling and want of colour, owing to comparative stasis in the venous and lymphatic circulation. The arterial circulation suffers first of all from inaction of the muscles, and a sluggish current in the capillary and venous area is the natural result.

In other cases one or more of the arterial blood supplies has been cut off as a result of a wound or operation, or as a result of arteritis or aneurism. The maintenance of a normal blood supply in the limb must depend upon collateral channels.

In all these conditions local thermal and hyperthermal baths are of the greatest value, and in surgical cases may very often be applied before the healing of the wound. By restoring or maintaining the circulation, they powerfully aid in the processes of healing and repair, both in bone and soft tissues (see also Chapter V.).

Ordinary trough baths at 105° to 110° F. may be safely and pleasantly used with open wounds, or running water as in the whirlpool bath. They may be given for twenty-five to thirty minutes three times a day.

At later stages, and when the wound is healed, the entire limb may be treated with a daily course of hyperthermal whirlpool baths (105° to 115° F.), or with hot air or radiation

baths, followed by massage. Effusions and œdema are by such means often speedily removed, and the nutrition of wasted muscles promoted. Baths of this kind flush the limb with arterial blood, and render massage and manipulation less painful and more effectual.

The same treatment may be used for intermittent claudication, in which gratifying success has, in the author's experience, attended the use of hot air baths, before the even more stimulating whirlpool bath was devised.

To promote the return of circulation after wounds, a course of thermal baths may be recommended at Bath for winter, and in summer at Buxton, Harrogate, and Strathpeffer.

Cases after Operation and Splinting.—Immobility of joints, painful scars, defective circulation, may be treated as above at the hospital or clinic.

Health-Resorts for Surgical Cases.—Many cases in which the general health is depressed are benefited by a course of baths at an appropriate health-resort. The choice of the spa and of the climate is guided in the first place by the condition of the circulation and of the nerve centres. In cases showing *neurovascular irritability* a sedative action should be primarily sought. In spring and winter, such resorts as Bath, Sidmouth and Torquay, may be chosen, and in the summer and autumn months Leamington or Woodhall Spa. If the irritability is less marked and combined with depression, a tonic sedative action is required. Among the British spas, Strathpeffer and Llandrindod fulfil this indication, and the baths of Dunblane and Southport. In winter such cases may be sent to Bath or Bridge of Allan, or such climatic resorts as Ilfracombe, Ramsgate, Bournemouth, or Malvern. If the case is marked by *neurovascular atony* a stimulant or tonic action should be sought. This can be readily obtained at Buxton, Harrogate, or Droitwich, and at the English East Coast stations, and in Scotland at Nairn, North Berwick, Peterhead, and Cromarty. In winter cases of this kind do well at Folkestone, Margate, Brighton, and Swanage.

It is an old and true observation that baths and lotions of

natural sulphur water like those of Strathpeffer and Llanwrtyd, and nearly isotonic waters like those of Llandrindod, favour the process of healing. Those who are familiar with such waters have often witnessed their favourable effect upon unhealed wounds. The deep thermal baths of Bath and Buxton are helpful in removing the stiffness, pain, and swelling, that follow upon contusions, wounds, and fractures, in the neighbourhood of joints. Massage may be given *in the water* with much advantage, and also whilst the patient is recumbent under a douche of thermal water. The same applies to imperfectly united fractures and to unresolved effusions.

Fractures with Osteitis and Necrosis (Obstinate Cases).— In addition to hyperthermal local baths, certain of the natural waters of Great Britain are favourable to these cases. They are the thermal baths of Buxton, Bath, and Matlock, and the salt waters and brine baths of Woodhall Spa and Droitwich. Bracing marine resorts, with or without baths, like Saltburn-on-Sea and Margate, are also helpful.

CHAPTER III

INDICATIONS IN THE SPECIFIC FEVERS

In *hyperpyrexia*, from whatever cause, the excessive febrile reaction may be mitigated by cold drinks and cold enemata. The ingestion of water allays the febrile excitement following wounds. The temperature in the rectum may be readily reduced 2 degrees, and the frequency of the pulse reduced 20 to 30 beats per minute, by repeated drinks of cold water. The excessive pyrexial reaction both of *specific fevers* and of *septic infection* may sometimes be controlled in this manner. Cool drinks favour the action of the kidneys and bowels. Hot drinks at first rather promote the febrile reaction, but subsequently relieve it by their diaphoretic effect. Both hot and cold water increase tissue waste and the elimination of bacterial toxins. Cool spring water, which is preferable to distilled water, may be given freely *after wounds* and after most operations. Relatively large quantities of cold water, to the amount of 2 to 4 pints daily, according to the degree of thirst, may be given with advantage in all acute and febrile cases. Very pure and unmixed spring waters of high solvent power, like those of Malvern, Church Stretton, and Pitkeithly, are especially to be recommended.

Cooling baths should seldom pass the lower limit of 75° F. Baths of 85° to 95° are often helpful in very febrile cases, especially if the temperature is kept constant by flowing water. It is better in most cases to prolong the duration of the bath than to make it cooler, if the body temperature shows a moderate reduction and the patient feels refreshed. But in acute and critical cases where the temperature ranges high (over 105°), and especially where consciousness is

affected, the patient may be wrapped in a sheet wrung out of ice-cold water and freely sprinkled. This cold wrapping may be renewed at short intervals until consciousness returns and the body temperature is reduced within safe limits. Free evaporation from a thin covering kept constantly wet rapidly and effectually cools the heated body. In hot countries, not only is water kept cool, but ice may be produced by this method. In practice it is free from risk, if skilfully done, and may be recommended instead of baths and repeated sponging in all serious cases.

In contrast with hyperpyrexia is the state of *collapse with subnormal temperature*. This acute condition may be, so to speak, either ante- or post-febrile. Sometimes in specific fevers, owing to the intensity of the invasion and the violence of the toxæmia resulting from it, the normal febrile reaction fails to take place. Or there has been an excessive febrile reaction followed by an equally sudden defervescence, and a fall of temperature of perhaps 6 or 7 degrees in a few hours. In either case the body temperature falls to a dangerous extent, and there is imminent danger of a fatal termination. Both these conditions are met with occasionally in most of the specific fevers, especially measles, pneumonia, cholera, typhus, and remittent fever. *Hyperthermal baths* are very valuable in the treatment of collapse—*e.g.*, in cholera. The immersion should be very brief, at a temperature of 105° to 115°, at first thirty seconds only, and should never exceed two or at the most three minutes. The immediate and primary stimulating effects of heat are by this means obtained. Both the heart and circulation and the nerve centres are promptly stimulated, and a favourable febrile reaction promoted.

1. Sunstroke, Heatstroke, Thermal Fever.—As in severe attacks of the specific fevers, so in sunstroke, the nervous mechanism for heat regulation is more or less thrown out of action, and it may be temporarily paralyzed. The cause of this failure of nerve centres is probably, as in fevers, toxæmic. Simple exposure to external heat, provided that the loss of heat by evaporation is insufficient to keep the body cool,

brings about in a very short time a condition of artificial fever, more or less intense, which closely resembles in its symptoms the acute specific invasions. This has sometimes been called "thermal fever." It may be witnessed in its initial stages in the febrile condition following a hot bath. The same causes, operating in increasing degrees, produce heatstroke and sunstroke.

The indication is to rouse and stimulate the failing nerve centres. One of the most powerful—indeed, the *most powerful*—of stimulants to warm-blooded animals, is external cold, acting through the peripheral nervous system. Friction of the surface increases the stimulating effect, and should be used in all serious cases in which consciousness is affected.

Many methods have been suggested for applying these principles. Cold applied to the head alone by means of ice or Leiter's tubes is usually insufficient in serious cases; for by this means only the *direct* effect of cold is obtained, on a small surface, and not the powerful *indirect* effects from a large surface. One of the best and most successful methods is the *cold needle spray bath*. The patient, lying on a waterproofed couch, is wrapped in a thin sheet, and cold water is sprayed over the limbs, trunk, and head, for one or two minutes, with brisk frictions of the sheet upon the skin. He is then removed to bed and lightly covered with a blanket, the sheet still *in situ*. The spraying and frictions are repeated at intervals, which should vary with the effect produced, as shown by the rectal temperature. When a needle spray cannot be obtained, streams of water may be made to fall from a height on the patient similarly wrapped in a sheet, the attendant meanwhile using brisk frictions. This treatment may be repeated every hour or oftener, until the rectal temperature falls to 100° F.

A third method is the *cooling bath* (75° F.), accompanied by frictions and prolonged until the rectal temperature reaches 100° F. After these applications of cold, by sprays, affusions, or bath, and when the heat regulation is partially restored, as indicated by a fall in the temperature of the body,

it is well to encourage the physiological reaction to cold as much as possible.

This reaction is marked by a dilatation of the peripheral arterioles and a return of circulation to the skin. *Hot baths* and blankets may therefore be applied at this stage, or, if necessary, a brief hot-pack. The indication now is to increase the peripheral circulation and to encourage the action of the skin.

It would be difficult to find a better illustration of the scientific use of heat and cold than in this treatment of sunstroke by physical remedies.

2. Typhoid Fever.—The hydrological treatment of fevers has largely fallen into disuse in England, partly owing to the advocacy of " cold baths " for typhoid fever. The use of the " cold bath " was not only recommended in many textbooks, but was widely practised, with disappointing results. Hence it was concluded with indifferent logic that baths were injurious in fevers, the truth being that baths, like other good remedies, can be made injurious by being badly applied.

There was the less excuse for the faulty practice of using " cold " in typhoid fever, since able hydrologists had already laid down the limits within which minus temperatures should be applied to the body in fevers.*

The correct practice is to employ such a degree of cold, and of such a duration, as is *stimulant* to the nerve centres. Any temperature below that of the skin, 93° F. in health, and higher, of course, in pyrexia, is *minus* with reference to the body. Baths at or below this point are therefore cooling baths. Their immediate cooling effect is proportionate to the difference between their temperature and that of the skin. It is the primary and immediate action of baths to impart heat or to withdraw heat from the body. But this primary effect of the cool bath, so agreeable to the heated body, is by no means the only effect. A secondary or indirect action follows, to which, indeed, the chief benefit of the bath is due. This is the well-known stimulating action

* Brand of Stettin in 1861, and Giannini of Milan in 1805.

of cool temperatures, through the peripheral nerve endings upon the nervous centres, especially those governing the vasomotor mechanism and the heart.

A very good method in cases of typhoid fever is to immerse the patient in a bath of 80° to 86° for a period of ten to fifteen minutes, whenever his temperature rises to 103°. This bath may be repeated every three or four hours, until the rectal temperature falls to 100°. Gentle friction of the surface is given during or after the bath, and baths are stopped between midnight and 6 a.m. This practice is widely followed upon the Continent, both in military and civil hospitals. Such baths often avert heart failure, the result of an excessive pyrexia.

Another method which may be useful in cases with high temperature and nervous disturbance is the *prolonged sub-thermal bath*. The patient is kept for many hours or even days reposing in a hammock in a bath at 90° to 93°—that is to say, a few degrees below the temperature of his skin. The chart should be closely watched, and the heat of the bath may be slightly reduced if the rectal readings do not fall below 101°. The condition of the nerve centres will, however, be a good indication of the effect of the bath.

It is noticeable that, although the rectal temperature may not fall during or immediately after a bath, it may do so an hour or two later. That is to say, the effects of cool baths on heat regulation may take some little time to be declared. This shows the necessity for frequent thermometric readings.

In case of hæmorrhage or perforation or peritonitis, baths cannot, of course, be employed; but if the fever is high the patient may be covered with a sheet and sprinkled or sprayed with cold water. Frequent cold spraying or sponging is grateful as well as stimulating in most cases of typhoid fever, whether baths are employed or not. When the temperature of the body falls to 100°, the use of cold should be at once discontinued, and the normal reaction to cold, surface warmth, and perspiration, should be encouraged in every

way, especially by hot blankets or bottles, and in most cases a dose of some diffusible stimulant.

Sir William Osler thus sums up the action of baths in typhoid fever: " The good effects of the baths are—(1) The influence on the nervous system; delirium lessens, tremor diminishes, and toxic features are less marked. (2) Increased excretion of toxins by the kidney. (3) The tonic effects on the circulation; the heart-rate falls, the pulse becomes smaller and harder, and the blood-pressure rises. Vasomotor paresis is lessened. (4) With hydrotherapy the initial bronchitis is benefited, and there is less chance of passive congestion of the bases of the lungs. (5) The liability to bedsore is diminished, and the frequent cleaning of the skin is beneficial. The addition of half a pound of alum to the water is an advantage. Should boils occur, one bath tub should be used for that patient alone. (6) Reduction of the temperature may occur, but is not an important effect. (7) The mortality is reduced. In general hospitals from six to eight patients in every hundred are saved by this plan of treatment." *

The same forms of hydrological treatment are applicable to *typhus fever.*

3. Pneumonia—The Exanthemata.—As fatal toxæmia is the most serious danger in pneumonia, so free water-drinking is to be recommended, in order to eliminate toxins by flushing out the kidneys. Much more active measures are, however, often necessary to combat this toxæmia, which in severe cases may threaten life at an early stage of the illness. Vasomotor paresis and failure of the circulation, with fall of blood-pressure, are its outward and visible signs, with or without hyperpyrexia.

To combat this failure of circulation, there is no remedy to compare with cold. It can be freely and repeatedly used with strict regard to the fact that its efficiency as a stimulant is confined within certain limits of temperature and duration.

The simple method of repeated sponging with water at 60° or 65° F. may be supplemented by the application of

* " Principles and Practice of Medicine," eighth edition (1912), p. 43.

cold compresses or an icebag to the chest. These local applications often relieve pleuritic pain and moderate the rapid action of the heart. Cold compresses or an ice-bag in the precordial region may be safely applied for short periods in the early stages of pneumonia, the patient's own feeling being a sufficient guide to their use. Both the local distress and the general fever are in many cases reduced by these means. The " ice-cradle " is also helpful in moderating the heat of the body, and cold to the head nearly always.

If, however, the circulation does not respond to these measures, and the pyrexia runs very high, cooling baths and frictions such as those described for typhoid fever may be safely used, the reaction of the skin being promoted by subsequent applications of warmth and the use of stimulants. *Brief* hot sponging or hot baths (108° to 110° F.) are also indicated, as in other acute fevers, when the shock of invasion is profound and when the skin is very dry and inactive. These hot applications actually reduce the fever by inducing a proper action of the skin. They are often serviceable in the early stages of pneumonia, and in severe types of the specific fevers (measles, scarlet fever, etc.) with a parched skin and scanty or absent eruption.

The same rule applies to the use of baths in pneumonia as to all other fevers—not to prolong the application when the body temperature has fallen 2 or 3 degrees. It may probably fall further in an hour or two. There is no harm in pyrexia *per se*. Here, if anywhere, the physician must move on physiological lines. Gentle and repeated stimulation by cold, even with a febrile reaction, is better than excessive stimulation with failure of reaction.

CHAPTER IV

INDICATIONS IN NERVOUS DISORDERS

BATHS of one kind or another are beneficial in the great majority of nervous disorders. And this is true at all stages or phases of these disorders—from the acute and hypersensitive phase with increased reaction to the smallest stimuli, through the subacute phases with periodical exacerbations, to the later atonic and chronic phases, with diminished reaction even to strong stimuli. Corresponding with the nervous gamut there exists ready to hand a gamut of surface treatments, and the hydrologist can at will press any note or combination of notes upon the ascending or descending scale.

For the acute phases he employs a purely sedative action prolonged at will. With this he can combine or alternate the gentle stimulation of slight changes of temperature, or rhythmic mechanical impressions (as in aëration and effervescing baths). Where the acute phase has passed and the nervous sensitiveness is diminished, he can use an ascending scale of stronger impressions, always measuring and checking the *action* of these surface impressions by the *reaction* produced in the nervous mechanism.

It follows that remedies having such power of nice adjustment can be readily misapplied. This is especially seen in the misuse of surface stimulants, as, for example, when strong *thermal* applications are used in the early stage of neuritis, or the stimulant treatment so beneficial for atonic and sluggish nervous depression is applied, with distressing results, in acute and irritative neurasthenia.

A proper bath treatment in nervous disorders varies with the phase. The sequence of a sound treatment accurately follows the sequence of the disease. What is injurious at one stage may therefore become beneficial and necessary at another. And over and above these evolutionary or dissolutionary phases there is the question of individual reaction to surface treatments. This reaction varies greatly. In some persons very slight impressions produce strong results; in others strong impressions produce but weak results. Such differences are met with in health, but are much greater in nervous disease. Happily, defective reactions can often be improved and *educated* under treatment.

These things being so, it will be readily understood that it is often necessary for the medical man to observe for himself the actual reaction produced under treatment by baths from day to day in cases of nervous disorder.

Palsies and Paresis.

In most cases bath treatments should be combined with massage, electricity, and exercises. Many cases occur in which the muscles are wasted from disuse after fractures or wounds or from long immobility of the limb in splints. The indication is to restore the activity of the circulation and the nutrition of the muscles, not only by baths, but by passive or active movements and electrical and mechanical stimulation.

1. Paralysis resulting from Injury to Nerves.—In the early stages pain and inflammatory reaction may be allayed by baths, local or general. More stimulating thermal and whirlpool baths followed by massage are appropriate in the later stages of the case; also douche baths and systematic massage, together with electrical treatment of the wasted muscles (see Chapter XI.). Where there is extreme sensitiveness to touch and burning sensations (causalgia), hot applications are sometimes badly borne, but prolonged tepid or even cold local baths have a pleasant and sedative effect.

No direct benefit can be expected from physical remedies

in cases of paralysis in which the nerve is severed. Baths, massage, electricity, and exercises, will, however, improve the circulation and nutrition of the limb, and assist the compensatory action of unparalyzed muscles, so far as may be.

2. Paralysis following Disease or Injury of Nerve Centres.—In all serious nervous disorders, physical remedies act better in combination than singly. Baths, massage, electricity, movements, are successively employed or combined to the best advantage according as it becomes necessary to relieve pain or irritability, to evoke or increase a sluggish reaction, or to improve the circulation and nutrition or the mobility of a limb.

In most organic paralyses the affected limb is cold, and the arterial circulation is diminished from disuse. Local hyperthermal and whirlpool baths greatly increase the arterial circulation, and by softening and relaxing contracted tissues form a good preparation for massage and movement. Very often gentler and more soothing treatment is alone permissible. Gunshot wounds affecting the vertebral column, with intrathecal hæmorrhage, or concussion of the spinal cord, often cause extensive paralysis, which may gradually clear up. In some cases there will persist an irritative condition of groups of muscles, which are easily thrown into painful contraction. In such cases sedative pool baths or the warm low-pressure douche with soothing massage is far preferable to stimulant surface treatments. Other cases of spinal or cerebral injury present only a residual paralysis or weakness in an arm or in the dorsiflexors of the foot, causing difficulty in walking. In using massage or mechanical movements, it must be borne in mind that the affected limb is very easily fatigued, and periods of rest must alternate with gentle exercises.

In old hemiplegias and monoplegias more stimulating treatment is admissible. Such cases may often be referred with advantage for a course of thermal treatment to Bath in winter or Buxton in summer.

The inco-ordination and lightning pains of " tabes dor-

salis " are also amenable within limits to physical remedies, the former by methodical exercises which " re-educate " the muscular movements, the latter by sedative baths. These may be given daily for many weeks, and the duration prolonged for several hours when the pains are severe.

3. Functional Paralysis, Subconscious Neurosis. — The same treatment as for neurasthenia, with addition of local douching, passive movements, massage, and suggestion.

4. Paralysis Due to Peripheral Neuritis.—The underlying toxic condition requires eliminative treatment. Diuretic, saline, sulphur, or muriated waters may be prescribed, according to general indications. Such cases are treated with benefit at Llandrindod, Leamington, Harrogate, Bath, Woodhall Spa.

Nervous Shock resulting from traumatism, explosion of shells, mental strain, or operation, requires naturally at first the most sedative remedies. Prolonged single or pool baths at 93° to 95° are especially indicated, good effects having been reported from their use in the present war. Later, more stimulating aëration baths and douches may be used, in a descending scale of temperatures. Convalescent cases can be treated at most of the British spas, the choice of locality depending on individual characters.

Insomnia, Slight Mental Affections, Subconscious Disorders (**" Hysteria "**), may be treated on the same lines. Prolonged subthermal baths have been many times proved to be capable of inducing sleep in refractory cases of insomnia where ordinary medication had failed. They also allay the excitement and restlessness due to nervous and mental overstrain, as well as those that belong to the more serious forms of mental disorder. For this reason it is very advisable that institutions for the treatment of the transitory nervous and mental disorders of wounded soldiers, as well as all homes and hospitals for mental and nervous disease, should be furnished with a suitable equipment of sedative and tonic baths. Persistent exaggerated impressions can often be removed by the counterimpressions of tonic douche baths, aided by suggestion (see Chapter I.).

Neurasthenia and Psychasthenia.—Hot baths as well as hot climates are seldom to be recommended in neurasthenia and psychasthenia, which should always be looked upon as more or less serious forms of debility. In the choice of health-resorts, marine and moorland stations should be preferred, with treatment either entirely sedative or gently and progressively stimulant.

1. In *irritative conditions*, *excitement*, or *insomnia*, the effect of climate is often well marked. If the individual is gouty or rheumatic, gentle eliminative treatment at a quiet and restful spa can be recommended, such as Strathpeffer, Leamington, Moffat, Cheltenham and, in winter, Bath. Where rest is mainly needed, with occasional baths, other localities may be chosen: in summer, Southport, Ilkley, Ben Rhydding, Dunblane, Shandon, or Rothesay; in winter, Bournemouth, Ventnor, Hastings.

2. In *depressed and atonic subjects* and in *neuralgia* a more tonic climate and treatment are necessary.

Cold hydrotherapy and invigorating douches may be had at all medical baths and at all the spas. Among bracing inland stations may be mentioned Harrogate, Buxton, and Malvern. In summer, marine baths may be had at the tonic East Coast resorts: Cromer, Scarborough, North Berwick, Peterhead; and in the south at Margate, Folkestone, and Eastbourne.

Where, as is often the case in these depressed cases, elimination is chronically defective, an occasional course of Turkish baths with douches and gentle massage may be given at any bracing health-resort. In the slighter forms of melancholia, purgative and diuretic waters sometimes have a happy effect, and may be suitably combined with baths, as at Harrogate, Strathpeffer, Llandrindod, and Leamington.

Brachial and Other Neuritis, Herpes Zoster, Neuralgia, and Migraine.—In the early stages of neuritis only the most soothing kinds of baths are applicable, and hot baths as well as massage and movement are best avoided. The limb should be rested and protected against changes of temperature. Hot sponging may be grateful in brachial neuritis

from the beginning. When the acute phase has passed, gentle movements and massage may be given, and applications of heat in local light baths or in peat or fango poultices. Local vapour baths are also of much assistance, from the combined sedative effect of heat and moisture. The same applies to the massage-douche skilfully given at low temperatures. In the convalescent stage, eliminative waters may suitably be prescribed, together with one or other of those forms of local baths, at well-appointed spas, such as Harrogate in summer or Bath in winter.

Many forms of neuralgia, like other neuroses, yield to a course of tonic baths and regimen, with or without massage and electricity. In particular, the cold or alternating douche affords at the same time the powerful impression of temperature and of mechanical stimulation. Cold spinal douches are often helpful in cases of migraine associated with vasomotor instability.

CHAPTER V

INDICATIONS IN CARDIOVASCULAR DISORDERS

1. Endo- and Peri-Carditis, Rheumatic and Other.—The relationship of skin areas to underlying organs is well exemplified in the case of the heart. It explains the effect of the " shock of cold " and slapping of the front of the chest in syncope. In the same way, cold applied for a longer period of time to the precordial region often quiets the action of the heart and alleviates pain and distress in acute endocarditis and pericarditis. Icebags may be employed from an early stage, and repeated so long as relief is obtained from them. This will be shown not only by the patient's own sensation, but especially by the diminution of the pulse-rate.

Children are much more quickly affected by cold applications than adults, and only brief applications are advisable for them. But for adults, especially in febrile cases, ice may be used freely and with the best results. Even when cardiac failure is threatened, cold judiciously used is often of the greatest value.

2. High Arterial Tension, Cardiac Hypertrophy, Hypertonus, Atheroma, Angina Pectoris.—In all these conditions warmth is advisable and cold is inadvisable.

Where high arterial tension is unaccompanied by marked degenerative changes, the condition may be regarded as a nervous disorder, a form of *neurovascular irritability*. Those who are familiar with hydrological practice have many times observed that this spastic condition of the vessels, and the arterial hypertension dependent upon it, have subsided under treatment by waters and baths. Even when degenerative changes have taken place, benefit may still be obtained from similar treatment. In either case

only sedative and subthermal baths are applicable. Eliminative waters are also often helpful, as there is usually a toxæmia in connection with high arterial tension. As regards baths, the indication is to increase the peripheral circulation by progressive dilatation of the arterioles, and so to relieve the burden upon the left ventricle, and at the same time to abate the nervous tension by the sedative action of temperature and moisture.

Both these indications are met by the subthermal bath, at or about the temperature of the skin (93° F.). The addition of salt to the bath increases the stimulation of the peripheral circulation. A still more marked peripheral stimulation is effected by the gradual disengagement of small bubbles of gas upon the surface of the body. The effervescing muriated bath at a subthermal temperature causes, indeed, a vivid congestion of the skin, and in spastic conditions sometimes rapidly restores the balance of the circulation.

There is no other agent known to medicine which so certainly and quickly dilates the peripheral arterioles, and at the same time slows and strengthens the action of the heart.

(*a*) *Subthermal Baths.* — Many cases of arterial hypertension with degeneration may be recommended for a course of subthermal baths at one of the spas, but the utmost care is requisite that the baths are not inadvertently overheated.

If the blood-pressure has recently increased, and especially if there is headache and fulness of the veins, it is good practice to perform a preliminary venesection, and keep the patient in bed for one week thereafter before taking the baths.

The form of bath should be chosen with some care. If the breathing is embarrassed or the recumbent position causes discomfort, immersion baths should be avoided, or at most given in a reclining position, with the front of the chest uncovered. But the subthermal douche given without pressure (see p. 19) and accompanied by massage is often to be preferred to the immersion bath. The patient is seated in a trough, and large volumes of tepid water are gently passed over the trunk and limbs from an *open* mixing box, the attendant meanwhile giving centripetal friction and

kneading of the limbs. Subthermal baths may be obtained in winter at Bath or Matlock, and in summer at Harrogate or Strathpeffer, among other resorts.

Sedative baths such as those just described can be used with comfort and safety even by many patients affected by insufficiency of the aortic valve or by angina pectoris. Such baths appertain especially to the slow and labouring heart.

(*b*) *Effervescing Baths.*—On the other hand, effervescing and muriated baths are to be preferred in cases where the heart's action is feeble and the pulse unduly frequent, or easily accelerated by slight exercise. The heart's action is slowed and strengthened by these more stimulating baths, which at the same time powerfully attract the blood to the surface of the body.

In both these two groups the action should be closely watched by the physician whilst the patient is in his bath, and the application made more or less sedative or stimulant in character according to the condition of the patient, especially according to the effect produced on the heart's action and pulse.

Certain *medicinal waters* are helpful in arterial hypertension, especially those having a diuretic action. Such are the calcareous waters of the Vosges spas, and in Britain those of Bath and Clifton, Strathpeffer, and Matlock Bath. Waters of high solvent power but very little mineral content are also to be recommended. Evian-les-Bains, Church Stretton, and Malvern, are typical of these, and there is not much to choose between the French and English water.

The ideal health-resort treatment of arterial hypertension is one that combines a suitable course of waters with sedative baths, in a restful and gently invigorating air. Strathpeffer, Matlock, and Malvern, are among the British spas that have this climatic quality, and adequate bath establishments at these health-resorts would certainly be of great value in the treatment of cardiovascular disease.

3. Cardiac Dilatation, Tachycardia, Vasomotor ataxia, Graves' Disease, "Soldier's Heart."—In all these conditions warmth is inadvisable, and cooling applications are indicated.

In acute conditions, the application of cold by means of icebags, renewed at short intervals, often allays cardiac distress and palpitation, whether arising from the heart itself or from vasomotor disturbance, as at the climacteric or in Graves' disease. Cold to the epigastrium or precordial region not only allays palpitation, but helps to restore the normal tone of dilated and throbbing bloodvessels. For this reason an icebag is often most helpful in *checking hæmorrhage* from a gastric or duodenal ulcer or from the lung.

Cold may, indeed, be regarded as the prime remedy for circulatory excitement.

In more chronic conditions—for example, in cardiac dilatation and where the heart's action is habitually rapid, and in many cases of heart strain—sedative baths have an important use. The sedative pool bath (93° F.), prolonged for an hour or more, slows and strengthens the rapid heart.

If, on the other hand, the heart's action is feeble and irregular, the more tonic subthermal baths are better, such as the salt or muriated bath, the effervescent salt bath, or the aëration bath. The latter can be taken in the seated position or recumbent. The effect on the pulse can be immediately detected by the physician, and is a safe guide to his practice with reference to the form of the bath and its duration and temperature from day to day.

After all such baths massage may be suitably given, but always short of fatigue. Resisted movements are in general best avoided during a course of sedative baths, but the patient may be encouraged to take gentle walking exercise on the level or on the slope, and to increase it day by day if the pulse-rate and breathing are unaffected.

In Graves' disease, even in severe cases, a prolonged course of cooling baths is sometimes very beneficial. The baths may be plain or salt or effervescent; but sea-water, or salt baths containing 7 to 14 pounds to 30 gallons, are generally the most helpful. The daily salt bath, beginning at 93° or 94° F., may be gradually lowered in temperature, as the days go on, to 85° or 80° F., and the duration increased from ten to thirty minutes.

Climate powerfully reinforces the effect of baths in Graves' disease. A cool and slightly rarefied air, such as that of the Northern moors, is for choice the best.

The chief British health-resorts that are, from a climatic point of view, eligible for this class of cases may be grouped as follows:

1. In a northern or bracing air: Strathpeffer, Nairn, Harrogate, Buxton.

2. At more sedative stations, favouring repose: Llangammarch, Rothesay, and, in winter, Matlock, Sidmouth, Hastings.

3. For marine baths: In summer, Eastbourne, Folkestone, North Berwick; in winter, Hastings, Bournemouth, Torquay.

The choice of a health-resort favourable to the individual requirement may often turn the balance of success and failure, for all these forms of treatment only produce their *optimum* effect when the climatic influence reinforces that of the bath employed.

There is a considerable mass of experience with reference to the use of physical remedies in the condition known as *soldier's heart*, so commonly met with in the present war. Disordered action of the heart appears to result from a variety of causes—shell shock, physical and nervous overstrain, as well as wounds and infective illness. In the treatment of this kind of heart affection, the older doctrine of rest is giving place to the newer one of exercise. A certain amount of active exercise is now generally prescribed, beginning with pleasurable open-air games if possible.* A group of sixty cases was treated at the Heaton Park Command Depot by graduated exercises and by faradic electricity.† All the men were placed as soon as possible on light physical training and light route marches (see Chapter IX.).

It was, however, generally found necessary to commence the exercise gradually, and about half the cases were unable

* See Sir James Mackenzie in a discussion on "The Soldier's Heart," Proc. Roy. Soc. Med., February, 1916.

† See note by Dr. H. J. Seeuwen, Proc. Roy. Soc. Med., October, 1916.

to proceed to full training. Enlargement of the thyroid gland was noticed in 25 per cent. of the whole number. The electrical treatment consisted in daily faradization over this gland and the heart, first with two tampons applied for three or four minutes over the gland, followed by a similar application with one tampon over the heart region, and the other over the neck.

In a number of cases of shell shock and nervous overstrain, showing tachycardia with or without enlargement of the thyroid gland, X rays have been employed with good results. They are commonly applied once or twice a week for a period of six weeks or two months* (see Chapter XI.).

The marked benefit in " soldier's heart " that has attended the use of prolonged sedative baths, followed by progressively increasing exercise, is elsewhere recorded in these pages (see Chapter I., p. 10 *et seq.*).

4. Periphlebitis.—Many persons in whom the veins are habitually congested or actually varicose show a liability to slight inflammatory attacks in or about the venous trunks. This is especially the case with the superficial veins of the lower extremity, in places where they are exposed to friction or pressure of the clothing. Varicose portions of the posterior or of the internal saphenous vein are apt to be affected in this manner.

There is also another somewhat allied condition from which many persons suffer. Quite apart from the main trunks, areas of swelling and congestion are apparently produced from slight traumatisms. In these areas inflammatory changes round the small subcutaneous veins appear to be the chief feature. The swellings are hot and tender, and generally result in the formation of additional phlebectases, or " seaweed marks."

For both these conditions a moderate thermal treatment by means of douches or baths at 98° to 102° F. relieves venous congestion, and helps to resolve inflammatory changes in the neighbourhood of the surface veins.

As these affections of veins are more commonly met with

* See Dr. Florence Storey in the discussion just quoted.

in those who are subject to portal congestion and "gout," a course of saline or sulphur waters is usually to be recommended.

What may be described as local *thermal pressure baths* are also of considerable benefit. These are applications of hot peat, fango, or sand, at high temperatures (108° to 112° F. or upwards), given as at Bagnoles-de-l'Orne, and may be obtained in Britain at Harrogate, Strathpeffer, and Matlock.

5. Defective Circulation, Peripheral and Other.—The defective peripheral circulation, so often associated with chronic catarrh and chilblains, in young subjects, may often be benefited by a course of brief hyperthermal baths followed by cold douching. By daily practice the temperature of such baths may be raised to 112° or 116° F., with a duration of 90 to 120 seconds. Brisk switching, as given in the Russian bath, still further increases the capillary dilatation.

If poor circulation is accompanied by sluggish elimination, the heart being sound, a full course of Turkish baths and massage is often beneficial, at any well-appointed medical bath establishment, or at hydrotherapeutic institutions, such as Ben Rhydding, Southport, Matlock, Bridge of Allan, or Dunblane.

For defective circulation in surgical cases, see Chapter II.

CHAPTER VI

INDICATIONS IN RHEUMATIC AFFECTIONS AND ARTHRITIS

1. Fatigue Fever and Muscular Rheumatism (Subacute Fibrositis).—This toxæmic condition is the result of excessive and prolonged fatigue and exposure, such as is witnessed in soldiers after forced marches, especially when the men are not fully trained. An excessive muscular metabolism causes an accumulation of waste products within the muscles, and a slight general septic intoxication. The symptoms vary in intensity. They may be slight or very severe. They are—fatigue with stiffness, and pain in the muscles, increased by movement. If the muscular work is too greatly prolonged, what has been called "organic exhaustion" ensues, perhaps with cerebral disturbance.

In slighter cases immediate relief is obtained by stimulating the circulation in the muscles by means of heat, and so sweeping away the waste products. A good example of this rapid cure of abnormal fatigue is the deer-stalker's hot bath, after a long day on the hill. Soldiers fatigued and exhausted by hard duty in the trenches in winter find in the same manner immediate relief from very hot baths. Even when fatigue fever is more serious and of many weeks' duration, the judicious use of brief hyperthermal baths gives surprising relief. The temperature may range from 105° to 112° F., and the duration from thirty seconds to three minutes.*

2. Fibrositis, Perineuritis, Sciatica, Lumbago, Convalescence from Acute Rheumatism.—It may be stated generally

* See the author's paper, "The Value of Medical Baths for Invalid Soldiers," Proc. Roy. Soc. Med., 1915.

that in subacute cases, and where pain is severe, the prolonged use of subthermal baths (95° F.) is to be preferred. These relieve nervous and circulatory irritability and spasm. The same may be said of vapour baths, and especially local vapour baths, which are very helpful for painful attacks in the shoulder, the result of injury or exposure to cold, where the movement of the joint is limited and painful, and where the muscles and their nerves are mainly affected. Sedative treatments are requisite in all these cases. In hospital the flowing pool bath may be used. Among health-resorts, Bath, Torquay, and Sidmouth are suitable in winter, and Leamington and Moffat in summer.

In chronic cases higher temperatures may be used in the bath, and gentle douche baths with massage may be employed and gradually increased in strength. The last-named health-resorts are adapted to chronic as well as to acute cases, where a sedative action is indicated. Sufferers from chronic or subacute fibrositis can often be sent with advantage in summer to the more bracing British stations, such as Buxton, Harrogate, Woodhall Spa, Droitwich, and Malvern. Soldiers with " rheumatism " should not be sent to the seaside or to damp or foggy localities. A dry inland climate and a porous soil greatly enhance the good effect of baths.

The bath treatment of *sciatica* and *lumbago* must be guided by the general principles just stated. Subthermal baths and sedative or stimulating douches with massage are usually helpful, also whirlpool baths. In some cases local applications of great heat are of much service, and *fango* or *peat* poultices may be used, as at Matlock, Strathpeffer, and Harrogate. The brine baths of Droitwich have a good reputation for chronic cases.

A course of medicinal waters, and especially sulphided waters, is to be recommended in *convalescence from acute rheumatism*. The saline sulphur waters of Harrogate may be used if an aperient action is desired, or, if a diuretic and tonic action is required, the pure sulphur waters of Strathpeffer or Llanwrtyd. Marine resorts on a dry soil are often

helpful, such as Torquay, Sidmouth, and Bournemouth (winter), and Herne Bay, Eastbourne, Nairn (summer).

3. Chronic Joint Affections, Synovitis, Degenerative Arthritis.—Whether apparently the result of injury and exposure in predisposed subjects, or of definite infective invasion, chronic joint affections always require treatment by heat in some form. Upon the subsidence of the inflammatory stage, a condition of defective blood-supply and sluggish circulation with subnormal temperature of the limb is usually found, and may persist indefinitely, whilst gradual degenerative changes ensue in the cartilages, and thickening of the fibrous tissues about the joint. This is the condition characteristic of chronic infective arthritis of one or many joints. In another group of cases, patches of smouldering subinflammation may remain in or about the joint, especially in parts that have been damaged, such as the interarticular cartilages of the knee. In many persons these subinflammatory foci show little tendency to clear up, and consequently fresh attacks of synovitis are readily produced from trifling causes. This is the condition characteristic of monarthritis the result of injury.

The treatment of these chronic affections of the joints by baths, of whatever type, must be guided by general principles (see Chapter I., Remedial Baths). In general, where the joint is swollen and the surface temperature raised, only soothing applications are permissible (local vapour baths and subthermal douches). Where swelling and heat have subsided, thermal baths and douches, like those of Bath (in winter) and Buxton (in summer), as well as Turkish and radiant and hot air baths, are useful. In the cold stage, when the joint is wasted and degenerative changes have set in, with subnormal surface temperature, local hyperthermal, still, or whirlpool baths and alternating douches are indicated, so as to stimulate the circulation and nutrition as powerfully as possible. It is noticeable that synovial effusions, even in acute cases, are sometimes removed by very hot whirlpool baths.

Arthritis, from whatever cause, is often benefited by a

course of medicinal waters, which improve the general health and promote nutrition. This applies especially, not only to traumatic and senile arthritis, but also to those forms which are associated with gout or fibrositis. Sulphur waters appear to be more beneficial than any other class, both in their internal administration and in the form of baths (Strathpeffer, Harrogate, Llanwrtyd). The powerfully stimulating surface treatment of Droitwich and the salt baths and douches of Woodhall Spa are especially helpful in the convalescence from acute infective arthritis.

As the arterial circulation in damaged joints is apt to be injuriously affected by the combination of damp and cold, whether in the house or in the climate, dry warm dwellings and a dry warm, sunny climate are to be preferred in all cases.

"To summarize briefly the more valuable therapeutic methods employed in rheumatic affections, these include—

"1. Diuretic, alkaline, and purgative waters, employed for their detoxicating and eliminative action.

"2. Sulphur and muriated waters, employed for their tonic and alterative action in indolent and torpid subjects.

"3. Subthermal baths and douches, given for their sedative effect on the nervous system, and because of their favourable influence upon the circulation and nutrition in conditions of debility and depression.

"4. Thermal baths, given for their more or less intensive effects.

"5. Natural vapour baths, employed both for their sedative and stimulant action.

"6. Local thermal and hyperthermal treatment by moor (peat) and various mud baths (fango, etc.), sometimes raised to high temperatures (130° F.)."*

For the mechanical treatment of joint affections, see Chapters VIII. and IX.

* "Principles and Practice of Medical Hydrology," p. 180.

CHAPTER VII

INDICATIONS IN DIGESTIVE DISORDERS, CATARRH, AND TUBERCULOSIS

Constipation and Irritation of the Colon.—The daily ingestion of cold water, when fasting and accompanied by exercise, promotes peristalsis and evacuation of the colon, sigmoid flexure, and rectum. For this reason a course of natural waters, whether saline, muriated, sulphurous, or "indifferent," is often the best possible treatment in chronic conditions of this kind. The waters of Harrogate, Leamington, Cheltenham, and Llandrindod, are all useful in cases of constipation.

Small enemata of cold water have an analogous action and a more immediate effect. They cause a brisk contraction of the lower portions of the alimentary canal, and so produce evacuation. They should always be given at the hour when it is the habit of the bowel in health to be evacuated. For example, it will be found with many persons that a small cold enema after breakfast effects a satisfactory relief, which would just fail to take place without this stimulus. By the daily use of a small enema, 4 to 8 ounces of cold water, the daily habit may be recovered in simple cases where the rectal reflex is from any cause weakened or lost.

Another useful form of enema, which acts in quite a different manner, is the copious injection of water at an indifferent temperature. The point of "indifferent temperature" for the stomach and bowel is from 5 to 8 degrees higher than that for the skin, and corresponds nearly to the temperature of the mouth or rectum. Water at this temperature does not stimulate the bowel to contraction other-

wise than by its bulk; and this is not likely to occur in chronic constipation if the water is injected slowly in such a position that it passes freely into the colon. The water should be injected, preferably at bedtime, in the left lateral position, with the hips well raised. A douche or bag with a long tube should be used, and 2 to 4 pints at 98° to 100° F. very gently and gradually passed into the bowel. The patient then turns upon his back for a few minutes, and lastly upon his right side. He will often feel, not only the passage of the water into the transverse colon, but its arrival at the hepatic flexure and in the ascending colon.

After this procedure water and fæcal matter will be expelled, but a certain amount of water will be retained. The amount of water retained increases with subsequent treatments, and during the night it helps to liquefy the contents of the colon. On rising the next morning a natural action frequently takes place.

These copious injections can be given with much advantage once or twice in the week in cases where the transverse or descending colon is atonic and dilated, and fæcal matter accumulates in pockets of the bowel. These accumulations and the fermentative changes set up in them cause patches of irritation and catarrh, and mucus is therefore often present in the evacuations. In this form of constipation with catarrh, there is no treatment so efficacious as periodical lavage, as above described, but it should not be too frequently repeated. It gradually liquefies and removes the fæcal residues, which have remained too long in the bowel and have irritated its lining membrane and relaxed its muscular walls. In brief, it removes one of the commonest causes and forms of constipation.

Of recent years a prolonged course of lavage of the colon has been practised at many health-resorts, under the name of "Plombières treatment." At this famous French spa, with its soft, silicious thermal waters, the technique of lavage has been raised to a high pitch, and its employment in disorders of the large bowel brilliantly advocated. According to this method, lavage is practised daily, or every second

day, for a period of weeks, by means of various kinds of medicinal water—salt or sulphurous or calcareous. A second injection usually follows the first on each occasion, in order that, the contents of the bowel being first removed, the waters may operate on the uncovered mucous membrane.

It is worthy of note that this practice has coincided in point of time with a widespread belief in the poisonous nature of the contents of the colon, and a desire to be rid, if not of it, at all events of them. Those patients who have suffered, or thought they suffered, from the colon have had recourse in large numbers to this specialized form of lavage, sometimes twice, sometimes only once, in the year. Never have cases of disorder of the colon been so numerous at all health-resorts. In default of a better nomenclature, the convenient name of "colitis" has been freely given to the various ailments that are evidenced by abdominal pain or discomfort, with flatus and either irregular and ill-formed or constipated actions. Even the diagnosis of "mucomembranous colitis," a comparatively rare and well-marked disease, has been made sometimes, with satisfaction to neurotic patients, in cases where no membranes were passed and no mucus seen until *after* lavage had been employed.

It may be freely admitted that a systematic course of lavage according to this method is helpful in a certain number of cases, especially where the bowel is in a very sluggish and atonic condition, with habitual constipation. By means of repeated and continued lavage, *the chronic and smouldering catarrhal process is temporarily intensified*, an abundant mucous discharge is poured out, the unhealthy coating of the mucous membrane removed, and muscular tone gradually restored.

On the other hand, a warning is not uncalled for. This treatment may and does cause irritation and pain in another and much commoner type of disorder. This is the case where the bowel is already over-sensitive, and where spasm in some portions is combined or alternated with dilatation in others. This condition is certainly aggravated by pro-

longed and frequently repeated lavage, and the untoward results produced may continue for many weeks or months.

On the whole, the author would submit that it is better, in treating the usual forms of constipation and irritation of the colon, to employ the milder methods, and to reserve the more specialized continuous and intensive method for quite exceptional cases.

It must not be forgotten that an appropriate diet, massage, and active exercises of the abdominal muscles, greatly contribute to the cure of these disorders.

Dyspepsia.—Medicinal waters are beneficial in most forms of dyspepsia. In the catarrhal form, mild muriated and sulphur waters are indicated, such as those of Llandrindod and Strathpeffer. In the frequent presence of neurasthenia, a tonic regimen and douches should be superadded to the waters. For the anæmic type of dyspeptics, recourse may be had to the ferruginous waters of Harrogate, or the climates of Brighton or Folkestone, and in summer to the bracing marine resorts, such as Nairn, Scarborough, Weston-super-Mare.

Hepatic dyspepsia, with obesity, the result of excessive or over-stimulating diet, responds best to a full course of saline or alkaline waters, such as those of Harrogate, Leamington, Cheltenham, or Woodhall Spa, with appropriate diet, vigorous exercises, and thermal or Turkish baths. Hepatic or gouty glycosuria is usually relieved by periodical resort to alkaline waters.

Respiratory Affections.—The subjects of respiratory catarrh and asthma, and those who suffer from incipient tuberculosis, are usually very amenable to the influence of climate. Persons with sensitive mucous membranes, for whom a sheltered and soothing climate is indicated, may go at all seasons to Hastings, Ventnor, Falmouth, Rothesay, Grange-over-Sands. Another class of catarrhal subjects may be described as atonic, and for these a more stimulating climatic influence may be found at Eastbourne, Brighton, Cromer, Southport, Tunbridge Wells, and Ilfracombe. Another class of catarrhal affections is gouty in character,

and these are best treated by waters. Bridge of Allan and Falmouth in the colder months of the year have a well-deserved reputation in gouty bronchial catarrh.

Both catarrhal and tuberculous affections in the young often respond to a judicious use of cold hydrotherapy. Indeed, the use of external *cold*—whether by way of exposure to the open air day and night, or in cold climates, or in cold douches and frictions—has very generally replaced the former reliance upon *heat*, in hot climates, hot bedrooms and hot baths, and with the happiest results in these young subjects.

Skin Affections.—Many skin affections are amenable to waters and baths. It must suffice to mention chronic eczema and acne, for which a "pure" sulphur water may be used, both internally and externally, as at Strathpeffer, Llanwrtyd, Lisdoonvarna, and Ripon.

PART II

MECHANICAL AND ELECTRICAL REMEDIES

CHAPTER VIII

FORMS OF MECHANICAL TREATMENT

Everyone is familiar with the simple apparatus—such as dumb-bells and clubs, weights, cords and pulleys—for resisted movements, and the other appliances of the gymnasium which are commonly used for exercises, remedial and hygienic. The more elaborate series of apparatus, which claims to provide all the movements and exercises of the body and limbs that are of service both in orthopædic and medical cases, has not been so much used in Britain as in Continental countries. Perhaps such a machinery of movement is not in ordinary time congenial to an active and athletic race. Originally and actually it is an instrumental form of Swedish medical gymnastics. In the latter the exercises and movements are effected entirely by the operator's hand. The manual system derives from Ling of Stockholm, the modern pioneer in gymnastics and physical training. The instrumental method was devised by his pupil, Dr. Zander. The two systems are in some sense rivals, and in their medical use each has many devoted advocates. The manual method relies upon the *tactus eruditus*, and requires for its proper application a high degree of special training and dexterity. It has, indeed, been wittily described as *exercice à deux*. In skilled hands manual exercises have proved of the greatest value, but it

is obvious that there are limits to the power and endurance of a single hand.

Hence it is that the war, bringing in its train many thousands of wounded and stiffened limbs, became the great opportunity for instrumental treatment. Moreover, it was evident that the immobile and disabled joints and muscles need above all to be moved and re-educated at the earliest possible moment. They need it already in the hospital, even before the fractured bones are firm and the wound is soundly healed. They need it if possible even more upon leaving the hospital and in the period of convalescence. Unless movement and re-education are provided promptly and wisely, the period of convalescence will in too many cases be the period of hopeless crippling and deformity. No after-care can atone for neglect in these critical weeks and months.

Thus, experience showed that both in the hospital and after hospital treatment injured limbs require systematic physical treatment, and the question presented itself whether to rely on the skilled hand alone or to make use of apparatus designed to produce the needed movements mechanically, with or without the active participation of the patient. The vast amount and urgency of the work to be accomplished made it necessary to utilize every available means in order to deal promptly with the wounded. Those who, like the present writer, have had the opportunity of witnessing the good results obtained in large numbers of cases by means of mechanical treatment, especially when associated with baths, cannot doubt the wisdom and necessity of providing the same means of treatment in the British Islands. Time and experience show more and more, not only the ill effects of delay, but that it is possible by remedies of this kind, if not to remove this disablement, at least to mitigate it in the vast majority of cases.

It is claimed, by those who have practised it, that the instrumental method of movement is more rhythmical and regular than the manual method, and especially that the range and force of the movements are more accurately

measured. This is no doubt a point of great importance in some cases. The movement made may also be mechanically recorded upon the instrument. Day by day it can be increased by known amounts, and the progress of the case is determined, not by the impressions of the operator, but by visible records.

The twelve pieces of apparatus here figured and described are those installed in the Red Cross Clinic for the Physical Treatment of Disabled Officers in London. They were the first of their kind to be used in England, being designed and manufactured in France for military cases after the outbreak of war.* In this clinic and in several war hospitals, light apparatus of this description has been installed rather than the more numerous and heavy instruments, often fifty to sixty in number, which constitute a complete series of what is known as "Zander apparatus." Those that are here figured have the further advantage that one apparatus serves for *two movements*—for example, flexion and extension, say, of the knee or of the elbow—the change being made by shifting the levers and weights. Many of these instruments are constructed on the pendulum principle, and made so as to give both active and passive exercises. Their actions and uses may be briefly described as follows: †

The apparatus shown in Fig. 9 is for **Circumduction of the Arm and Shoulder-Joint.** A sideways position is assumed against the stirrup designed to receive the armpit, and the seat is raised or lowered until this fork touches the axilla. The movable handle is grasped, the arm well extended, and the sector turned. The axis around which the movement is made is adjustable, so that it may assume various angles of inclination.

Rotation of the Arm and Shoulder-Joint (active and passive) is shown in Fig. 10. A seat is taken in front of the apparatus, and the forearm is placed on the wooden lever. The hand grasps the handle, and the elbow is held within

* By Messrs. Borderel, 46, Rue St. Ferdinand, Paris.

† See "Physical Treatment for Disabled Soldiers." *Lancet*, March 25, 1916.

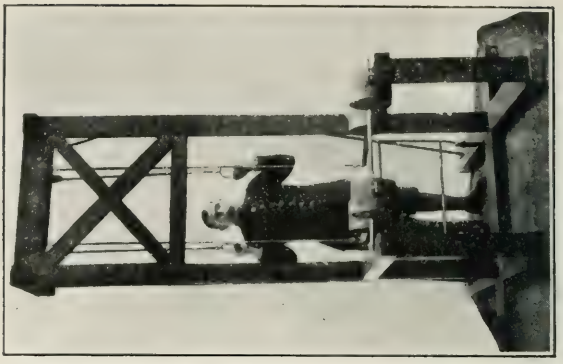


Fig. 11.

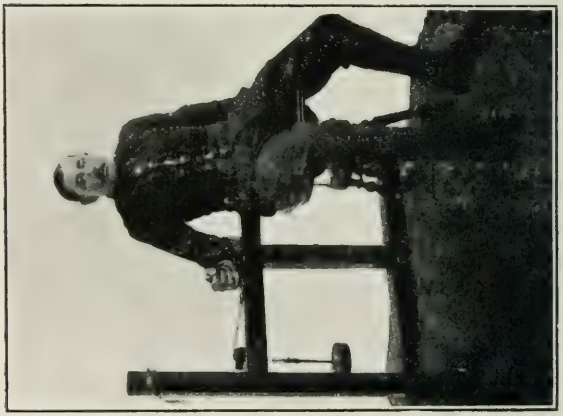


Fig. 10.

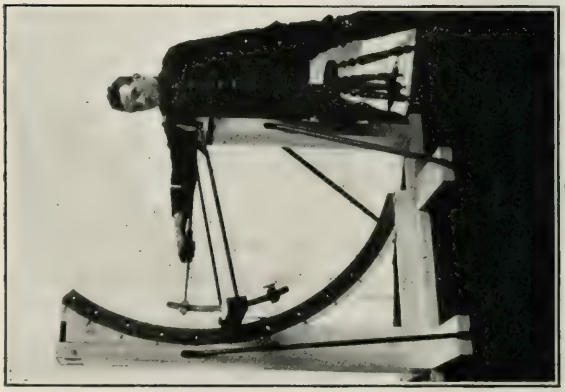


Fig. 9.

Fig. 14.

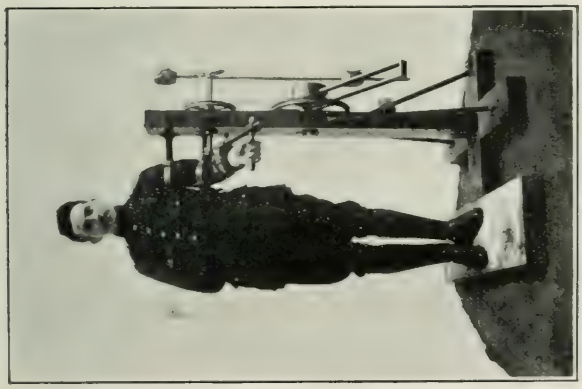


Fig. 13.

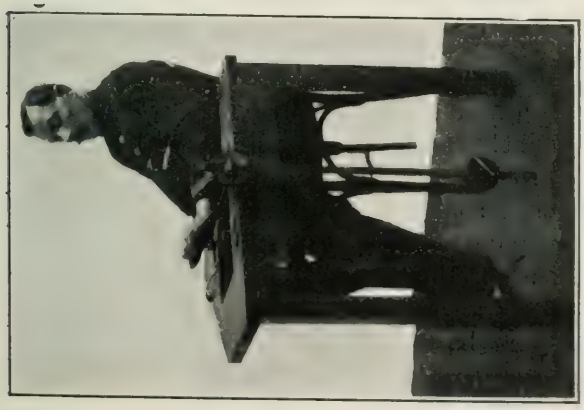


Fig. 12.

the iron rim attached to the fixed end of the lever, care being taken to hold the arm vertical. In order to prevent associated movements of the trunk, the other arm is firmly fixed by means of the leather strap fixed to the upright. The scale plate is loaded with one or more flat weights, and the forearm yields slowly to traction.

Lowering of the Arms with Flexion of the Forearm (Fig. 11).—This exercise consists in lowering the arms extended vertically above the head while bending the forearm on the arm. The patient places himself under the hanging handles, which must be arranged at the height of the shoulder. He has to grasp them, and to yield slowly to the action of the weights which cause the arms to be extended vertically. Then he lowers the arms until the hands come to the level of the shoulders, and yields afresh to the traction of the weights.

Flexion and Extension of the Wrist (Fig. 12). — The mechanism of these simple resisted movements is sufficiently explained by reference to the illustration.

Flexion and Extension of the Forearm.—Fig. 13 shows the position taken at the side of the apparatus, the arm which is to be exercised being attached to the leather straps of the supports. The elbow should be placed in the axis of the lever; by means of planks placed beneath their feet, persons whose height is below the average may bring their elbows to the height desired. The hand grasps the handle, the palm turned forward. In the movement of *flexion*, the handle should be below, and the counterpoise on the half of the double lever which is situated in front of the patient. In the movement of *extension*, the handle should be situated above, and the counterpoise on the half of the double lever which is behind the patient. In order to pass from flexion to extension, it suffices to displace the weight from one half to the other of the double lever. When it is proposed to exercise the left arm after the right arm and *vice versa*, the lever with the handle must be shifted on its shaft by moving the washer which is supplied with clutches; this action withdraws the eye bolts retaining the lever,

which then turns by 180 degrees around its axis. This apparatus is one of the most useful of the series.

Pronation and Supination of the Forearm (Active and Semi-Active Movements: Fig. 14).—The handle of the apparatus is brought into a horizontal position when pronation is proposed, and into a vertical position when supination is required. The double lever should be in either case in a vertical position, and the counterpoise below. At the commencement of the movement of pronation the back of the hand is turned down, the thumb behind. At the beginning of the movement of supination the back of the hand is turned forward, the thumb below. The arm should be held firmly extended. When the active movement is required, one weight is placed at the centre of the lever, and the other at a distance from the centre which corresponds to the resistance in the patient which it is desired to overcome. The movement may have another object than that of exercising the rotatory muscles of the arm. It may be designed to produce a relaxation by a stretching of the rotatory muscles, of the tendons, and of the articular capsules of the arm. In this case one weight is placed at each end of the lever, and there is no occasion to pay attention to the position of the handle and the lever.

Circumduction of the Hand (Fig. 15).—The forearm rests on the platform to which it is firmly strapped. The hand grasps the handle attached to a rotating disc at an adjustable distance from the centre. A handle on the back of the disc makes passive movement possible when desired.

Flexion and Extension of the Fingers (Fig. 16). — The mechanism of these simple resisted movements is sufficiently explained by reference to the illustration.

Extension of the Thigh and the Leg (Fig. 17).—The exercise consists in producing simultaneous extension of the articulation of the thigh and of the leg. A position is taken in front of the apparatus, the hands on the wooden uprights, a foot is placed on the iron pedal which is retained near the level of the floor by a catch. Placing the foot on this pedal causes it to become disconnected, and there-

Fig. 17.

Fig. 16.

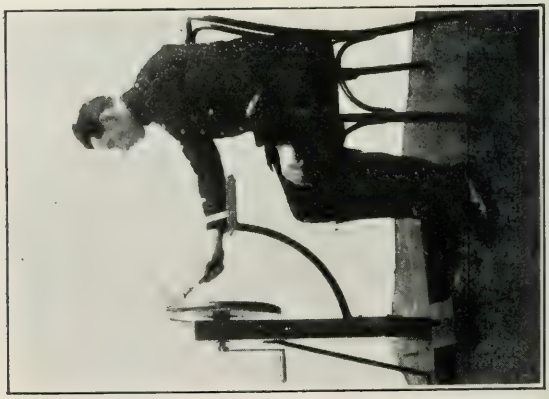


Fig. 15.

FIG. 18.

FIG. 19.

upon an upward movement is produced which is slowly yielded to. When it is desired to terminate the exercise, the catch on the arm of the lever must be applied.

Flexion of the Thigh and the Leg (Fig. 18).—The exercise consists in performing simultaneous flexion at the hip and knee-joints. A position is taken in front of the machine, the two feet at the same level. The foot which is to be exercised is then introduced under the stirrup. The patient supports himself on the lateral uprights, and raises the foot against the adjustable resistance.

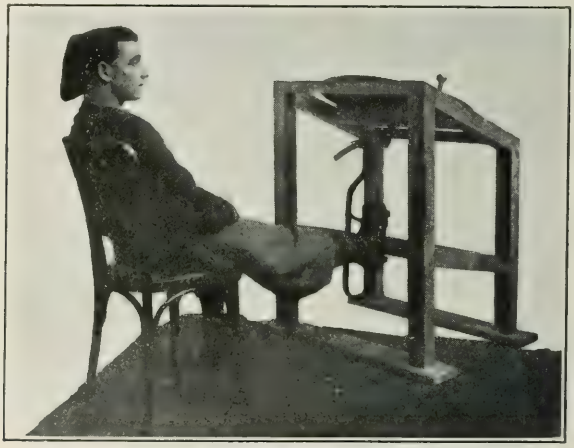


Fig. 20.

Flexion and Extension of the Knee (Fig. 19).—The exercise consists in bending the leg at the knee-joint. The patient takes a seat in the armchair, and slides down until the articulation of the knee is at the level of the axis of rotation of the apparatus. *Flexion :* The leg which is to be exercised is placed on the padded hook of the beam; the hook ought to engage a little above the heel. The thigh is fixed with the leather straps of the seat. *Extension :* The leg which is to be exercised is placed behind the beam; the hook should engage just above the ankle-joint. The little weight which is placed on the single lever is intended to counterbalance the weight of the leg in the movement of

flexion. It ought to be fixed, to fulfil this condition, at the extremity of the lever seen at the level of the patient's shoulder. In the movement of extension it ought to be fixed lower down, nearer the axis of rotation. Cases of anchylosis of the knee may demand forced flexion or extension. In order to obtain forced flexion, the apparatus is put in a position of flexion. Care must then be taken to shift the weight gradually and without jerks.

Circumduction of the Foot (Fig. 20).—The foot is placed on the iron sole or treadle, and it is fastened firmly with the binding strap. The circumduction is performed by a succession of movements of flexion and extension of the foot. The amplitude of the movement may be determined at will by fixing the rod at a greater or lesser distance from the axis of the fly-wheel, on the iron sector. The crank handle placed on the fly-wheel permits of the movement being performed passively.

It will be seen that three several forms of exercise may be given by a series of instruments of this kind.

1. Passive Exercise.

Many limbs are so much injured, or the muscles so weak, that active movements of all kinds are impossible. The tendons or muscles may be contracted, or the muscles paralyzed by injury to a nerve or simply atrophied by disuse. In all such cases the adjacent joint or joints is usually stiffened. All these are conditions in which passive movements with the appropriate apparatus may be used with advantage, especially when the stiff limb has been prepared by heat. At a later stage, when muscular power begins to return, active movements may be superadded.

2. Active Movements.

All good authorities are agreed that this is for the majority of cases the chief and most valuable form of mechanical treatment. The movement of a limb is resisted, not by the operator's hand, but by a weight placed upon a lever or

suspended from a pulley. Where the muscles are weak, only the very lightest weights are at first employed. As the treatment progresses, the resistance, or perhaps the duration of the exercise, may be gradually increased. It seems reasonable to suppose that a form of exercise that can be measured with mathematical exactitude is in that respect, at all events, preferable to exercise by the hand. It has been well said that the cardinal rule, in exercises of this sort, is not to ask of a muscle more than it can give. *Festina lente.*

3. **Active-Passive Movement.**

Another and valuable form of mechanical treatment which can be obtained from several of the instruments here figured may be described as the *minimal form* of active movement. Considering the extreme weakness of muscles after injury, or when wasted from disuse, or temporarily or partially cut off from their nervous supply, it is helpful to have a rhythmical exercise which imposes a very slight effort. This indication is well met by apparatus in which a pendulum is put in motion, and all that is required of the weakened muscle is the slight and intermittent rhythmical effort to *maintain* the motion of the machine. This exercise is considered to be of much benefit in functional weakness of muscles and the articular stiffness usually associated with it.

In treating stiffness or wasting in the upper or lower extremity, it is generally advisable, after a preliminary application of heat (see Local Baths, Chapter I.), to make use of several pieces of apparatus successively—perhaps four or six in all—giving an exercise of, say, three to five minutes with each. In this way the normal movements of the limb are strengthened and re-educated more equably than by any one form of exercise. With intervals of repose this will occupy perhaps half or three-quarters of an hour. This treatment should be repeated daily, as well as the preparatory treatment by heat and any electrical applica-

tion that may be suitable. The average duration of a course of this kind has been stated as two months, but slight cases require a much shorter time, and severe cases may need more, and sometimes return at intervals for further courses of treatment with great advantage.

The effects of mechanical treatment in suitable cases, and the indications for its use, have been thus described:

"1. **Mechanical Effects.**—It stretches the muscles and tendons and renders them more supple; it helps to lubricate the tendinous sheaths and the articular surfaces; it increases the amplitude of movement, the area of muscular contraction, and the activity of the arterial and the lymphatic circulation.

"2. **Physiological Effects.**—These are the well-known effects of active exercise in health—an increase of tissue change, of intramuscular energy, and of the process of nutrition. Moreover, movements put into action the cerebral and medullary nerve centres, with which they are in correspondence.

"3. **Psychical or Psycho-Physiological Effects.** — The *rationale* of exercise is functional education. The gradual restoration of a lost habitual movement reawakens latent nervous and voluntary power, and the patient is induced by the returning movement to bring it again into play.

"An atrophied muscle exhibits softness (*hypotonus*), want of normal reflex, *diminution in volume*, and *functional impotence*. The latter very soon becomes a permanent infirmity. It is not only that function makes the organ, and the suspension of function tends to destroy it, but a physical atrophy rapidly becomes a psychical atrophy.

"**Indications for Mechanical Treatment.**—All wounds which have caused atrophies, provided that the surgeon has removed mechanical obstacles and re-established the channel of voluntary impetus by reuniting divided nerves, muscles, or tendons. The treatment should begin very early and very gently, and should not always wait for the complete healing of the wound.

"**Contra-Indications.**—These are—(1) Articular or peri-

ACTIVE MOVEMENTS.

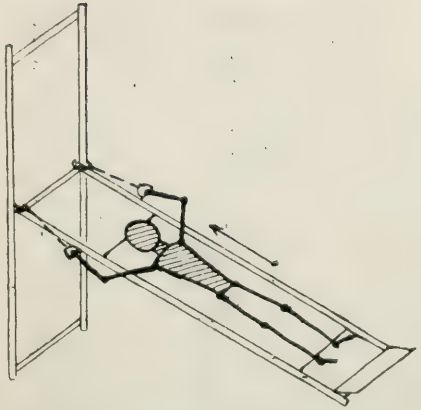


FIG. 21.—FLEXION, EXTENSION, AND ADDUCTION OF THE UPPER LIMBS.

For the last movement the arms are placed cross-wise, and then brought to the sides.

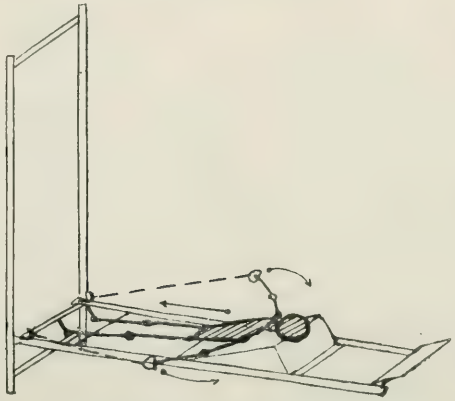


FIG. 22.—ABDUCTION OF THE UPPER LIMBS.

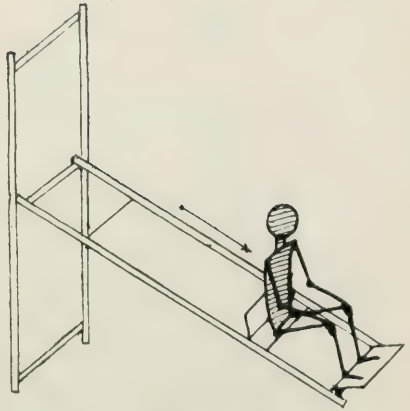


FIG. 23.—ALTERNATE FLEXION AND EXTENSION OF THE LOWER LIMBS.

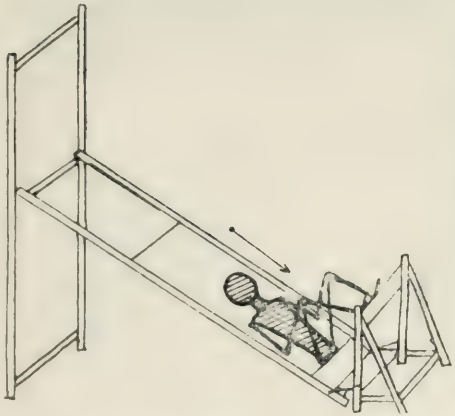


FIG. 24.—MOVEMENT OF THE HIP-JOINTS.

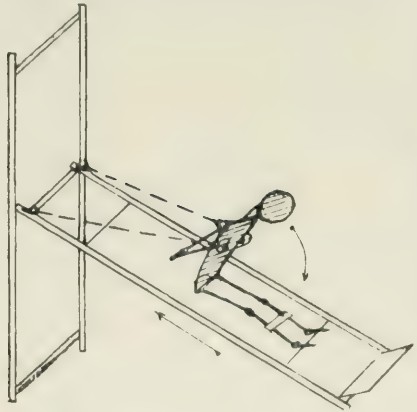


FIG. 25.—FLEXION AND EXTENSION OF THE TRUNK.

FIG. 26.—ROWER'S MOVEMENT AND GENERAL GYMNASTIC EXERCISES.

PASSIVE MOVEMENTS.

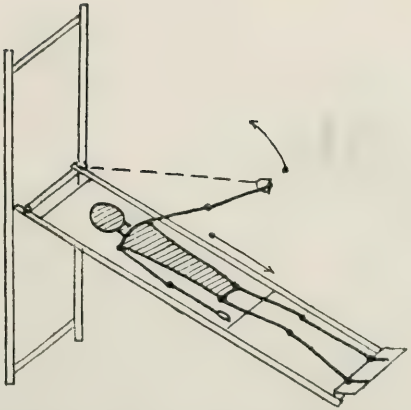


FIG. 27.—MOVEMENT OF THE SHOULDER-JOINT, BY FLEXING THE LOWER LIMBS.

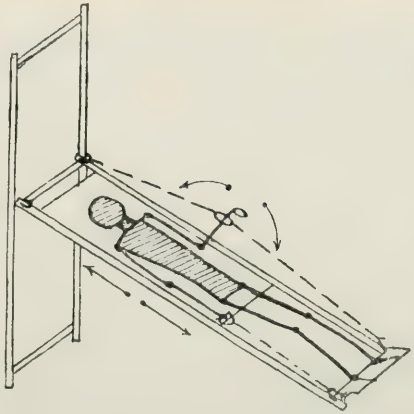


FIG. 28.—MOVEMENT OF THE ELBOW.

The lower limbs flex; the sound arm draws upon the wrist to flex the joint; the lower limbs extend to extend the joint.

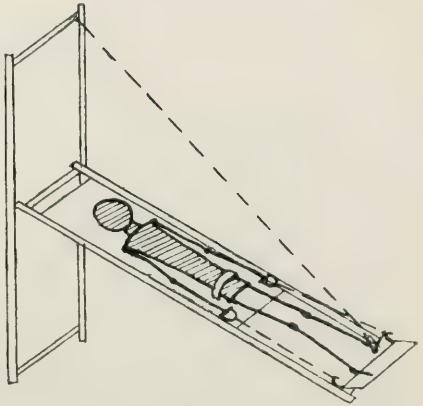


FIG. 29.—MOVEMENT OF THE HIP-JOINT.

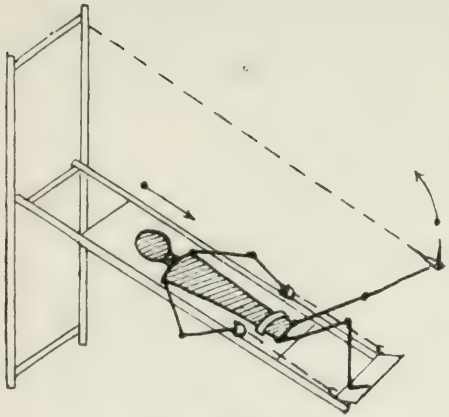


FIG. 30.—MOVEMENT OF THE HIP-JOINT.

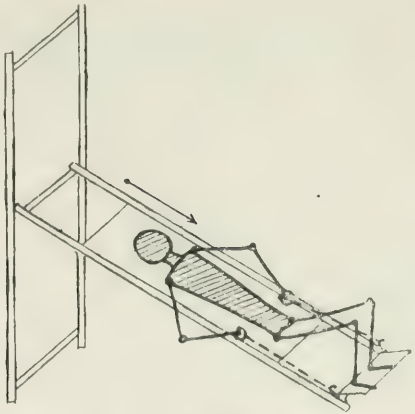


FIG. 31.—FLEXION OF THE KNEE AND OF THE ANKLE-JOINTS.

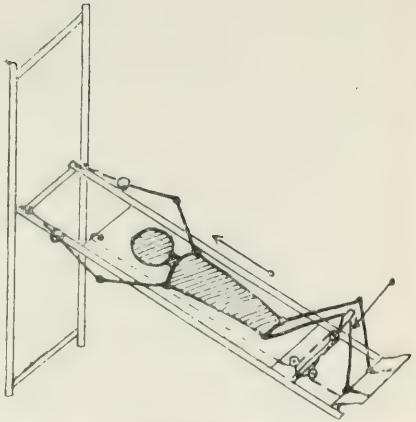


FIG. 32.—EXTENSION OF THE KNEE-JOINT.

For flexion, see Fig. 28.

articular inflammation, abscess, or arthritis, tuberculous or otherwise. (2) Foreign body in a joint (metallic or bony). The latter accident occasionally happens in a knee-joint from induration and separation of a portion of the synovial fringe. (3) Foreign body in the muscle or in the neighbourhood of nerves or bloodvessels. (4) Division or compression of the nerve. Treatment is here guided by electrodiagnosis. (5) Danger of displacement of a partly consolidated bone. To these should be added as 'partial or relative contra-indications' (1) unsuitable wounds; (2) neuritis of such sort that muscular contraction or movement reawakens pain; (3) persistent pain. But allowance must be made for the susceptibility of patients and for 'defensive reaction.' In practice pain often quickly subsides under treatment."*

A great number of active and passive movments, both of the limbs and the trunk, can be given by means of a simple and ingenious apparatus devised by Dr. E. J. Hirtz.† It consists essentially of a platform which moves by means of ball bearings up and down an elongated frame. This frame rests on the ground at one end, and at the other is attached by hooks to a metal bar, which can be placed at any height on vertical supports. The patient takes his place upon the platform, and goes through the appropriate exercises by means of a series of simple tackles. For active movements he draws his own weight and that of the platform along the length of the frame. The exercise can be increased by raising its attachments on the metal bar, the force expended varying with the inclinations, being at a minimum when the plane is horizontal. Passive movements are obtained by utilizing the weight of the body as the moving power, assisted by other muscular movements. Affections of the hip-joint are especially mentioned as often amenable to exercise on the inclined plane. The figures taken from Dr.

* "Traitement mécanothérapeutique des atrophies musculaires, consecutive aux blessures de guerre," by Dr. Pierre Faidherbe, lately Chief of the Department of Mechanotherapy in the Hôpital Complémentaire Grand Palais, Paris (*Paris Médical*, March, 1915).

† *Paris Médical*, March 30, 1915.

Hirtz's paper sufficiently explain this ingenious method of mechanical treatment.

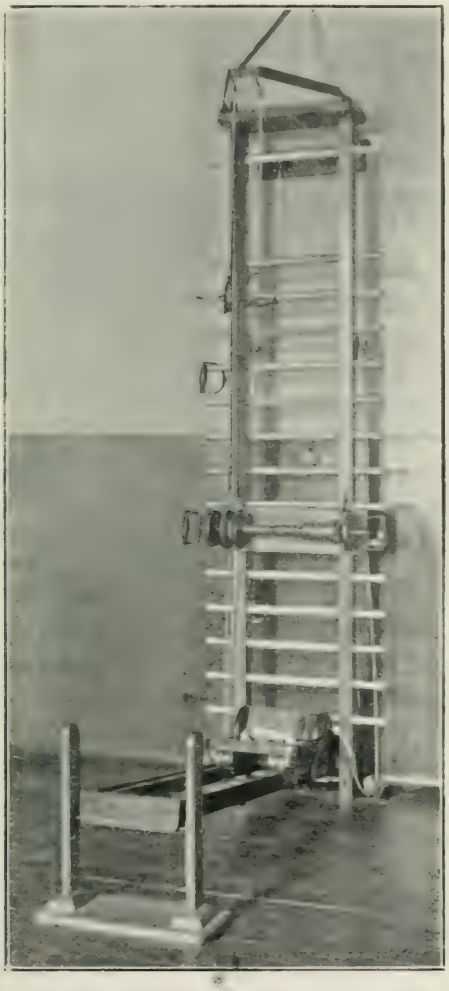


FIG. 33.—PULLEY-WEIGHT APPARATUS AT THE MILITARY ORTHOPÆDIC HOSPITAL AT SHEPHERD'S BUSH.

Fig. 33 represents another form of pulley-weight apparatus in use in the Massage Department of the Military Orthopædic Hospital at Shepherd's Bush. The device is thus

described by Dr. J. B. Mennell: "It consists of a ladder, space being left near the top for backward hanging exercises—*i.e.*, hanging by the arms with the back to the ladder. The bottom rung is of metal, and serves to support one end of a sliding seat. This is so arranged that the inclination of the runners may be varied from the horizontal to about 60 degrees. The foot-piece can be left loose or can be fixed at any desirable angle. A complete weight and pulley system is attached to or near the uprights of the ladder, and from the floor pulley on the left side the cord can be attached to the combined roller and rotator apparatus for wrist exercises and rotation of the forearm. This is provided with grips of three different sizes and with handles at both ends, so that either arm may be used when rotation exercises are ordered. The movement is controlled by a rachet in one direction, and by a pawl in the reverse. Upright poles (detachable) are fixed to the front of the ladder. These are for the use of those patients who are unable to perform rotation. They also provide substantial loose poles for use in various exercises."

CHAPTER IX

MASSAGE, PASSIVE MOVEMENT, MECHANICAL TREATMENT AND EXERCISE

By MAJOR R. TAIT McKENZIE,
Royal Army Medical Corps; Professor of Physical Education and Physical Therapy, University of Pennsylvania.

Massage.

Objects.—Massage is used to dissipate effusions after sprains, to restore stiffened joints to function, to soften and stretch contracted scars, to prevent atrophy and contractures following nerve injuries and fractures, to stimulate the circulation after frost-bite, and to improve general nutrition in local and general rheumatism.

Procedures : Effleurage, or Stroking.—This is a surface manipulation. It forms the beginning of treatment in all painful conditions, like sprains and fractures or after breaking down adhesions, as well as for effusions into joints. It is a preparation for more active movements. The hand is passed lightly over the skin, usually from the periphery to the centre. It is performed by the palm of the hand, the thumb, or the finger-tips. Both hands are used for large fleshy parts like the buttock, thigh, chest, back, or neck; the thumb or finger-tips are employed around bony parts like the hand, ankle, or wrist (the fingers adapting themselves to the part worked upon), about adherent scars, or on the forehead and scalp. It acts as a sedative to pain, and mechanically pushes on the surface circulation. As toleration is established, friction may be made more vigorous so as to act upon the deeper structures and stimulate the circulation in and about the underlying scar tissue.

Pétrissage : Pinching, Grasping, or Kneading.—This is a deep manipulation in which the skin moves with the hand like a glove. It is done with the thumb opposed to the hand, the fingers opposed to the palm, or the two hands opposed to one another. The muscles are rolled under the hand and skin, and intermittently pressed against the underlying bones. It is slow and deep, usually following the course of the venous circulation. This manipulation should be firm, but not too painful, and improves the nutrition of the muscles through the circulation. It is

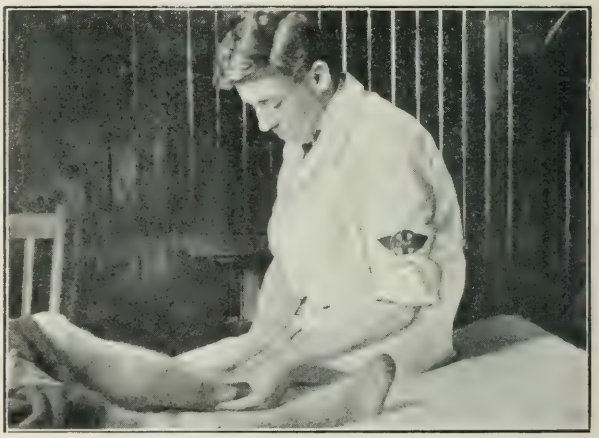


Fig. 34.*—Blind Masseur.

most useful for stretching adherent scars, removing the products of fatigue or effusions. It is the main manipulation used in general treatment for rheumatism, fibrositis, or lowered circulation from any cause.

Striking, or Tapotement.—This is a surface and also a deep manipulation. It consists of striking or beating with the open hand, the ulnar border of the hand (hacking), the tips of the fingers used like a flail, or the flat of the

* This figure and Figs. 35 to 38, Figs. 40 and 42, and Figs. 48 to 53, are reproduced from a paper by Major Tait McKenzie in the Proceedings of the Royal Society of Medicine, July, 1916, by kind permission of the Society.

clenched knuckles. The blows should be sharp and quick, but not heavy enough to bruise. They should be short and snappy, and done from a loose wrist. The main action is stimulation of the superficial nerves and vessels. If repeated often enough and strongly enough, it has a marked anæsthetic effect.

Vibration.—This is a rapid form of tapotement in which the rate of the strokes runs from 500 to 5,000 to the minute,

Fig. 35.—The Vibrator.

and is best performed by a machine for the purpose, with various forms of applicators for the different regions. Vibration is followed by a feeling of numbness, then tingling and then warmth, so that its general effect is stimulation.

Prescription.—The choice and sequence of these procedures in a treatment should always be definitely planned, and no one manipulation should be continued more than four or five minutes over one region. It should then be interrupted and replaced by another procedure, and a

definite sequence maintained. Conversation with the patient should be limited to the giving of directions, and the treatment must not degenerate into a social visit accompanied by the aimless rubbing, pulling, and twisting, of a limb, which too often goes by the name of massage.

Preparation.—The surface to be treated should be scrupulously clean, and should not be greased or oiled, except

FIG. 36.—BOMB WOUND OF RIGHT HAND. IRRITABLE SCAR, BEST TREATED BY DRY HEAT.

occasionally about a tough and irritable scar. The part may be dusted with talcum powder, and a very hairy surface may be protected from irritation by manipulating through a silk or cotton undergarment.

A stiffened joint or painful scar should be prepared for massage by heat in the form of baths of running water at about 110° for thirty minutes, or by exposure to radiant heat until it is thoroughly reddened. Where these are not available, it may be packed in hot sand or salt, for anything that will flush the part with blood greatly assists by making

it possible to use massage and manipulation that would otherwise be too painful.

Special Cases.—In sprains massage should be given at once, and followed by effleurage and continued by kneading, alternating these two procedures until the whole region has been covered. In certain fractures the splint is removed after the third day, a similar treatment given, and

Fig. 37.—Fracture of Ulna. Anchylosis of Elbow, Wrist and Fingers, due to Long Confinement in Splints. Complete Recovery under Massage, Stretching and Exercise.

the splint replaced. Stumps of limbs remaining after amputation should be prepared by heat, given massage, passive movement and exercise, and where necessary contractures stretched. In the case of painful scars, whose colour (red or purple) indicates that the circulation is still busy with repair, great care must be taken to prevent tearing of the new and vascular scar tissue by rough treatment. Such procedure may easily leave it worse than before. Treatment must begin, after preparation by wet or dry

heat, with effleurage, circular friction, and kneading, of the neighbouring tissue.

Scars may not show on the surface and yet may involve large areas of deep muscle and fibrous tissue. Persistent pain following treatment always shows that too much force is being used. Some patients wince on the slightest touch, and this false pain must be distinguished from real. Slow and gradual increase of pressure, at the same time distracting the patient's attention, will frequently serve to make the diagnosis clear. Occasionally massage may be used to assist in removing a sequestrum. Here the pain following treatment will be continual until the dead bone is discharged, but such cases require the most careful supervision.

General massage is best given at an hour midway between meals, and never immediately after a meal, and the séance should last from thirty to forty minutes and be followed by a rest.

Passive Movement.

Object.—Passive movement is used to stretch contracted scars, to increase the range of movement in stiffened joints, to rehearse the movement of joints whose muscles are paralyzed or weakened, to prevent contractures, and to restore joints to activity. It does not always accompany massage, and may be contra-indicated, as in fractures or imperfectly healed scars.

General Rules.—All movements should be done by slow insistent pressure; never use quick or jerky motions—they make the patient apprehensive, and the joint becomes locked by muscles thrown into spasm to resist the attack (Fig. 38). The patient's attention should be distracted from the movement that is being given, especially in functional cases. It greatly assists in getting a fuller range of movement, and suggestion, encouragement, scolding, or even bullying, all have their uses in such cases. Slight adhesions can be broken down by this means with great relief, but serious or firm old adhesions should be left alone

or broken down by the surgeon under an anæsthetic, passive movement being started the following day, and the joint being moved once only through its range each day and kept at rest between treatments. In all cases of scars and contractures in which pain persists for twelve hours after treatment, the joint should be rested and fixed in the best possible position by a splint until the pain has disappeared, and massage only, without movement, given after adequate preparation by heat. All old white scars can be stretched only by continuous tension, best given by the use of splints, which require to be worn for weeks or even months.

FIG. 38.—MANIPULATION OF ANKLE-JOINT.

Procedure : Fingers.—Passive movement of single fingers is done best by the operator's hand, the joint being slowly extended and flexed as far as possible, and the improvement maintained by a splint worn between treatments. This is especially true of functional contractures where fixation in the correct position is essential until the patient can be taught to maintain the correct position himself.

Wrist.—The wrist is flexed, extended, adducted and abducted, by hand or by machine. When the hand of the operator is used, the patient's fist should be clenched and grasped by one hand, the other being used to steady the forearm. Movement should be strong, firm, and slow, and

should not be repeated more than five times each way. If the wheel is used (Fig. 39), the forearm must be strapped in place both at the wrist and at the bend of the elbow, and the handle firmly grasped. The wheel is then slowly turned by the operator, and the range of circumduction extended by moving out the attachment of the handle as improvement warrants. This appliance may also be used actively by the patient.

Forearm.—Pronation and supination may be done passively by an apparatus (Fig. 14) having a swinging pendulum or weight, or by the hand of the operator grasp-

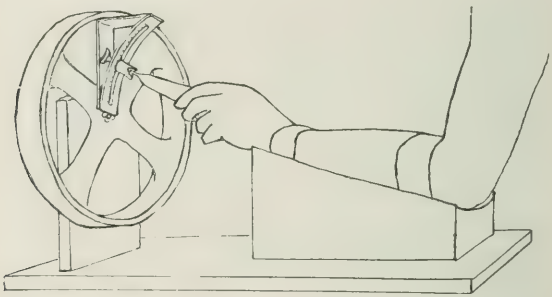


FIG. 39.—MACHINE FOR WRIST CIRCUMDUCTION.

The arm is strapped in position at the wrist and elbow, the hand grasping the handle rotates the wheel. The extent of movement is governed by a scale marked in inches.

ing the patient's hand, palm to palm, the patient's arm and forearm being kept at right angles, and so fixed as to prevent rotation of the shoulder.

Elbow.—Flexion and extension is performed by the hand of the operator or by the pendulum apparatus (Fig. 13).

Shoulder.—Rotation of the shoulder is performed by the operator as follows:

The patient sits with the arm down, the forearm flexed at a right angle. The operator grasps the wrist and forearm; the elbow is the fixed point, and the wrist is used as a lever, being brought out and in without changing the angle of flexion at the elbow. This movement should be slow and strong, and repeated not more than five times.

Circumduction.—Circumduction is performed by seating the patient on a bench, the arms stretched straight and out to the side, the operator standing behind with one foot on the bench, and the knee under the axilla to steady the shoulder, which is also held by one hand whilst with the other he circumducts the shoulder by grasping the arm just below the elbow. By the apparatus (Fig. 9) this movement is done by grasping the handle and rotating the arm bearing two balanced weights, the range of the movements being

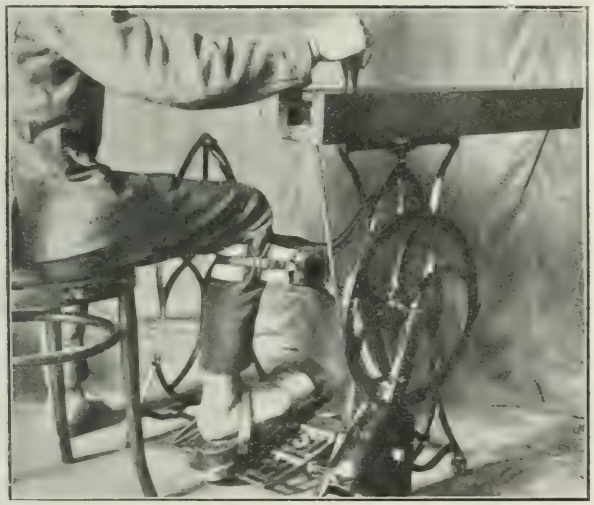


FIG. 40.—FLEXION OF ANKLE (PASSIVE) BY THE USE OF A HANDLE AND COUNTER WEIGHT.

gauged by the radius of the attachment to the arm. The most difficult point of circumduction is when the arm is raised and brought backward, and the ability to do this movement should govern the setting of the machine. Slight adhesions may be broken down by these means not only without injury, but with great relief to the joint, but persistent pain after treatment proves the necessity for caution.

Ankle.—Circumduction of the ankle is done by the hand, but full flexion is difficult or impossible when the powerful tendo Achillis is contracted, and a preliminary tenotomy is

usually indicated. The hold for this purpose is shown in Fig. 38. It is better done by a machine like Fig. 20, in which the foot is strapped to a footpiece and circumducted through an increasing radius by the adjustable crank to which it is attached. The driving gear may be turned by the hand of the patient or by the operator. The pendulum and weight can also be used for this purpose. A simple apparatus for passive flexion of the ankle is shown in Fig. 40. Certain conditions like flat-foot and claw-foot (pes cavus) are often treated for long periods by massage and passive movement without results. These procedures can have but a minor place in the treatment of such conditions, and they should be referred for surgical or other orthopædic treatment.

Knee.—Flexion and extension may be done by the hand, the patient being seated with the leg over the end of a plinth for flexion, or the patient lying prone on a plinth for extension; or by a machine with weight and lever (Fig. 19). The hand is much better than the machine, because it can give the important rotation movement of the leg upon the thigh in flexion so well insisted upon by Robert Jones. This should be given at the end of each complete flexion of the knee.

Hip.—The hip can be extended, flexed, rotated, adducted and abducted, with the patient supine on a plinth, the ankle of the thigh to be moved being grasped by the operator by one hand, his other hand placed on the knee of the same leg. No machine will give all these movements satisfactorily, and separate machines for each action are both cumbrous and costly.

Back.—Passive movement of the back can best be done with the patient strapped prone to a plinth, with the body projecting over the end and supported by an assistant (leg lying); the trunk can then be flexed, extended, or rotated, on the fixed pelvis. Rotation can also be given from the position of sitting astride a plinth by pressure on one shoulder and tension on another.

Neck.—Passive movement of the neck in all directions should be done by the hands only and with the greatest caution.

Measurements.—Careful measurements should be taken of the angle of limitation from time to time by the goniometer, and a record of improvement kept. The encouragement of the patient, who is thus enabled to see his own improvement, is most important. The case cited in the footnote* illustrates a sequence of methods that may often be employed with advantage.

Active Movements.

Object.—Active movements are done free or with apparatus, and are for correction, re-education, and the cultivation of strength and endurance. Free movement of the joints need not be explained in detail; they are simply a rehearsal of all the movements natural to each joint. But apparatus is necessary to give a graduated and measurable load, which may be increased as improvement warrants, because muscles work better under resistance than when unresisted. The necessary resistance may be given by friction, which makes the turning of the

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* Private B., bomb wound, left forearm.

Diagnosis.—Neurotic contracture, shoulder and elbow.

History.—Invalided August 15, 1915; in hospital thirteen weeks.

February 23, 1916.—The muscles fixing left elbow are all contracted, the joint cannot move at all; the left shoulder-joint moves partially, but the patient complains of pain on even slight movement. Hypercontraction on faradic stimulation. *Treatment.*—Hot-water bath and five minutes' effleurage of elbow under water and slow, slight movements of joint; also suggestion and re-education.

March 4.—All muscle contraction has improved; joints move more easily after each application. The elbow, which was fixed before at 70°, now moves to 90°; the forearm still horizontal.

April 6.—Much improvement; more complete massage and passive movement. To begin active exercises for the arm and shoulder.

April 19.—Has had about forty treatments, and is now quite well. Going on full physical training and route march. Reported fit two weeks afterwards, and returned to active service.

wheel or handle more difficult. Or it may be given by stretching elastic cords or compressing springs. But neither

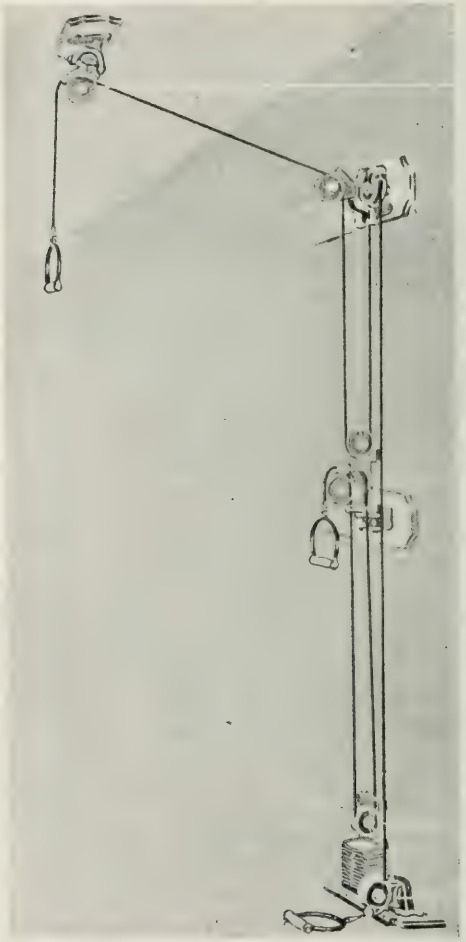

FIG. 41.—TRIPLEX PULLEY WEIGHT MACHINE.
From the author's "Exercise in Education and Medicine" (W. B. Saunders and Co.).

of these devices is easy to measure; they are variable, and the patient tires quickly, and becomes discouraged if he cannot notice a definite and measurable improvement.

The two best devices are the raising of graduated weights either by a lever or by a rope and pulley. In the former the weight is clamped on a lever at points measured by a scale, and the lengthening of the lever increases the force necessary to raise it. The angle of the lever is arranged so that the maximum lifting power is applied when the lever is at right angles to the ground, the beginning and ending of the movement being thus much gentler when the muscle is working

FIG. 42.—EXERCISES GIVEN BY PRESCRIPTION FOR THIGH, SHOULDER, FOREARM, AND CHEST, BY PULLEY WEIGHTS, AT HEATON PARK, MANCHESTER.

at a disadvantage. This is the principle employed by Dr. Zander in most of his machines. His machines are expensive and require much space, however, and an engine to supply motive power. Substitutes for them can be devised and constructed to produce the same effects at one-tenth the cost, especially if the weight and pulley be employed.

The principle of the weight and pulley has been carried to a high point of mechanical perfection, and machines are available in which the direction of the pull can be varied according to the needs of the exercise. Fig. 41 shows

diagrammatically an arrangement by which the direction of the resistance may be upward, downward, or from the side. Machines combining these three movements are called

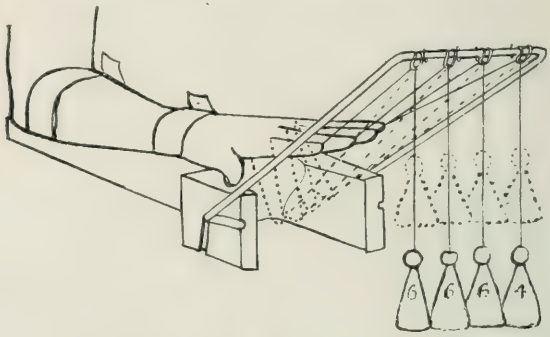

FIG. 43.—MACHINE FOR EXERCISING THE FINGERS.

First position: fingers extended. Movement, flexion at the metacarpo phalangeal joints. Movement represented by dotted lines. Weights in ounces.

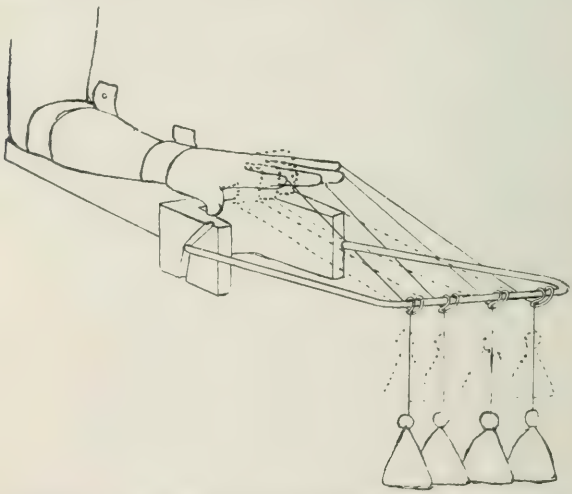

FIG. 44.—MACHINE FOR EXERCISING THE FINGERS.

Second position. Movement, flexion of the interphalangeal joints. Movement shown by dotted lines.

triplex or triplicate machines (Fig. 41), but, in addition to these, special devices are necessary for the exercising of certain joints.

Fingers.—Figs. 43 to 45 represent an apparatus for exercising the joints of the fingers by means of shot-bags from 2 to 8 ounces in weight. These are attached to cords which go through rings, and are fastened to glove fingers on the hand. By adjusting the hoop from above the hand to a right angle or to a position below the level of the hand,

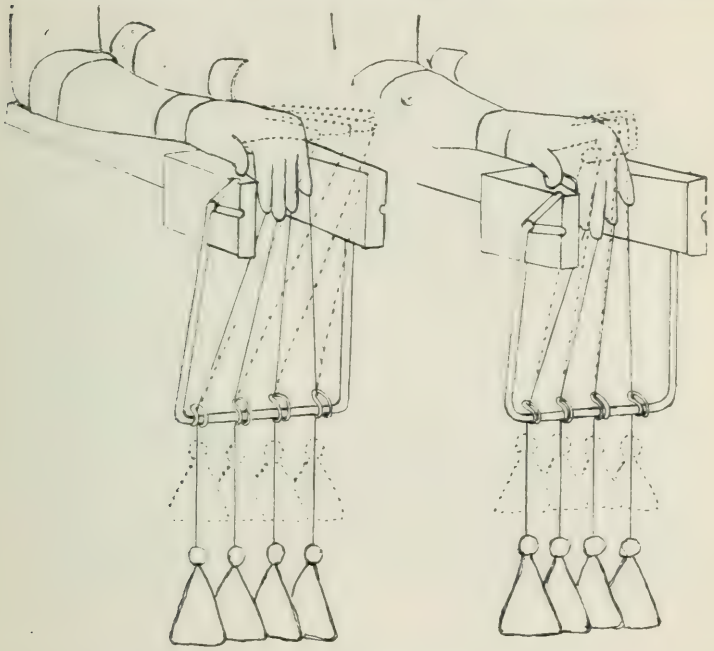

FIG. 45.—MACHINE FOR EXERCISING THE FINGERS.

Third position: (*a*) Extension of the metacarpo-phalangeal joints; (*b*) flexion of interphalangeal joints with the extension of metacarpo-phalangeal joints.

the direction of the pull is changed so as to obtain flexion or extension.

Wrist.—The wrist is exercised by the wheel already described, and by a roller (Figs. 46, 47) around which a rope is wound, by flexing the hand in pronation and raising a weight of 6 to 12 pounds from the floor. By using the under-grip, and by reversing the direction of the winding movement, flexion and extension, both in pronation and

supination, can be given in measurable doses; but the attendant must be on his guard lest the movement be simulated by raising and lowering the elbow instead of flexing the wrist.

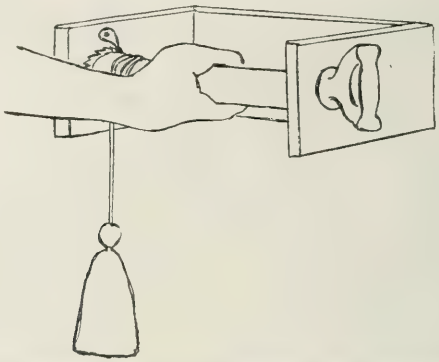

FIG. 46.—WRIST MACHINE, NO. 1: BEGINNING OF FLEXION OF THE WRIST.

At the end of flexion the roller is held in position by the racket, seen at the left. The handle on the right is for pronation and supination.

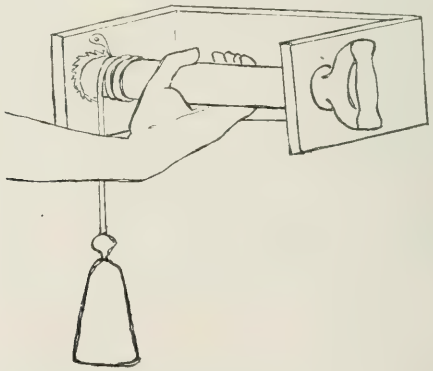

FIG. 47.—WRIST MACHINE, NO. 2: AN UNDERGRIP FOR EXTENSION OF THE WRIST.

Forearm.—Pronation and supination is obtained by a handle which is turned in either direction, the reverse movement being held by a wheel and ratchet. For this movement the patient should stand with the free hand behind his back, grasping the other arm just behind the

elbow. The elbow should be bent to a right angle, the hand firmly grasping the handle. The amount of pronation or supination can be measured by the number of clicks of the ratchet, and the dose by the weight raised multiplied by the distance.*

The shoulder machines already described can be used for active circumduction of the shoulder, the weights being arranged to carry the movement past the most difficult part of

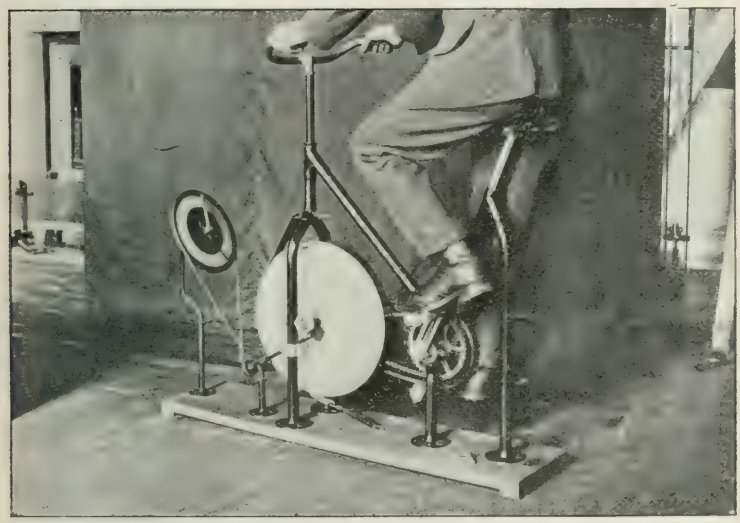

FIG. 48.—BICYCLE TRAINER FOR THIGH AND CALF MUSCLES.

circumduction—*i.e.*, where the arm is raised and brought backward. Rotation is practised by attaching to the wall opposite the pulley weight machine a shelf shoulder-high, on which the elbow rests; the hand grasps the handle of the foot attachment of the pulley weight. By pulling up and letting down the weight, rotation of the shoulder-joint is obtained. It is also obtained by the arrangement in which the patient uses the pulley weight while seated (see Fig. 9, p. 72).

* These three devices have been combined on a single table with bench attached, which has been constructed by S. Megarity, Wellington Street West, Manchester.

Legs.—The thigh, knee, and ankle, are well exercised on the bicycle or its modification (Fig. 48), or by prescriptions of exercises on the pulley weight.

Prescriptions.—The following seven prescriptions will show combinations of active movements, for various regions, free, resisted by the hands, and by apparatus. They should always be closely supervised, as it is easy to simulate a weak or missing action by another that is like it. One operator should be able to supervise the work of a dozen patients, and so should be able to treat 100 to 150 a day. By multiplying the apparatus, cases can be grouped in classes, thus economizing both time and supervision.

Prescriptions of Remedial Exercises as used at Heaton Park.

Figures refer to illustrations in textbook, "Exercise in Education and Medicine" (W. B. Saunders and Co.). Weights raised by pulleys should be gradually increased, and number of times up to twenty for each movement.

I.—Remedial Exercises: Forearms and Wrists.

(*A*) *Movement with Resistance.*

(1) Flexion; extension of elbow with resistance. (See "Exercise in Education and Medicine," Figs. 423, 424.)

(2) Fist clenched; flexion, extension, adduction and abduction of the wrist with resistance.

(3) Pronation and supination with resistance.

(*B*) *Pulley Weights.*

(1) Position: Face to, arms downward; floor attachment.
Movement: Flex and extend elbow.

(2) Position: Face from, arms forward, palms up; high attachment.
Movement: Flex and extend elbow.

(3) Position: Face from, arms downward; floor attachment.
Movement: Flex and extend elbow.

(4) Position; Face to, arms downward, elbows bent; high attachment.
Movement: Extend and flex elbow.

(*C*) *Wrist Machines.*

(1) Handle Grip: Pronation and supination with increasing weights.
(2) Roller Grip: Overhand, winding movement.
(3) Roller Grip: Underhand, winding movement.
Circu mduction of wrist, passive and active on machine.

Fig. 49.—Heel-Raising by the Aid of Sticks: One of the First Exercises for Crippled Men.

II.—Remedial Exercises: Single Shoulder.

(*A*) *Movement with Resistance.*

(1) Arm raise side upward with resistance.
(2) Arm lower side downward with resistance.
(3) Arm raise forward with resistance.
(4) Arm raise backward with resistance.
(5) Arm circumduct with resistance.

(See "Exercise in Education and Medicine," Figs. 421 to 430).

(B) Pulley Weights.

(1) Position: Side to, arm sideward raised; high attachment.
Movement: Arm forward across chest, elbow straight.

(2) Position: Side to, arm sideward raised; floor attachment.
Movement: Arm upward raise, elbow straight.

(3) Position: Side to, arm sideward raised; high attachment.
Movement: Arm downward and forward, arm downward and backward, alternating.

(4) Position: Side from, arm across chest; high attachment.
Movement: Arm side outward, elbow straight.

(5) Position: Side from, arm downward and behind; floor attachment.
Movement: Arm side upward raise.

FIG. 50.—SLOW DEEP BREATHING WITH ARMS RAISING, EACH MAN JUDGING HIS OWN TIME.

(C) Shoulder Machine.

Stretching contractures up to point of pain. (If pain persists discontinue and report.)

III.—Remedial Exercises: Chest and Shoulders.

(*A*) *Free.*

(1) Arms forward raise, inhale, side downward lower, exhale. (See "Exercise in Education and Medicine," Figs. 304, 305.)

(2) Arms side upward raise, inhale, trunk forward bend and raise, arms side downward lower, exhale (See "Exercise in Education and Medicine," Figs. 309, 310.)

(*B*) *Pulley Weights.*

(1) Position: Face to, both arms forward; high attachment.
Movement: Arms downward, arms outward, arms upward, repeating in rotation.

(2) Position: Face from, arms forward, elbows straight; high attachment.
Movement: Arms flex, inhale; arms forward, exhale.

(3) Position: Face from, arms downward; floor attachment.
Movement: Arms forward raise, elbows straight.

(4) Position: Face from, arms forward; high attachment.
Movement: Arms raise, inhale; arms lower, exhale.

(5) Position: Face from, arms forward; high attachment.
Movement: Arms sideward and inhale; forward, exhale.

(*C*) *Stall Bars.*

(1) Span bending with chest raising one or both arms. (See "Exercise in Education and Medicine," Fig. 521.)

(2) *For one side only.* Overhead grasp and side stretching.

(*D*) *Plint.*

(1) Supine. Artificial respiration with slow, deep breathing. (See "Exercise in Education and Medicine," Figs. 411, 412.)

(2) Supine. Slow breathing with arms forward upward raising and side downward lowering. (See "Exercise in Education and Medicine," Fig. 312.)

IV.—Remedial Exercises: Abdominal Muscles.

(*A*) *Free.*

(1) Position: Standing, hands clasped across abdomen.
Movement: Abdominal breathing. (See "Exercise in Education and Medicine," Fig. 401.)

(2) Position: Standing, hips firm.
Movement: Trunk circumduction. (See " Exercise in Education and Medicine," Figs. 391, 392.)

(B) Stall Bars.

(1) Position: Sitting on stool, hips firm, feet fixed.
Trunk extension and flexion, with twisting. (See " Exercise in Education and Medicine," Fig. 393.)

(2) Position: Hanging to stall bars, face outwards.
Movement: Raise knees, extend and flex legs with knees raised.

(3) Position: Standing, back to.
Movement: Span bending and chest raising. (See " Exercise in Education and Medicine," Fig. 52.)

(C) Plint.

(1) Position: Supine, hips firm.
Movement: Both legs raise 12 inches, knees straight, alternate feet raise and lower 6 inches, ten times; legs lower. (See " Exercise in Education and Medicine," Fig. 450.)

(2) Position: Supine, hips firm.
Movement: Trunk raising and lowering. (See " Exercise in Education and Medicine," Fig. 452.)

(3) Position: Sitting astride, neck firm.
Movement: Trunk circumduction. (See " Exercise in Education and Medicine," Plate III., Fig. 2.)

V.—Remedial Exercises: Shoulders and Back.

(A) Free.

(1) Arms forward raise, inhale, side downward lower, exhale. (See " Exercise in Education and Medicine," Figs. 304, 305.)

(2) Arms side upward raise, inhale; trunk forward bend and raise; arms side downward lower, exhale. (See " Exercise in Education and Medicine," Figs. 309, 310.)

(B) Pulley Weights.

(1) Position: Face to, arms forward; floor attachment.
Movement: Both arms upward stretch.

(2) Position: Face to, arms forward; floor attachment.
Movement: Forearms flex and extend, drawing the elbows back.

(3) Position: Sitting on rowing machine.
Movement: Rowing movement with increasing weights.

(*C*) *Plint.*

(1) Position: Prone, neck firm, feet fixed.
Movement: Extend back and neck. (See "Exercise in Education and Medicine," Fig. 311.)

(2) Position: Sitting astride, neck firm.
Movement: Flexion and extension of trunk.

(3) Position: Prone, arms bend, feet fixed.
Movement: Swimming. (See "Exercise in Education and Medicine," Figs. 313 to 315.)

VI.—Remedial Exercises: Thigh.

(*A*) *Movements with Resistance.*

Position: Standing with support for hand.
Movement: Thigh abduction, adduction, flexion and extension with resistance. (See "Exercise in Education and Medicine," Figs. 438, 439, 440, 441, 443.)

(*B*) *Pulley Weights.*

(1) Position: Side to, strap to foot; floor attachment.
Movement: Hip adduction, knee straight.

(2) Position: Face to, strap to foot; floor attachment.
Movement: Hip extension, knee straight.

(3) Position: Side from, strap to foot; floor attachment.
Movement: Hip abduction, knee straight.

(4) Position: Face from, strap to foot; floor attachment.
Movement: Hip flexion, knee straight.

(*C*) *Bicycle Trainer.*

Increasing distance and friction.

VII.—Remedial Exercises: Leg and Foot.

(*A*) *Movements with Resistance.*

(1) Position: Standing, knee flex and extend. (See "Exercise in Education and Medicine," Figs. 442, 443.)

(2) Position: Sitting, flex and extend, adduct, abduct foot with resistance. (See "Exercise in Education and Medicine," Fig. 446 and Figs. 442, 443.)

(3) Position: Standing, toes in.
Movement: Heels raise, full knees bend.

(B) Pulley Weights.

(1) Position: Face to, strap to foot; floor attachment.
Movement: Flex knee.

(2) Position: Face from, strap to foot, knee flexed; floor attachment.
Movement: Extend knee.

(C) Bicycle Trainer.

(1) Increasing distance and friction.

(2) Circumduction of the ankle, passive or active on machine up to the point of pain.

Special Cases.—Cases of functional weakness or paralysis cannot be said to be cured, however free their movement may be, until they can be made to take these active exercises voluntarily. They will start on massage, progress to passive movements, but must take free active movements before being discharged as cured. These exercises are necessary also to develop parts after tendon transplantation, and especially after long fixation or disuse, following fractures, as well as for the re-education of lost movements and general physical development following exhausting disease.

Class Gymnastics.—When improvement is sufficiently advanced, and sometimes whilst a prescription is being carried out, the patient should be thrown on his own resources still further by gymnastic exercise in classes in which he comes under the discipline of the gymnastic instructor. The mental attitude of many military patients is the opposite of that found in private practice. They will frequently resist improvement just as they will refuse an operation, preferring to retain a disability rather than return to active service. This attitude of mind must be reckoned with in class work, and can be changed only by

disciplinary measures and by attaching increased privileges as improvement occurs.

The following tables of gymnastic exercises have been compiled for convalescent soldiers, tested at a command depot, and approved by the Headquarters Gymnastic Staff at Aldershot. They start with slow simple movements for the legs, arms, and trunk. These movements have a definite progression in speed and difficulty, and are repeated daily for a period of thirty minutes. They can be taught by any instructor holding the Aldershot certificate.

Special Cases.—This light physical training is specially adapted to cases of shock, irregular heart action, debility, and imperfect recovery from wounds. Where necessary, men when wounded in the leg or arm should be excused the movements which they are not able to do; but these need not be many, and the fact that they are conspicuous in the class enables the medical officer to watch their progress more closely, and to test their disability from time to time, while the emulation of class work makes progress more speedy than if they were definitely or permanently excused. In addition to these exercises, men should be encouraged to play gentle games like bowls, croquet, and quoits, or even tennis, rowing, paddling or swimming, which will keep them occupied and out of doors. And the movements required in gardening, carpentry, and many other trades, serve a double purpose in giving them exercise and training them for useful work after the war.

Exercises in Light Physical Training.

Notes on Tables of Exercises.

These tables of exercises are to control the training of convalescents.

Duration of table about half an hour, repeated daily for twelve to eighteen days.

In moving from one table to another after teaching the new marching exercise, the marching exercise of the previous table or tables should be frequently practised.

Occasionally high and long jumping should be substituted for jumping and vaulting exercises.

Games should occasionally be substituted for marching and jumping, and vaulting exercises on reaching Tables II. and III., such as relay races, front rank *v.* rear rank, under passing relay race, jumping the bay, three deep (or " tag "), cat and the mouse, slipper tag from a circle.

Quickening exercises, either those of a rhythmical or competitive nature, should be applied at any time when the slackening of attention occurs.

The nomenclature of positions and exercises is that authorized and approved by the Headquarters Gymnastic Staff at Aldershot, and the tables can be taught by any of their certificated instructors.

FIRST TABLE OF EXERCISES IN LIGHT PHYSICAL TRAINING.

(A) Introductory Exercises.

Leg exercise	(*a*) Feet close; (*b*) heels raise.
Neck exercise	Head backward bend.
Arm exercise	(*a*) Hips firm; (*b*) arms bend; (*c*) arms bend, arms upward stretch.
Trunk exercise	Feet close, hips firm, trunk turning.
Leg exercise	(*a*) Hips firm, foot sideways place; (*b*) feet astride place.

(B) General Exercises.

Preparation for span bending	Feet astride, arms upward stretch (taken free).
Balancing exercise	Hips firm, knee raise.
Lateral exercise	Feet close, hips firm, trunk bending sideways.
Abdominal exercise	Hips firm, feet sideways place, trunk bending backwards.

Dorsal exercise	.. ..	Hips firm, feet sideways place, trunk bending forwards.
Marching exercise	.. ..	Quick march; (later) on the toes march.

Practice class arrangements: in two ranks fall in, numbering, opening and closing ranks.

(*C*) *Final Exercises.*

Heels raise. Arms raising sideways.

FIG. 51.—KNEE-RAISING BY A SQUAD ON LIGHT PHYSICAL TRAINING.

SECOND TABLE OF EXERCISES IN LIGHT PHYSICAL TRAINING.

(*A*) *Introductory Exercises.*

Leg exercise	.. .. ..	Hips firm, heels raising and knees bending (later quickly).
Neck exercise	.. .. ..	Head bending backward (later head turning).
Arm exercise	.. .. ..	(*a*) Arms bend, one arm upward, one arm downward, stretch; (*b*) arms bend, arms sideways stretch.
Trunk exercise	.. ..	Hips firm, foot sideways place, trunk turning.

Leg exercise	(*a*) Feet close and full open; (*b*) hips firm, foot placing sideways.

(*B*) *General Exercises.*

Preparation for span bending	Feet astride, arms upward stretch, trunk backward bend (slight movement only).
Balancing exercise	Hips firm, leg raising sideways; (later) "backward" and "forward."
Lateral exercise	Hips firm, foot sideways place, trunk bending sideways; (later) feet close, one arm downwards, trunk bending sideways.
Abdominal exercise	(*a*) On the hands down (by numbers); (*b*) on the back down (ground permitting) (later) with leg raising.
Dorsal exercise	Hips firm, foot sideways place, trunk forward bend, trunk downward bend.
Marching exercise	Hips firm, with knee raising quick mark time.
Jumping and vaulting exercise	Upward jumping.

(*C*) *Final Exercises.*

Hips firm, foot sideways place, trunk turning. Heels raise. Arms raising sideways and upwards.

THIRD TABLE OF EXERCISES IN LIGHT PHYSICAL TRAINING.

(*A*) *Introductory Exercises.*

Leg exercise	(*a*) Arms bend, heels raise, knees bend, arms stretching sideways; (*b*) hips firm, feet full open, heels raise and full knees bend.

Neck exercise	Head turning quickly (later head bending forward).
Arm exercise	(*a*) Arms sideways raise, arms forward bend; (*b*) arms swinging upward.
Trunk exercise	Arms bend, foot sideways place, trunk turning.
Leg exercise	(*a*) Hips firm, foot placing sideways; (later bend); (*b*) hips firm, feet full open, foot outward place; (later) foot placing outwards.

(*B*) *General Exercises.*

Span bending	Feet astride, arms upward stretch, trunk backward bend.
Complex exercise	Hips firm, feet sideways place, trunk bending forward and full downward.
Balancing exercise	Hips firm, leg raising forward, sideways, and backward.
Lateral exercise	Arms bend, feet sideways place, trunk bending sideways.
Abdominal exercise	(*a*) On the hands down (by numbers): (*b*) on the back down, leg raising.
Dorsal exercise	Hips firm, feet sideways place, trunk bending forward and downward.
Marching exercise	Hips firm, in quick time sideways march (later slow march).
Jumping and vaulting exercise	With three paces forward, off the left or right foot jump.

(*C*) *Final Exercises.*

Hips firm, feet sideways place, and trunk turning. Hips firm, foot placing sideways. Arms raising forward and upward, lowering sideways and downward.

Many men can do the foregoing tables, but are unable to do more. Nervous disorders, functional heart conditions, the bronchitis following gas-poisoning, asthma, rheumatism, and advancing age, all weed out the men when exercises in double time, climbing, jumping, and active games, are introduced, and the following table is compiled to mark the line of difference between such cases and those who will ultimately be fit for active service. It is almost as heavy as the table for the trained soldier, and all men should be able to do all the movements in it for a couple of weeks before being declared fit for the hardening process that they must undergo before rejoining their unit.

Table of Exercises in Full Physical Training.

(*A*) *Introductory Exercises.*

Leg exercise	Hips firm, feet full open, heels raising and full knee bending (four times).
Neck exercise	(*a*) Head bending backward (twice); or (*b*) head turning (twice in each direction).
Arm exercise	Arms bend, arms stretching forward, sideways, and upward (three times).
Trunk exercise	Arms bend, feet sideways place, trunk turning (twice in each direction.)
Leg exercise	Hips firm, feet full open, outward lunging (twice each foot).

(B) General Exercises.

Span bending	Feet astride, arms upward stretch, trunk bending backward (three times).
Complementary exercise ..	Feet astride, arms upward stretch, trunk bending forward and full downward (twice).
Supplementary exercise ..	Hips firm, heels raising and knees bending (three times).

FIG. 52.—BALANCE EXERCISES.

Balancing exercise	(*a*) Hips firm, leg raising forward, sideways, and backward (twice each); (*b*) hips firm, knee raising, leg stretching forward (twice each leg).
Lateral exercise	Feet closed, one arm upward, one arm downward, stretch, trunk bending sideways (twice to each side).

Abdominal exercise	On the hands, arms bend (three times), and add later with leg raising (twice with each leg); or (ground permitting) lying arms upward raising, legs raising (three times).
Dorsal exercise	Arms bend, feet sideways place, trunk forward bend, arms stretching sideways (three times).

FIG. 53.—HIGH KNEE-RAISING THROUGH WIRE ENTANGLEMENTS.

Marching exercise	Quick march, double march, marching on the toes (to be done each time). Slow march: Hips firm, with knee raising quick march (one to be done each time). Double mark time: With hips firm, knee raise. Quick march: with hips firm, on alternate feet hop.

Jumping and vaulting exercise	Complete training on obstacle course.

(*C*) *Final Exercises.*

Leg exercise	Hips firm, heels raising and knees bending (four times).
Trunk exercise	Hips firm, feet close, trunk turning (twice each way).
Corrective exercise	Arms raising forward and upward, lowering sideways and downward (until the action of the heart and lungs is eased).

Note.—Duration of a table, including obstacle course, *about one hour.*

Marching, Light and Full.—Gymnastics can only test the power and possibilities for movement in all directions, composed as they must be of exercises requiring single efforts rather than continuous easy movement; and they cannot provide for the training of endurance under long-continued action, in which a man's stamina is finally tested. So that parallel with gymnastics should go graduated walking, first on level and then on hilly ground, starting with a mile or two at the patient's own pace, and even with the help of a stick, progressing to three or four miles, and finishing with a full route march of six miles in quick time. There is no better way of testing endurance, especially if the full kit of 60 pounds be carried. Games that involve running, like soccer, ballee, basket-ball, rugby, and field hockey, will serve as most valuable and interesting accompaniments to this training for endurance, and serve to make the final test for active service in the field complete.

CHAPTER X

THE ADMINISTRATION OF MASSAGE

By JAMES B. MENNELL, M.A., M.D., B.C., Cantab., etc.;
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Massage and its Complement.—Massage is manipulation applied to various parts of the body. Rarely, if ever, is it all-sufficient as a method of treatment, unless combined with movement—active, passive, or reflex.

Objective of Massage.—Before commencing any massage movement, it is essential to decide what it is that we hope to attain by it, and to consider how the movement selected can assist in the attainment. Failing these considerations, the movement must be purposeless, and it will probably be ineffective. It is necessary, therefore, before commencing treatment, that the massage worker should realize as fully as is possible what has happened in the past and what is hoped for in the future. Given these two pieces of information, it should be possible to decide what structures are at fault, and to draw out a regular scheme to be followed up until every structure that has suffered injury has been restored to the uttermost.

Responsibility for Massage.—The surgeon or physician in charge of the case should also have in his mind some definite idea as to what progress he expects to see in his patient, and should examine him at regular intervals, in order to insure that his scheme is progressing favourably. Otherwise disappointment is almost inevitable. He alone is responsible for failure or success, as he cannot shift his

responsibility in the event of failure, and retain it only in successful cases.

The Effects of Massage.—There are two possible effects of massage—reflex and mechanical. The former may be beneficent or inimical according to the skill of the worker and the suitability of the movements prescribed; and the latter, while aiming chiefly at mechanical effect, is rarely devoid of reflex action.

Action of Varieties of Massage.—Of the three main varieties of massage movements (which may be classified as being performed by *stroking*, *compression*, or *percussion*), the first aims solely at securing reflex action, if performed superficially. Deeper stroking and all forms of massage which entail the use of pressure serve to empty the structures pressed upon of their contents, or to exert tension on something which it is hoped to stretch. Percussion tends to "shake up" the part under treatment if the muscles are relaxed, and is generally described as "stimulating" if performed, as is usually advised, with the muscles maintained in a state of contraction. This movement has the reputation of restoring muscular strength; how or why is never stated. It is true that nutrition may be maintained by massage, and this may prevent wasting; but there is one way, and one only, in which muscular power can be developed, and that is by the performance by the individual fibres of their natural function—namely, contraction. Massage can render voluntary movement more easy of performance; it cannot cause any actual development of power except indirectly.

Massage in Recent Injury—(1) *Immediate.*—Whenever possible, the first treatment to be meted out to a recent injury should aim at checking hæmorrhage from the injured structures by pressure. This cannot apply to recent fractures, but to almost every other form of injury. Firm kneading over the injured structure has this effect, and at the same time helps to disperse any blood that may have escaped into the surrounding tissues before it has had time to commence organization. The application of a

thick pad of wool and a bandage then checks any further local effusion. Tight bandaging without adequate padding is fatal to success.

Massage in Recent Injury—(2) *Second Stage.*—Presuming immediate treatment to have been administered, or, if the case is not recommended for massage until need for this treatment has ceased, two things remain to be accomplished: to hasten repair and to prevent the formation of adhesions.

To Hasten Repair.—Repair depends on an adequate blood-supply. After injury there is always an amount of disorganization in the vasomotor system, which is directly proportionate to the severity of the injury. This is caused by direct reflex, and can only be alleviated by the counteraction of a beneficent reflex. To attain this end there is, in the first instance, one agent only, namely slow, gentle, and rhythmical surface stroking of the whole limb. The stroke should avoid the whole neighbourhood of the injury when treatment commences, and should gradually approach it more nearly as time goes on, until this, too, is included in the stroke, provided (*a*) that there is no fracture, (*b*) that the surface is intact, (*c*) that the need for local pressure to check subcutaneous hæmorrhage has passed. In any of these three contingencies the site of injury must be avoided.

This surface stroking relieves pain and spasm, and prepares the way for a dose of mobilization, which at first should be passive. By this is meant that the patient takes no part either in assisting or resisting the movement performed by the operator, but co-operates with him by allowing all his muscles to remain in a condition of perfect relaxation. Assistive, free, or resistive movements follow as soon as possible. It is thus that the formation of adhesions is prevented. This may constitute the whole treatment.

If local effusion has already taken place, or if the results of the disorganization of the vasomotor system are already evidenced by swelling or œdema, some further treatment may be called for. This should aim at assisting the venous

circulation and the onflow of lymph, and may be performed by any of the forms of massage that consist of compression. The aim of the movement being to empty the part under treatment of its fluid content, it is necessary to observe two laws. It is useless, as Wharton Hood used to say, to try to empty the bottle with the stopper still in. Hence manipulation must start at the proximal end of a limb, and gradually approach the periphery. It is useless to knead a swollen foot if the lymphatics of the leg are water-logged. It is futile, also, to try to secure any result from pressure on a limb if its muscles are in a state of contraction. The second law in treatment, then, is that compression should be performed only when the muscles are in a condition of absolute relaxation. In other words, there must be a definite sequence between the superficial stroking which assists to reduce spasm, and the deeper stroking or compression which are only efficient when relaxation has been secured. Given relaxation, a limb, being perfectly flaccid, resembles a rubber hot-water bottle rather well filled. The slightest pressure at any given point is instantly transmitted throughout the whole segment of the limb. Thus, no great pressure need be exerted to empty veins and lymphatics in which the maximum pressure is perhaps 5 to 10 mm. of mercury. If, on the other hand, the muscles are allowed to remain contracted, no amount of pressure will induce them to yield beneath the hand, and therefore the whole aim and object of the movement is lost.

Massage during Later Stages after Injury.—As already shown, massage alone can never restore muscular power. This is effected by movement, but massage can prepare the way. Any assistance to the circulation which massage can give will promote repair, and by massage also scars may be loosened and adhesions stretched.

The Restoration of Circulation should be attempted on lines similar to those employed when the injury is recent; but now the effusion and œdema is more or less organized, and rather more vigorous treatment is required to remove them. No great force is needed: a slow, steady pressure

starting at a point just proximal to the swelling, and slowly extending distally, will prove efficient. Some form of percussion will also help. The best is vibration, preferably administered by a mechanical vibrator. If the muscles, contrary to the usual rule, are kept relaxed, the effect is a sort of general shaking up of the part, and this can also be effected to a greater or less extent during the application of kneading or other forms of compression massage. It is thus, too, that the way can best be prepared for exercises.

The Treatment of Scars.—It should be remembered that these are rarely superficial, and that what is apparently a surface scar may have deep ramifications. Treatment must commence with an attempt to loosen these, and to this end the structures underlying the scar must be relaxed to the uttermost. The whole of the injured tissues may then be picked up and manipulated freely in all directions. The structures are then gradually rendered more and more taut, the manipulation becoming correspondingly less free owing to the greater strain placed upon the structures requiring stretching. If a nerve is involved in the scar, the process must be graduated most slowly, the indication as to the amount of treatment that can prove beneficial being the measure of the pain caused. If it is such that the pain continues for twenty minutes after treatment has ceased, or if it in any way reduces the amount of active movement that the patient can perform, then treatment must be regarded as excessive. To try to hasten recovery leads to disaster—insomnia and general nervous collapse. Ignorance of this fact has been responsible for many neurasthenic symptoms amongst the wounded. The same holds good in—

Treatment of Adhesions by Massage.—Here can be seen, perhaps to its greatest extent, the lack of co-operation between surgeon and masseur. Adhesions are of two kinds —the white fibrous and the yellow elastic. The former should be dealt with by the surgeon by manipulation, with or without an anæsthetic. The yellow elastic are not to be "broken down," save in rare instances, but require slow,

steady tension. This is given most effectively by splintage; but failing this the method of treatment that alone can succeed is slow tension accompanied by deep stroking or kneading. This is the treatment that should always be given to all cases of tendon insufficiency or for such conditions as ischæmic contracture. Sudden or violent tugs can effect nothing for good, and have great possibilities for evil. They tend to stir up afresh septic infection that has become quiescent, and are a fertile source of much and very detrimental suffering. A special warning is necessary in those cases where a scar is bound down to bone by adhesions. The bone attachment gives, as it were, a sort of definite function to the adhesions, which respond to forced movement by development; and the greater the irritation to which the bony attachment is subjected, the firmer it seems to become. It is essential, therefore, to guard these adhesions from tension caused by movement, and to loosen them from the bone while the whole area which they involve is kept flaccid.

Massage in the Treatment of Joint Injuries should follow on the lines previously laid down. In the early stages stroking for reflex effect is all that is necessary, the other forms of massage being added as the date from the receipt of injury recedes. In the early stages relaxed movement of the injured joint is all that may be prescribed; later on, when the joint has become stiff, massage may assist greatly in restoring movement. Suppose, for instance, that the range of movement in a knee is limited to 30 degrees, the patient is placed in the prone position and deep massage of the back of the leg and thigh commenced. The leg is supported on the forearm that is disengaged, and flexion is slowly given while the massaging hand renders a counter-pressure whenever it passes the region of the knee. The steady pull of the supporting forearm is thus constantly reinforced by a most gradual process. A point to remember is that, when flexion has progressed to its full extent, it must not be relaxed suddenly, or the patient will suffer much unnecessary pain. Gradual relaxation of tension is

almost as important as gradual increase of tension. For emphasis it is well to add that, if the limitation is due to adhesions which are binding neighbouring muscles to the bone, the adhesions must not be subjected to the strain until they have been loosened from the bony attachment. If a patient arrives for treatment with greater limitation of movement, with an increased sensitiveness in the joint, or with any further swelling than was present the previous day, treatment must be relaxed until these symptoms have subsided.

Massage in its Relation to Movement.—Massage can prepare the way for movement in two ways. By relieving pain and spasm a dose of relaxed movement can be given which, without the aid of massage, it would be quite impossible to perform. In later stages of treatment a patient may be able to carry out movement through a greater range after deep stroking, kneading, or percussion, than he could beforehand. It is often wise to commence a *séance* with massage, prescribe a few movements, and then to continue to give alternate doses of movement and massage. The dosage of massage should steadily decrease, while that of movement increases. Great help can often be given to a patient by continuing massage during a dose of mobilization, be it relaxed, assistive, resistive, or active, but particularly during the administration of the first two.

Massage After Nerve Injury: I. Of the Lower Motor Neuron.—(*a*) If there is complete paralysis, all that massage can be expected to do is to maintain the nutrition of the limb, which, owing to lack of exercise and trophic influences, is sure to suffer. But a muscle in health with nerve-supply intact is a very soft and delicate structure when completely relaxed. In paralysis there is a relaxation which can never be equalled in health, and so the utmost care must be exercised not to add injury by manipulation to that which already exists from the lack of innervation. Under no circumstances, therefore, must a paralyzed muscle be pressed against a bone, and only the most delicate movements must be performed. Any force or jar cannot be

resisted by reflex contraction, and so it is impossible to estimate the exact border-line between safety and danger. Provided we secure the full benefit of reflex action, which is done by surface stroking, and assist the venous circulation to the uttermost, which calls for a pressure that should not exceed that of about 5 mm. of mercury (*i.e.*, the gentlest possible touch), then nothing more need be done. It is very easy to overdo massage in the treatment of a paralyzed muscle, and anything in excess of what is here suggested is calculated to do so. Above all, percussion should be avoided. It is recognized that the movements comprised under this heading should be performed with the muscles kept taut, if beneficent action on the muscles is expected. A paralyzed muscle cannot be contracted, and therefore these movements are contra-indicated. The temptation may be great to see the vivid flush appear on the skin that so often follows this treatment. In all cases of paralysis it only serves as a cloak to the damage done beneath. It is the duty of the massage worker to see that all joints are kept supple, that all non-paralyzed muscles receive their dose of exercise, and that no strain whatever is placed upon the paralyzed muscles until they have completely recovered their tone. Up to this point they must be kept as fully relaxed as anatomical considerations will allow.

(*b*) If a nerve has been *injured* only, not severed, massage should be conducted on similar lines. But there is liable to be some area of hypersensitiveness. This must be avoided. Massage should commence over the non-sensitive area of the limb, and gradually approach the painful part. In this way only can hypersensitiveness be allayed: it can never be accomplished by irritating the sensitive portion.

II. Of the Upper Motor Neuron.—The patient now suffers from a spastic paralysis. Massage to maintain nutrition, to help prevent the onset of contractures, and to aid re-education, is a comparatively simple matter. The reflexes are all very exaggerated in this condition, so that all sudden or unexpected movements in massage should be avoided. Deep stroking and gentle, rhythmical kneading will suffice

to secure full benefit from massage. Relaxed movement should form part of treatment.

Massage in Neurasthenia.—The neurasthenic presents the picture of fatigue incarnate. Irritability may be present, but it is the irritability of fatigue. There may be insomnia: the patient is "too tired" to sleep. The phobias and obsessions are phantasies called up by sheer fatigue of brain, while the depression is, as Hartenberg puts it, "the expression in consciousness of the plaint of the cellular aggregate, suffering from the deficiency of vegetative life." To try to stimulate the neurasthenic is simply to flog the tired horse; to soothe is to assist the cure. Nothing but superficial stroking should ever be allowed, the idea being to send up to the exhausted nervous system, no matter what the cause of exhaustion, smooth, gentle, and rhythmical stimuli to soothe the tired and irritable nerve cells throughout the body. This treatment can produce in the patient a hypnoidal state during which suggestion treatment can be carried out with great effect. This, however, is no part of massage. The two points always to be kept in mind are that no so-called "stimulating movement" is permissible, and that any point that is tender or hypersensitive must be avoided by a wide margin. This may be decreased day by day till finally the whole area is under treatment. By this time, however, it is no longer hypersensitive.

Neuritis is rarely if ever amenable to massage in the early stages. If prescribed, the lightest possible stroking is all that should be administered, unless any attempt can be made to maintain the nutrition of the limb without causing pain. In the later stages this should be the main object of treatment. The massage that is used will also prepare the way for voluntary movement.

Sciatica is a particular form of neuritis, and massage treatment may be most valuable in the later stages. In addition to the actions described above, it is possible by massage so to "shake up" the whole of the thigh that minute adhesions, the presence of which often renders

convalescence so tedious, may be broken or stretched. This process is aided by suitable movements.

It is usually possible to give great relief to patients suffering from **Neuralgia.** Surface stroking should alone be employed throughout, unless it is thought that part of the trouble may be due to deposits of irritating material in the sheath of the nerve. Very gentle local frictions may then hasten recovery. They should be given with great care and discrimination, and never during the acute stage.

Fibrositis, Lumbago, Chronic Rheumatism, can all be benefited very materially by massage. The reflex effect is shown in reduction of pain, and this should be secured by surface treatment only. As soon as the pain has gone, or is markedly decreased, compression massage for circulation may be undertaken. It should, however, be most gentle. This will suffice to empty veins and lymphatics, and leaves no deleterious after-effect. Heavier work may lead to a subsequent paralytic vaso-dilatation in the part, and this rapidly undoes any good that may have been secured. The rule, then, should be to allay pain by surface stroking, then aid circulation by a very gentle and very short treatment. The duration of treatment may be gradually increased if the patient experiences no return or increase of pain.

All forms of **Cramp**—occupational, functional, or postural—should receive the most delicate treatment. Surface stroking should form the whole of treatment till the liability to cramp is obviously lessening. Then gentle compression may be added, but great care must be taken to maintain the rhythmical nature of the movements. Surface stroking should terminate the *séance*. Re-education of movement is an essential part of " the cure."

Massage in Diseases of the Circulation.—For **Local** vasomotor disturbance, as in Raynaud's disease, " trench foot," chilblains, indolent ulcers, and so forth, massage plays its usual double part, the reflex action being of greater value in some cases, the mechanical in others. In no event can either be ignored; and in no case should treatment be local,

however localized may be the diseased area. Massage treatment should embrace the whole of the limb, its application to the thigh in the treatment of a chilblain on the little toe being of no less importance than treatment of the toe itself. Certain areas are often hypersensitive; they should be avoided, and approached gradually as treatment progresses. Sometimes it will be found that even so pain will be accentuated an hour or more after treatment has ceased. The inference is that treatment has been too vigorous. It should commence with surface stroking of the whole limb; deep stroking follows, then the gentlest possible, slow and rhythmical kneading of the whole limb progressing from above downwards to the extremity.* The value of exercise, as far as it can be devised to suit individual requirements, must never be overlooked.

In the treatment of **Heart Affections** massage can play a prominent part. The patient is as a rule deprived of the benefits conferred by exercise, and the excretion of waste products is thereby rendered sluggish. By massage this evil may be remedied, wholly or in part. Also, by rendering assistance to the circulation, the enfeebled heart receives assistance which always stands it in good stead. Surface treatment over the cardiac area may have a profound reflex effect on the heart-beat, producing a sense of comfort and security, and relieving the tendency to discomfort from the sensations known as "palpitation." How far any psychical element may play a part it is difficult to say. The ideal treatment consists of general surface stroking of the whole body centripetally, the strokes becoming firmer and firmer as the manipulation of each part in turn proceeds. Gentle rhythmical kneading should follow. Any local treatment must be performed with the utmost delicacy of touch.

Thrombosis is usually included in the list of vascular diseases that may be treated by massage. It should only be included as a warning. Every massage worker should

* In rare cases considerable vigour may prove beneficial, but only if spasm of the vasomotor system is present.

know the signs and symptoms of thrombosis, and always be ready to detect their earliest appearance. The sudden onset of localized pain and tenderness in a situation that did not present these symptoms the day before is very suggestive. The presence of swelling below this spot, and of a tenderness along a line running in the long axis of a limb, is almost pathognomonic, even without rise in temperature. Immediate cessation of massage treatment is imperative. It must be replaced by absolute rest. When the clot has fully organized, massage treatment appropriate to chronic œdema may be commenced.

Diseases of the Respiratory System all cause a certain amount of back-pressure in the vascular system. General massage as prescribed for heart troubles will therefore be of great service. Manipulation of the chest by squeezing and percussion will aid the interchange of gases, stir up the residual air, stimulate respiration, and help to loosen mucus. This treatment should not be included under the heading of "massage," as the massage is really an incidental part of treatment by exercises.

Massage in Abdominal Conditions that are amenable to treatment is usually very simple. It depends for its action chiefly on the reflex response of unstriped muscle to mechanical stimulation. The success of all attempts to move onwards, by mechanical pressure, the fluid contents of any portion of the bowel is problematical. This is shown by the difficulty experienced in emptying a small piece of jejunum by actual manipulation in the performance of a gastro-jejunostomy. In **Colitis** the bowel is subject to spasm; every care must be taken not to add any form of irritation. The action of the Plombières treatment is probably dependent on the paralytic effect of overstretching as much as on the washing away of irritating matter. All pressure on the bowel should be avoided, but stroking of the surface of the abdomen and treatment of the back may prove of great assistance. In the treatment of all **Gastric** troubles, whether there is dilatation or not, reflex effect can be secured by surface stroking over the areas supplied by the lower six

left intercostal nerves. Deep stroking over the lower ribs on this side, and of the epigastrium, stimulates contraction, and the addition of hand vibration increases the stimulus. It should be remembered that the aim is to stimulate normal peristalsis, and not to send the whole organ into spasm. Hence time must be allowed between the administration of stimuli for the wave of contraction to pass. In other words, stroking must be slow and rhythmical; vibration must be administered intermittently.

The evils of **Constipation** can be remedied to a very great extent by massage. Treatment should commence near the termination of the large bowel. The last portion that is amenable to direct influence is the iliac colon, and this should be subjected to intermittent vibration with the tips of the fingers. Deep, downward stroking along the descending colon follows, then vibration round the splenic and hepatic flexures, upstroking of the ascending colon, and finally vibration of the cæcum. Alternate up-stroking of the ascending colon and down-stroking of the descending may be indulged in. The treatment usually advocated includes that of the transverse colon. Its position is too uncertain as a rule to render this possible; and, if it happens to be low and the stomach is at all enlarged, the only effect will be treatment of the stomach "against the stream." Heavy percussion over the sacrum and over the gluteal region, where the sciatic nerve emerges from the sciatic notch, has many advocates, and is sometimes most effective.

General toxic conditions, such as **Gout,** can be remedied by massage. Abdominal treatment should follow the general administration of firm compression massage to the limbs. The same applies to the treatment of **Obesity,** but here rolling and squeezing of the subcutaneous tissues plays an important rôle. It is difficult to explain the physiological action; it is possible the fat in the cells undergoes a process of emulsification.

CHAPTER XI

ELECTRICITY AND RADIATION

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Forms of Electricity ("Modalities") used in Medicine.

"Galvanic" or "Continuous" Current.—The current obtained from a battery of twenty to forty cells, or from a small motor generator having a maximum voltage of about 60. The current of a "direct" main supply is of the same nature, but its voltage—usually 200 to 250—backed as it is by a large ampèrage or volume, makes it unsuitable for use unless modified by a resistance. Even then it should be remembered that *absolute* safety cannot be guaranteed. The galvanic current is unidirectional, has polarity, is without effect in stimulating nerves or muscles unless varied in strength, but has marked chemical effects. It may be employed to drive certain "ions" into the body, metals entering under the positive pole, non-metals under the negative.

Sinusoidal Current.—This current is always produced by mechanical means. It resembles the "alternating" supply in the mains. Its polarity is reversed some thirty to forty times per second. It is therefore stimulant to nerves and muscles, except in very weak strength, when it is sedative. Its rise and fall of potential, when plotted as a curve, is of sine form.

Faradic Current.—This is produced by means of an induction coil. A continuous current of two to four volts is interrupted and passed into the primary, and is transformed in the secondary into an alternating current of high voltage. It is commonly used as a stimulant. On account of its extremely small volume it may be passed through the brain, but it is the only form of interrupted current which it is safe to use for this purpose.

Condenser Impulses.—A condenser may be regarded for purposes of exposition as a means of storing minute portions of continuous current. All other conditions being the same, the larger the condenser the more current will it "hold," and the longer time will it take to discharge itself. Condenser impulses can excite nerves and muscles, the condition being much the same as when a galvanic circuit is "made." A single condenser impulse produces a "twitch"; a series thrown into a muscle at the rate of twenty per second or more cause a tetanization similar to that produced by faradism.

High Frequency.—By the aid of Leyden jars, a spark-gap, and a solenoid (wire spiral), the already high voltage current of an induction coil can be raised to a potential of millions, its volume being correspondingly decreased. By means of a suitable electrode (vacuum electrode) this current may be discharged through a patient in the form of sparks. Sparks as long as 3 inches may be used; or the electrode may be placed flat on the skin, when the sparks are numerous and extremely minute.

Diathermy.—The diathermic current is a modification of the original "high frequency" current. The latter was so called because of the enormous "frequency" of its interruptions—millions per second. The diathermic current is of similar frequency, and is without either contractile effect on muscle or direct chemical effect upon the body fluids. Its one demonstrable physical result is the production of heat, which is generated in the whole area between the electrodes because of the resistance which the tissues offer to the passage of this form of current. Although most observers claim that the physiological effects are solely those due to this "through heating," the present writer believes that there are also others due to electronic disturbances within the atoms of the body. In contradistinction to the ordinary high frequency current, the voltage is comparatively low, and the volume of current large. As to sensory effects, there are at first none, but later there is a subjective feeling of warmth.

Static Electricity.—This is produced by a Wimshurst Machine or some modification of it. The current may be looked upon as a continuous current of immense voltage and small volume. It has, of course, polarity. The patient may be charged positively or negatively, or sparks may be discharged into him. A special form of application, known as the "static wave current," is said to produce mechanical

vibratory effects in the tissues, and to relieve congestion and stasis.

Radiant Heat, Ultra-Violet Light, and X Rays.—These do not admit of any short description. It must suffice to say that they are all forms of radiant energy which act at a distance from their source. Light and X rays produce chemical effects within the tissues, also alterations in the electron systems of the body atoms themselves.

So far as surgical conditions are concerned, electricity* is used in military work in the same type and range of cases as have been proved to benefit by it under peace-time conditions.† It has, however, been employed to an extent hitherto unknown in this country, although as yet we still fall short of the grand scale of French electro-therapy. As to medical applications, these are necessarily more limited, as a military hospital is not the place for the treatment of chronic maladies. There are, nevertheless, not a few non-surgical disabilities which may be successfully dealt with within a reasonable time.

Electricity as an Aid to Diagnosis.

Before considering the therapeutic applications of electricity, it is necessary to deal with its use as an aid to the diagnosis of injuries to nerves and muscles. Electrical methods have been employed for more than half a century, but there has never been agreement as to their value, some writers asserting that they were almost infallible, while others looked upon them as useless, and even misleading.

This divergence of opinion has probably been due to two causes—a failure to recognize the true significance of the so-called "reaction of degeneration"; and the entire lack of uniformity which has, until recently, obtained in the

* The term is here used to include electrically produced radiations—*e.g.*, X rays.

† It should be noted that everything which follows applies equally to similar conditions found in civil practice. This is obvious as regards most of the conditions mentioned; and even gunshot injuries are closely simulated by the effects of explosions in factories and mines.

instruments employed and in the method of their employment.

A normal muscle is sensitive to stimuli of very short duration. An impulse lasting only $\frac{1}{24000}$ second, delivered at a potential of about 100 volts, is sufficient to cause a definite contraction in the muscles of the upper extremity. If, however, motor impulses are prevented for some days from reaching the muscles, a change occurs in their response. Impulses of longer and longer duration are required to excite them. In three weeks a stimulus lasting $\frac{1}{600}$ second may be needed; in six, $\frac{1}{200}$ second may be insufficient. The average effective impulse from a faradic coil lasts approximately $\frac{1}{1000}$ second, and such a stimulus ceases to be effectual in about ten days. A muscle which will no longer react to faradism has been said to show "reaction of degeneration." If, however, a muscle which has just ceased to respond to a given length of impulse be stimulated by an impulse of the same duration *delivered at a higher voltage*, contraction again occurs. The same phenomenon occurs if, voltage and impulse length remaining constant, an increased number of impulses per second is discharged into the muscle. The ordinary faradic coil, which has hitherto been considered good enough for nerve and muscle testing, is not a standardized instrument as regards any of the three factors above referred to—impulse length, voltage, and rate of interruption. The late Dr. Lewis Jones, after a very exhaustive study of the subject, concluded that the induction coil was essentially unsuited for exact work, and to take its place he brought out his condenser apparatus, in which impulse-length and voltage could be accurately controlled. A tetanizing current of known rate of impulse-delivery could not, however, be obtained from it, but in the instrument as modified by the present writer the individual impulse may be discharged at anything between one and thirty times per second. This apparatus has fifteen gradations, the longest obtainable impulse being $\frac{1}{32}$ second. It is therefore possible to do all testing by one instrument. The shortest impulse is found which will cause a muscle

to show a visible contraction, and this is the only fact which need be stated in the report so far as that muscle is concerned. In order that results may admit of comparison, the same size of pad must always be used, and applied in the same manner. One pad should be placed on the motor point of the muscle, and the other moved about on the belly of the muscle until the optimum position is found—that is, the position in which the maximal contraction occurs for a given impulse length. The limb must always be thoroughly warm, and the patient must not be fatigued.

A muscle whose motor nerve has been injured, and which requires a very long impulse to excite it (old "reaction of degeneration"), may nevertheless clinically recover within a few months; and in quite a large proportion of cases—perhaps 50 per cent.—its peculiar electrical response persists long after voluntary movement returns. A muscle exhibiting good active movements, though still requiring long electrical stimuli to excite it, cannot be said to be "degenerate" in any ordinary acceptation of the term. The expression "reaction of degeneration" is therefore not a happy one, and it will probably be gradually abandoned. Meanwhile it would be well always to use it in inverted commas.

It is obvious from the foregoing that the "reaction of degeneration" has *in itself* a prognostic value only when it is found soon after a nerve injury. It is then safe to say that the muscle will not be useful for at least two or three months. If present some months after the lesion occurred, it is evidence to the effect that the motor path was at the time of the injury completely blocked for at least several days.* If there is no voluntary movement, and if stimulation of the nerve trunk above the lesion produces no muscular contraction, the "reaction of degeneration" is confirmatory evidence that the motor conduction is still interfered with. Also, when some voluntary movement is

* No data are yet available as to the minimum time during which a motor nerve must be blocked in order to produce "reaction of degeneration" in the muscles which it supplies.

present, but the case seems to be at a standstill, the persistent failure of the electrical responses to improve is usually an indication that there is fibrous tissue pressing on the nerve trunk. The condenser instrument enables us in many cases to show that a muscle which still will not respond to faradism is nevertheless improving. For instance, at the first test an impulse lasting $\frac{1}{200}$ second may be required; a month later $\frac{1}{400}$ second may suffice. Such fine differences cannot be shown by the old system of faradic and galvanic testing.

The above account is intended merely as a brief introduction to the subject of electro-diagnosis. Electrical testing is an art in itself, requiring much knowledge and experience for its successful practice. It is not, however, in itself a means of settling all problems connected with nerve injury; the phenomena elicited by it must be viewed intelligently in their relation to all the various circumstances of the individual case.*

No reference to electrical testing, however brief, should omit a reference to the work done with the Kelvin astatic galvanometer by Dr. Horne Wilson. Certain deflections occur when the electrodes are applied to the human body, and Dr. Wilson has worked out a chart of the normal. He claims that definite departures from this are associated with certain diseases, and the present writer has seen cases tested which lend support to this view.

It may finally be noted that in some cases of suspected injury to tendons the question as to whether or not they have been severed can be settled only by stimulating the muscles concerned by a tetanizing current, and noting if there is any tautening of the tendons.

* (It must be remembered that the condenser testing apparatus is an instrument of precision, and, like all delicate scientific apparatus, must be kept in perfect order if reliable results are to be obtained. Any dirt or grease on contacts is fatal to good work.)

A full discussion of condenser testing, with details of technique, will be found in a paper, by the present writer, published in the *Lancet* of February 22, 1916.

Electricity as a Therapeutic Agent.

Electricity in various forms may be used to produce the following effects:

1. To cause the contraction of muscles either directly or through their motor nerves (tetanizing currents)—*e.g.*, faradism; rapid condenser discharges. Electrical stimulation is often of value in improving nutrition and restoring function in diseased or wasted muscles.

2. To promote the absorption of inflammatory products—continuous current, negative pole; long high frequency spark; static spark; static wave current; diathermy; X rays.

3. To soothe pain—continuous current, positive pole; mild sinusoidal current; high frequency vacuum electrode directly applied; diathermy; X rays; positive static breeze.

4. To assist in the cleansing of septic cavities, and to stimulate old-standing sluggish wounds which show little or no tendency to heal—ionizing bath; X rays; ultra-violet rays.

5. To check excessive glandular activity—X rays.

6. To "increase metabolism," and thus improve the general health—full-body sinusoidal bath; high frequency; static charging.

It will be noted that in the above list only the function of tetanizing currents can be sharply defined. They are invariably employed to raise the "tone" of nerves and muscles, usually by actually exercising the latter. Most of the other electrical modalities are to some extent interchangeable, though with differences in the details of application. In some cases we understand something of the *rationale* of our procedures; in others they are purely empirical. The treatment of a septic hand in a bath of zinc sulphate solution is as rational a procedure as any in medicine. Electro-chemistry teaches us that the metal is carried deeply into the wound, and Russ claims to have demonstrated that pus-producing germs actually leave the wound under such circumstances—*i.e.*, when the electrolyte surrounding the wound is made the positive pole of a con-

tinuous current. The employment of X rays in hyperthyroidism is another instance, as experiment has shown that these rays in appropriate doses depress glandular activity. On the other hand, we do not know in what way the high frequency spark relieves sciatica, nor why the positive pole of a galvanic battery should banish some forms of headache as if by magic.* In all cases, however, definite physical and chemical effects can be demonstrated in the tissues. With X rays, and probably with diathermy, these effects are extremely subtle, extending even to the electrons within the atoms of the body.

Some of the principal surgical and medical conditions in which electricity is of value will now be dealt with. Details of technique are given only in cases where the usual textbook descriptions are not very full, or where it is considered advisable to emphasize special points. For the description of apparatus, also, standard works must be consulted.

A.—Surgical Conditions.†

The following account, although necessarily far from complete, includes the principal surgical lesions in which electricity can be usefully employed in a military hospital.

Disabilities following Nerve Injuries.—Patients suffering from the long train of evils which follow damage to important nerves form a large proportion of the cases which call for electrical treatment at the present time.

(*a*) **Cases of Complete Severance in which an Operation has been performed to unite the Nerve Ends.**—In such cases severe muscular wasting is either present or will shortly occur. Professor Langley of Cambridge has shown that muscles cut off from their anterior horn cells are in a state of constant fibrillary contraction, and he suggests that the atrophy is due to fatigue. However this may be, no good

* The astatic galvanometer previously referred to may in future help to throw light on some of these problems.

† Some disabilities not strictly surgical, such as psychical paralysis, are for convenience discussed in this section.

comes of treating such muscles by contraction-provoking currents. A mild sinusoidal bath daily, however, with light massage, will help to remove waste products. This bath need as a rule be local only, as in the case of limbs; when trunk muscles are involved, a whole-body bath is usually necessary. The current is derived from a small motor generator, and should not be strong enough to produce any visible muscular contraction. It should be administered for 15 to 20 minutes daily.

During the long period which precedes restoration of motor conductivity, there is a marked tendency for adhesions to form in connection with tendons and joints, a tendency which is not wholly checked by the treatment above advised. Hyperthermal and whirlpool baths should also be employed, and systematic passive exercises carried out. In the writer's opinion, occasional courses of Rays to the joints, etc., are of value in diminishing fibrous tissue formation; they may also be applied to the site of operation if there is any reason to fear that scar tissue may form round the nerve trunk.*

Not until there is definite evidence that the motor fibres are to some extent restored should a more vigorous policy be pursued. This restoration is indicated (1) by the production of muscular movements when the nerve is stimulated above the site of injury; (2) by definite improvement in the electrical reactions of the muscles, determined by the Lewis Jones condenser apparatus; (3) by the reappearance of faint voluntary power, evidenced first by the ability to " twitch " tendons when the limb is so held that they are relaxed. The appearance of any of the above signs means

* It is sometimes stated that " X rays encourage fibrosis." This is only so where moderate fibrous tissue formation is Nature's method of cure, as in the strangulation of cancerous growths or in the involution of a hypertrophied gland. Where fibrous tissue tends in itself to become harmful, X rays retard it, or cause its absorption if already present. Any tissue, connective or epithelial, which has developed activities which are not in accordance with somatic welfare is by that fact rendered sensitive to depression by X rays in doses which are merely stimulating to normal cells.

that the time has come to stimulate the affected muscles to actual contraction. This should always be done by some form of tetanizing current. The simple "galvanic twitch" which was at one time so much in favour is comparatively ineffective; and the same statement holds good with regard to single condenser impulses.

Physiological experiment shows that a voluntary contraction, however brief, is always of the nature of a tetanus; and it is reasonable to suppose that the more nearly the artificial stimulus approaches the natural, the greater will be its therapeutic value. At any rate, as a matter of clinical experience, it is found that cases which have progressed slowly or not at all by single impulse methods often improve rapidly when tetanizing currents are used.

Stimulation may be either through the nerve trunk, in which case the whole group supplied is thrown into contraction, or *both* electrodes may be applied to individual muscles. The two methods should be applied where feasible, but the latter is of universal applicability. A metronome is placed in series with the patient, and timed to complete the circuit about once in two seconds. The silver contact wire should be so set as to dip into the mercury for a maximum depth of about a quarter of an inch. The procedure is known as "rhythmical tetanization," and is the sheet-anchor of treatment in a large class of cases.

The ordinary faradic current has been mostly used in the past, but the difficulty of measuring and recording it makes faradism by no means an ideal modality even for treatment. Also, it may be well again to emphasize the fact that muscular response to faradic currents and other brief forms of electrical impulse, in many instances, does not return even when a very advanced stage of clinical recovery has occurred: some other form of tetanizing current must therefore be used. The modified Lewis Jones condenser instrument, previously described, serves to get over this difficulty, as by it practically any muscle can be tetanized.

The muscular stimulation must at first be carried out with the greatest circumspection. The muscles are natu-

rally in a state wherein they are readily overfatigued; and excessive exercise, if often repeated, would make progress impossible. The amount of electrical exercise which is desirable must be carefully determined in each individual case. The only safe rule to follow is to stimulate upon the first occasion until there is distinct falling off in the response, and in future to give only *half* this amount. Re-testing should be done once a fortnight to ascertain progress, the treatment being modified according to findings.

Periodic testing of muscles under treatment is also of value in ascertaining the desirability or otherwise of continuing the stimulation in cases where no progress is clinically apparent. In a few instances the " fatigue-point " is reached more quickly after a fortnight's treatment, and it is then better to return for a time to the sinusoidal bath, care being taken that the current is not strong enough to produce any muscular contraction. It may be mentioned here that a few minutes' immersion in a hot sinusoidal bath is a useful preparatory measure in all but very sultry weather. When nerve-supply is interfered with, limbs are often clammy and subnormal in temperature, and thus not in a condition to respond well to stimulation. A bath should not, however, be used for purposes of rhythmical tetanization. As the undamaged opponents of the injured muscles are the most stimulated, the latter are violently outstretched, and actual harm is done by this method of treatment.

It is obvious that, if successive tests are to have any comparative value, they must be done under conditions as nearly as possible identical. The details which must be attended to have been discussed in connection with electrodiagnosis. If faradism is used, careful attention to the " setting " of the coil will do much to secure uniformity, provided that the same instrument is always used, but the recorded details are likely to be valueless if the patient is transferred elsewhere. On the other hand, if the condenser set is used, exact repetition can always be secured. *All* the affected muscles should be systematically dealt with.

This is not always attended to; *e.g.*, the extensor muscles of the thumb are frequently neglected in musculo-spiral lesions.

The greatest care must be taken that spreading of the impulse does not excite healthy opponents to the detriment of enfeebled muscles. This can usually be avoided by choosing the right strength of current, and selecting suitable points for stimulation. Sometimes it is best to pinch up the muscle between the electrodes. In cases where the response is very feeble, it is necessary for an assistant to hold the limb in such a position that the weakened muscles are fully relaxed during stimulation—*i.e.*, so that they can contract without pulling on their points of attachment.

The Relaxation Splint.—This is an indispensable adjunct to electrical treatment. A muscle which is chronically overstretched cannot recover: therefore a partially paralyzed limb should be placed on a splint designed to give rest to injured muscle groups. The principle is simple and immutable: nevertheless its practical application calls for much skill and judgment. In many instances more than one nerve has sustained injury, and conflicting claims must be nicely balanced. It is, for example, a little disappointing to a man, whose wrist has been kept rigidly dorsiflexed for several months because of a musculo-spiral injury, to find, when this nerve has at length recovered, and the splint is removed, that he must go through another long course of treatment before his power of flexion, previously but little impaired, can be regained. In some cases the bandages only should be removed for treatment, the limb always resting on the splint; in others its use may be necessary at night only.

(*b*) **Cases of Partial Nerve Blockage.**—There is at present no known means, apart from exploratory operation, of distinguishing between actual mechanical severance and physiological blocking which may prove only temporary. All sensation may at first be absent in a case which will ultimately recover. The "reaction of degeneration" has already been proved to be no evidence of irreparable damage.

Any case showing it must, however, be treated, from the electrical standpoint, as if it were certain that the nerve had suffered division and been united. Rhythmical tetanization is not indicated unless and until there are signs of restoration of the motor path.

Pain, or sensory disturbances which are merely uncomfortable, are frequently complained of in partial lesions. They are often due to the pressure of scar tissue at the site of injury. X rays and the galvanic current are indicated locally, the latter being made to pass transversely through the nerve. A mild sinusoidal current made to traverse the nerve trunk from the wound to the extremity is sometimes of value. In the case of a wound in the upper arm, for example, a pad is bound over the region of the original injury, and the hand is placed in a bath. This is especially indicated when the sensations complained of are of the "pins and needles" order.

Many cases, naturally, do not improve at all, and others, after progressing favourably up to a point, obstinately stick there. It is essential to recognize when a case should be turned over to the surgeon; but this is really part of the subject of the diagnosis and prognosis of nerve injuries, which was briefly referred to at the beginning of this chapter.

There is a large class of injuries in which muscular paralysis or paresis occurs, but in which there is no lesion of the nerve trunk. A crush in the neighbourhood of the ankle is a common example. Varying degrees of myositis and traumatic peripheral neuritis may be present; but, in the type of case referred to, these conditions are not serious enough to produce marked changes in the electrical reactions, although the condenser instrument will show, at least in the early stages, small but definite departure from the normal. Following the routine treatment, the patient is usually put to bed for a fortnight or longer until the pain subsides and the bruising more or less disappears. As a rule it is not until he gets up that he comes into the hands of the electro-therapeutist. It is then often found that he is suffering from flat-foot and ankle-drop. Sometimes

there are practically no voluntary movements left about the foot. If, however, the affected muscles be judiciously stimulated by a tetanizing current, and the patient be encouraged to endeavour to use them, most cases will recover in a month or so. The condition of flat-foot will disappear *pari passu*, assuming, of course, that no fracture or subluxation exists.*

A few cases of paralysis of the above type do not yield to the treatment described. They are for the most part men of neurotic temperament, and the motor disability is often accompanied by anæsthesia of "stocking leg" or other erratic distribution. Bad handling may, however, cause the transition of a physical into a psychical paralysis in patients who cannot be considered abnormal. They may be merely somewhat lacking in initiative. If elaborate electrical and massage treatment, *unaccompanied by re-education and persuasion*, be persisted in long after physical tests show an apparent *restitutio ad integrum*, the patient's attention becomes focussed on his disability. Cases which have been thus dealt with on wrong lines are almost impossible to cure, though hypnotism may succeed in some cases. The imposing array of apparatus which has been brought to bear upon him, with no success, causes the patient to believe that he is an interesting and unique incurable; sometimes he is rather proud of the fact—an example of medically manufactured hysteria.

Occasionally the after-effects of crushes, etc., take the form of persistent spasm of certain muscles. Electrical stimulation of their opponents may help, but suggestive treatment—if necessary under hypnotism—is invaluable. It should always be tried before the tenotomies advised by some surgeons are resorted to.†

* It may be noted here that the proper treatment of early flat-foot depending on loss of muscular tone is electrical stimulation, later combined with suitable exercises and such alteration in the boots as may be necessary.

† In one case which came under the writer's notice, spasmodic inversion of the right foot had persisted for a year after a sprained ankle. He was

(*c*) **Psychical Paralysis.**—The true psychical palsies and spasms are to be distinguished from the cases just described. In these there has been no physical injury, or the trauma has been trifling, and may be at some distance from the site of the paralysis. The most delicate electrical testing shows no abnormality in the response of the muscles concerned. This type of paralysis, which is occasionally met with in civil practice in industrial districts, has always been termed "hysterical." The expression, with its implied stigma, is, however, objectionable when applied to psychical trauma which is the result of the abnormal strain and shock of modern warfare. Most of the patients are by no means weaklings, and many are of proved endurance and courage. It is a great mistake to tell such patients brusquely that there is nothing the matter with them. They should be shown that their muscles are all capable of vigorous movement under electrical stimulus, and told that with a few days' proper treatment perfect recovery will take place. The judicious holding out of the prospect of furlough "as soon as the power returns" also has a good effect. Harshness may easily render an otherwise readily curable disability lengthy, or even permanent.

The prognosis in these cases, unless there has been previous mishandling, is generally good. But in some instances temperament or past history complicates the issue and makes the outlook doubtful.

Again, we may have to deal with a definite organic injury in itself curable, but accompanied by an emotional instability due to shock. The general condition should, if possible, be treated coincidentally with the local paralysis; but it may be at times necessary to suspend local treatment until the tone of the nervous system has improved. In some cases, *e.g.*, the most gentle muscular stimulation produces uncontrollable weeping.

No electrical department can be a success in which the

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kept for four months on a splint in eversion, but relapsed within a few hours of its removal. In two weeks he was completely cured by hypnotism, and returned to duty.

psychical side of disease is not studied. A competent psychotherapeutist should be attached to, or work in conjunction with, every such department. Waking suggestion is most useful, but hypnotism is often necessary for both diagnosis and treatment. The importance of hypnosis in diagnosis is perhaps not fully realized even by those who advocate it as a treatment. Yet, in cases where the disability is partly organic and partly functional, it is often the only means of determining the precise extent to which each of these factors is operative.

Many patients require for their restoration to health a careful combination of physical, electrical, and psychical measures. A human being is an entity both as to mind and body, and anything which deleteriously affects either the one or the other in any respect may interfere with the recovery of a local lesion. For instance, a dropped wrist, which should apparently do well, may hang fire because the patient is insufficiently clad; because he smokes too much; because he fears—it may be subconsciously—that recovery will mean a return to the front; or because he has had no leave for months and is "fed up" with hospital life. A narrow specialism working in water-tight compartments is a false ideal. A broad clinical outlook and an understanding of human nature are not less essential to success than specialized knowledge and technical skill. "Where there is no vision, the people perish."

Exercises.—The respective merits of graduated exercises (active) and muscular contractions provoked by rhythmical tetanization are sometimes discussed as though they were means to precisely similar ends. The fact is that, while a considerable proportion of cases may be cured by either method, both procedures should be employed either in combination or separately at some period in the course of treatment. Each can accomplish at the same time both more and less than the other.

In the purely psychical case, electrical stimulation of muscles should be used daily for a few days, as a demonstration to the patient that his muscles are sound. If

prolonged it not only does no good, but is positively harmful.

On the other hand, there are many cases in which either (*a*) the pain produced by the first movements of a disused muscle is so severe that the patient will not make the necessary start; or (*b*) the mental and physical fatigue engendered by even a few movements is so great as to prevent progress; or (*c*) the patient may, after severe injury and long disuse, be unable to initiate voluntarily even the slightest movement, although after some days or weeks of treatment by rhythmical tetanization he becomes able to do so.

If electrical stimulation of normal muscle is apt to perpetuate, or even to produce, psychical paralysis, attempts to induce a patient to perform "graduated exercises" before his muscles and nerves are physically capable of benefiting thereby may be equally productive of disaster. Voluntary effort which results in pain, or in fatigue bordering on pain, or in sheer nothingness, may bring about various psychical disorders. A protective spasm of opponents may develop, or the patient's mental attitude may become one of despair. If there is pain, electrically provoked contractions must have become painless before voluntary effort is urged; if the muscles are wasted or flabby in texture, attempts at active movement are better postponed until there are visible or tangible signs of betterment.

Fortunately, it is possible by a simple procedure to make the transition from electrical exercise to "active" exercise a gradual one. When sufficient progress has been made, the patient is directed to use his will at the same moment that the current is thrown into the muscle. The regular beating of the metronome aids him in this. At first he may feel that he has lost all contact with the affected muscle; a little later he feels as if he were helping, although there is no apparent result from his efforts. Gradually, however, it is found that a weaker current serves to keep up a given amount of contraction. The current strength is decreased day by day as voluntary control increases, and the gap between the artificial and the natural is bridged by safe and

easy stages. In looking for the first sign of voluntary power, it must be remembered that inability to perform ordinary movements is no proper test. A patient may have complete "wrist-drop," and yet be able to move the hand backwards when the forearm is held parallel with the ground, and in a position midway between pronation and supination, so that no weight has to be raised. Or, again, it may be possible to detect voluntary contraction in the tibialis anticus only by holding the foot in extreme dorsiflexion, and feeling for a "twitch" of the tendon when effort is made. Neglect of these simple precautions leads to many errors, even to operations upon intact nerves for supposed divisions.

(*d*) **Paralysis following Injuries to the Brain.**—Paralysis of this kind must be carefully distinguished from that of lower neuron type. Its most common analogue in civil practice is the disability which follows cerebral hæmorrhage or thrombosis. To forecast what will happen is equally difficult in the two cases. The most extensive paralysis may clear up entirely, and a mild lesion may fail to improve. Although prognosis is difficult, diagnosis is generally easy. But in some cases mixed lesions occur: upper neuron, lower neuron, and perhaps a functional element superadded. In such the brain injury may be overlooked, and a confident prediction of complete recovery, apparently justified by improvement for a time, may raise false hopes which make a permanent disability all the harder to bear.

As regards electrical treatment, measures directed to the brain itself are of more importance than those applied to the muscles and nerve trunks, although the latter are not without value. A galvanic current should be employed. Owing to the fact that a continuous current distributed unevenly to the cerebral hemispheres causes giddiness, a large electrode should be applied, so as to rest equally upon either side of the skull. That is to say, while we should secure as far as possible that current passes into the injured portion of the brain, an equal amount should be made to traverse the corresponding sound portions on the other side The positive pole should be placed over the skull;

the negative may be either a pad on the back of the neck, or *both* hands or *both* feet may be placed in a bath.

Very small currents must be used—1 to 3 milliampères, half to three-quarters of an hour daily. Any irregularity of the strength of the current will cause unpleasant " flashings " before the eyes. No apparatus depending directly on the mains should ever be employed. The old-fashioned cell battery with a variable resistance in addition to the " collector " is the ideal instrument; but a " pantostat " or " mustostat " may be used. No pantostat motor is infallible, however, and should it stop suddenly the patient will get a shock, which may alarm him.

The current must be turned on and off with especial care and slowness. A sinusoidal current should never be used, but a mild *faradic* current is sometimes of value. Although the alternations of potential are considerable, the actual *volume* of current is so small that no unpleasant effects result. The condenser instrument is totally unsuited for this work. Cerebral galvanism should be carried out only by those skilled in electro-therapeutical technique.

The results are often very striking as regards paralyzed limbs; and even where the paralysis does not improve, the " side-effects " of the injury—headaches, dizziness, and lack of mental clearness — are almost always greatly benefited.

As to local treatment of the limb, massage is always indicated, and splints may be necessary to prevent contractures. These muscle groups which tend to be overstretched by opponents may be rhythmically tetanized. It should be remembered that peripheral electrical stimuli are never without effect centrally, provided that the sensory path is intact.

Sprains.—As indicated above, the electro-therapeutist rarely sees sprains and kindred injuries until at least two to three weeks after they have occurred. Yet much can be done by electrical means, combined with other physical remedies, from the first. The immediate application of radiant heat or local hypothermal baths for ten to fifteen

minutes has a sedative effect, and tends to reduce swelling. It should be repeated two or three times a day until the joint has ceased to be acutely tender. A cabinet of small lamps may be used, or a 3,000 c.p. incandescent, or an arc-lamp. After forty-eight hours, provided the skin is intact, the galvanic current should be applied (+ pole), preferably by means of a bath. If for any reason a bath is inconvenient, a large towel wrung out in warm saline, and covered by a chain-mail electrode, will answer the purpose. The application is made once daily. Light massage and gentle passive movements follow in another day or two, and finally stimulation of all the muscles around the joint by some form of tetanizing current.

Sprained joints will be restored to usefulness in less than half the time which is required where "expectant" methods are followed, even where the latter are ultimately successful. Furthermore, the formation of adhesions is largely prevented and permanent disability is unlikely to occur.

If the sprained joint does not come under observation for weeks or months, when there is chronic swelling, and stiffness and pain due to adhesions, it is often still possible to do a good deal by treatment on similar lines. The radiant heat is omitted, and the negative pole is used for the bath instead of the positive. Penetrating X rays, filtered through 2 mm. of aluminium, are often of service in causing the absorption of organized inflammatory products.

If the adhesions are so resistant as to need surgical breaking down, *the joint should then be immediately afterwards treated as if it were a case of acute sprain*, which indeed it has become. If this is not done, the adhesions almost immediately re-form.

I am strongly of opinion that surgical breaking down should be resorted to sparingly. In the large class of lesions in which passive movement after prolonged soaking in a whirlpool* or in a hot electric bath is nearly normal in range,

* Where a whirlpool bath is not available, the following arrangement gives good results: A "grid" is placed 2 to 3 inches above the bottom of an ordinary electric bath, such as is used for the treatment of

but where the joints stiffen up within a short time, surgical wrenching is unlikely to do any good. When there is a not fully recovered nerve lesion, or defective general nutrition following sepsis, the fresh trauma may be followed by most serious consequences.

On the other hand, we should not waste time in trying to benefit by electrical means cases which are almost certain to need preliminary surgical measures. For example, a foot fixed rigidly in the equinus position by old-standing contraction of the calf muscles will surely require an operation on the tendo Achillis before electricity and massage can be of any service. Such malpositions should, however, become increasingly rare. Their occurrence should be limited to the few cases where awkwardly placed wounds, or the existence of nerve injury with trophic disturbance, has prevented the application of proper splints.

The remarks just made apply with equal force to the contractures and deformities which follow **infantile paralysis.** With proper treatment from the first they should rarely occur; but, when they are met with, electricity and massage are useless until surgical correction has been accomplished. The obvious fact, that the range of active movement can never exceed that which can, *without forcing*, be passively produced, appears sometimes to be forgotten.

It is interesting here to note that the treatment of nerve injuries of lower neuron type is identical in principle with that which has been found successful in dealing with the results of poliomyelitis. The combination of the relaxation splint with rhythmical tetanization and other electrical measures is often productive of great improvement, even in apparently hopeless cases. Repeated courses are, however,

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limbs. In the space so formed is placed (*a*) an electrical heating arrangement similar to that used in an electric kettle, and (*b*) a piece of lead piping bent into an ellipse, in which are punched numerous holes. The perforated pipe is connected with a " Fon " hot air douche, and hot air is driven in, which bubbles freely through the water. The temperature is kept as high as the patient can reasonably bear, and is regulated by a sliding resistance in the heating circuit.

necessary so long as the child is growing; otherwise relapse is apt to occur. The prejudice which still exists in some quarters against electrical treatment in infantile paralysis is probably a relic of the days when all cases were treated indiscriminately by electric baths. It cannot be too strongly emphasized, however, that surgical treatment, massage, and exercises, valuable though they are, will often fail to give anything like the maximum improvement which it is possible to attain; and the present writer has no hesitation in saying that the practitioner who disregards the skilled use of electricity in the after-treatment of poliomyelitis—and, it may be added, of cerebro-spinal meningitis—takes upon himself a responsibility as grave as that of the surgeon who fails to employ X rays as an adjunct to the operative treatment of cancer of the breast.

It may be noted that the after-effects of cerebro-spinal meningitis in young soldiers have frequently to be treated in the electrical department of a military hospital; and paralysis following poliomyelitis is occasionally seen.

Fractures.—A fracture in the neighbourhood of a joint is for the most part accompanied by the conditions of sprain. The responsibility for its treatment in the early stages must rest wholly with the surgeon. Where the X-ray examination shows that open operation should be performed, but where excessive swelling prevents this, radiant heat for a few days will often make the case operable. Afterwards the treatment of sprain should be followed when and in so far as the surgeon considers safe. When any handling at all is deemed undesirable, X rays may be substituted for galvanism.

As regards old fractures of the shafts of the long bones, pain and stiffness can usually be successfully dealt with by electrical and other physical remedies, provided that bony union is sound and the mechanical conditions as they should be. The application of the high frequency spark relieves the " toothache-like " pain so often complained of; electrical stimulation of the adjacent muscles cures the muscular weakness and stiffness.

The first necessary steps in the reusage of a muscle or part of a muscle which has been injured are somewhat painful, and the patient instinctively avoids them. The tetanizing current exercises the muscles in spite of their owner, and in a few days voluntary movement ceases to be an ordeal.

When more or less bony deformity is present, a certain amount of improvement can nevertheless be obtained, but the prognosis should be guarded.

Wounds.—The use of the electrolytic bath in cases which would ordinarily be treated by more or less continuous antiseptic soaking has already been mentioned. Theory indicates that "positive ionization" should always be employed, as, in addition to driving such a metal as copper, silver, or zinc, deeply into the wound, pus-forming organisms are at the same time withdrawn (Russ). In practice, however, negative ionization (*e.g.*, by iodide of potassium) sometimes produces as good or better results.

It will, perhaps, have been noted that, in dealing with the continuous current in conditions where the skin is unbroken, ordinary salt and water was mentioned as the electrolyte, stress being laid, however, upon the choice of pole. This is in accordance with the teachings of the older school of electro-therapy, which regards the nature of the electrolyte as of secondary importance.* Bearing in mind the predominating importance of polarity, it is nevertheless desirable in certain cases to choose an ion which, when taken internally, has a good effect on the condition under treatment. The use of salicylic ions in rheumatism is a case in point. In dealing with raw surfaces, however, the choice of ion assumes great importance; *e.g.*, a primary syphilitic sore will heal best when perchloride of mercury solution is used and the positive pole applied. Mucous membranes are to be regarded for purposes of ionization as raw surfaces. The

* In a work upon Ionization the late Dr. Lewis Jones mentioned a case of neuralgia "which resisted salicylic ionization, but yielded readily to quinine ionization." It may be suggested that in this case the improvement was due to change of *pole*, the + pole, used for the quinine, being sedative.

excellent effect of zinc ions upon pyorrhœa is well known. X rays are often of great value in causing the "cleaning up" of dirty wounds, and in accelerating the healing of indolent ulcers. Ultra-violet rays may be used instead, provided that the wound surfaces can be freely exposed to them. A Cooper-Hewlett mercury vapour lamp may be employed as a generator. The so-called "Simpson Light" is really a means of producing abundant ultra-violet rays by means of a tungsten arc. Although some of the rays appear to be rather more penetrating than those produced by other generators, it must be clearly understood that the depth of tissue which can be *directly* affected by them is limited to at most a couple of millimetres. The rays produced are in no sense analogous to X rays, except in so far as the latter have been of late shown to obey the ordinary laws of light. Some observers claim that even deep wounds are benefited by ultra-violet rays; if this is so, it must be by some indirect and at present obscure process. The known penetrating qualities of Röntgen rays appear to make them more suitable if it is desired to affect tissues at some depth below the surface.

The blue, rigid, and painful hand which, unfortunately, is a common sequela of septic wounds can frequently be restored to usefulness by the sinusoidal bath and X rays combined with massage. Later on, stimulation of the muscles should be resorted to. Attempts to bend the fingers should be made while the hand is in hot water through which the sinusoidal current is being passed in as great strength as the patient can reasonably bear. Much greater force can then be exercised without causing pain.

A somewhat similar condition may result from "trench foot," and a like treatment should be followed. When numbness or tingling is complained of, the high frequency spark is useful.

Scars.—The scars which result from battle wounds are often hypertrophic, painful, and adherent to subjacent tissues. The X rays exercise a marked softening and analgesic effect upon such scars, and when combined with

other suitable measures (massage, etc.) will often entirely remove the disability to which they give rise.

Rodent Ulcer.—This condition is seen not infrequently in military practice. It can be effectively dealt with by X rays in a short time, provided that the soil is "virgin." If the rodent ulcer has been already ineffectively treated by radiation, ionization, or other similar methods, the chances of cure are lessened.

As all the malignant tissue in a rodent is easily reached by X rays, and as there is practically no tendency towards metastasis, the condition is a suitable one in which to test the effects of the rays upon cancer cells, the more so as the general results are plain to the eye. In the early days of Röntgen-therapy, when soft unfiltered rays were used, small doses were administered frequently for prolonged periods, as much as sixty applications sometimes being given in five or six months. Some of the results were good, but more often than not the ulcer, after improving for a time, retrogressed, and the surrounding area became blue and unhealthy in appearance. Such cases, when eventually operated on, generally extended rapidly. Later, when it became customary to use penetrating X rays filtered through aluminium, results were obtained which at the time were described as "brilliant." A dozen applications or so of such rays caused the "rodent" to heal without pain or visible reaction. It was soon found, however, that recurrences occurred with great frequency, and these yielded with difficulty or not at all to a second course of treatment.

The next move was made by workers with radium, who found that a few doses, sufficient to produce with their cumulative effect a brisk reaction—redness, swelling, and a little pain and burning sensation—were capable of causing a rodent ulcer to heal within a few weeks. These results, on the whole, appeared to be lasting.

The merit of the radium-therapists lay in their combination of a penetrating radiation with a dosage concentrated in time, avoiding on the one hand the error of prolonged irritation, and on the other that of failure to produce definite

reaction. Their results were compared with those of the X-ray treatment of some years before, greatly to the detriment of the latter.

Effects in rodent ulcer precisely similar to those of radium may, however, be obtained by X rays properly used. Penetrating rays filtered through aluminium, and so administered that a response of moderate severity is produced within six weeks, give excellent results. Once the reaction occurs, no further radiative treatment is given. The redness rapidly disappears, and the ulcer should be completely healed in from eight to ten weeks from the commencement of the treatment.

Cancer of the Breast.—This is occasionally seen in men, and is, of course, often found in the special hospitals devoted to the treatment of the wives and children of soldiers.

The disease is very amenable to X-ray treatment in conjunction with surgery. Surgical measures are still necessary, because it is not possible, with our present knowledge, safely to produce a "reaction" in the breast comparable with what is aimed at in the case of rodent ulcer.

It will be remembered, however, that it is possible to cause the disappearance of a "rodent" without producing a reaction, although recurrence will occur in a considerable proportion of cases. It is, however, upon this method that we must depend in breast cancer. As one can never be really sure that all the malignant cells are killed, it is well to give courses at intervals for at least two years after operation.

There is, of course, not only the danger of local recurrence to contend with, but that of metastases. However skilfully the operation is done, it is probable that in some cases malignant cells are liberated and carried to distant parts in the blood-stream. If, however, their vitality can be reduced before this event happens, they are unlikely to be able to establish themselves in new surroundings. This is quite easily accomplished by giving not more than half a dozen X-ray sittings *before the operation*, which need not be delayed by more than a fortnight. Provided that hard

filtered rays are used, a dosage sufficient for the purpose can be administered without the production of any skin effect whatever. The risk of metastases apart from those which may be caused by surgical trauma is best combated by " preventive radiation " directed to areas which are known from experience to be specially liable to attack—*e.g.*, mediastinum, stomach, axilla, and root of neck.

A Note on the Uses of Radium.—The cost and scarcity of radium render it unlikely that it will be used extensively in military hospitals. It must, however, be briefly referred to, as the phenomena which make it of interest in medicine are electrical. The gamma rays are strictly analogous to X rays; and although no X rays have yet been produced which are as penetrating as the hardest gamma rays, the gap remaining to be bridged grows less year by year, owing to improvements in X-ray apparatus and to the introduction of the Coolidge tube. It is the present writer's belief that in the near future what may be called, following a prevailing fashion in nomenclature, *super X rays* will be exclusively used when radiations externally applied are needed for treatment. Already X rays in cancer of the breast give results which cannot be bettered by radium. In cancer of mucous membranes, however, the hardest known radiations are necessary, and here radium is likely to hold its own for some time to come.

The use of radium or its emanation in solution offers a therapeutic field with immense possibilities of development. As the supply of radium is, in the opinion of physicists, never likely to be abundant, it is a matter of the utmost importance to employ X rays whenever this can be done without loss of efficiency. Thus more radium will be liberated for those forms of treatment in which it is irreplaceable. In the middle of last century " bottled electricity " was a remedy often sold by quacks. It is well to realize that a radio-active solution actually *is* " bottled electricity," in so much as every atom or ion within it is a centre of electrical forces.

Radium in solution, given either by the mouth or hypodermically, is of some value in various diseases, but it appears to cure when all else has failed in *severe neurasthenia with*

depression. The nerve troubles following the strain and shock of active service are suitable for its exhibition. Quite small doses of 5 to 10 microgrammes per day (1 microgramme $=\frac{1}{1000}$ milligramme of metallic radium) suffice in such cases. In obstinate syphilis, which resists the usual antispecific treatment, large doses of 50 to 100 microgrammes for some days may supply the necessary stimulus towards recovery. "Stimulus" is the correct word. The radium is not to be looked on as in itself curative of the disease.

Finally, the effects of syringeing out septic sinuses with radium solution are sometimes strikingly beneficial, especially where their ramifications make it difficult to deal with them effectively by other electro-therapeutic measures.

Dangers of X-Ray and Radium Treatment.—That such powerful agents, if improperly used, are capable of doing great harm is self-evident. It is well to understand, however, that only in serious diseases need the dosage reach such an intensity that unpleasant results may follow from the treatment itself. In cancer the disease is in itself so deadly that risks may be, and indeed ought to be, taken. But in all the other conditions where X rays are advocated the amount necessary is not such as to create any risk.*

B.—Medical Conditions.

Hyperthyroidism.—Many men sent back from the front labelled "neurasthenia" or "shell shock" are found, on careful examination, to show signs of increased thyroid activity. Sweatings, fine tremor, sleeplessness, weakness of the legs, and tachycardia, are common. Exophthalmos and visible enlargement of the thyroid occur, but with less frequency.

As in analogous cases met with in civil life, X rays to the thyroid region exercise a most beneficial effect, and are in

* In the treatment of scars, fibrous adhesions, wounds, exophthalmic goitre, and other non-malignant conditions, the present writer finds that very small doses of filtered rays are effective. One milliampère in secondary, spark-gap 7 to 8 inches, aluminium filter, 2 mm. in thickness, distance of antikathode from skin, 20 inches, time, ten minutes, is a useful routine dosage, not oftener than three times a week.

most instances the most important *single* therapeutic measure. Small doses not less than three times a week are necessary: large doses at longer intervals have not the same effect. A definite slowing of the pulse and general betterment should occur within a month, but to be permanently curative the treatment may occupy from eight to sixteen weeks. Other well-recognized measures should not be neglected, but even if attendance for X-ray treatment involves some amount of fatigue, it should be persisted in, as the patient soon becomes more fit for exertion. In very severe cases the patient should be admitted to hospital, and treatment be given by means of a portable outfit at the bedside.*

Severe cases are not, of course, likely to be mistaken, but milder ones are often overlooked. Many men suffering from so-called " soldier's heart " are the victims of Graves' disease, and should be treated by X rays.†

Rheumatism.—This is a vague term which here is used in its popular sense. It includes all ambulant cases of pains in the joints.

Where the pain is generalized, and is associated with old rheumatic fever or gonorrhœa, spa treatment is needed. The teeth and gums should always be examined. Some cases have recovered very quickly after their mouths had been properly treated. The same remark is applicable to neuritis, lumbago, etc.

Cases of localized joint trouble should be X rayed, and, if found to show no organic changes, may be treated electrically for a few weeks. Diathermy is the procedure most likely to be of value, but other treatments—*e.g.*, galvanism, high-frequency spark—sometimes succeed when it has failed. Unless there is some sign of improvement within three weeks,

* This was done with gratifying results in a remarkable case in the writer's experience. The patient was a man whose life was despaired of. After having had a dozen applications (which were at first given daily), he was able to leave his house for treatment within three weeks, and returned to his employment in two months.

† The general condition of such cases must also be considered. See p. 166.

ultimate complete success is unlikely. But there are very few patients who cannot be benefited to some extent.

Sciatica and Lumbago.—These are here classed together only for the reason that high-frequency or static sparks as intense as the patient can bear seem to be the best form of electrical treatment for both.

Cases of sciatica so severe that the patients are bedridden are by this means not seldom made to walk without a limp within two months; but they are very apt to relapse with hard work or exposure. If they do so, the wisest thing is to put them right a second time, and then to forbid any form of duty which would be likely to cause a recurrence.

The sciatic nerve is not dealt with under the treatment of neuritis, because its reaction to powerful sparks seems peculiar to itself.

Neuritis.—This term covers such a multiplicity of symptoms that treatment can only be dealt with here in a most general way. Where pain is the most prominent feature, the galvanic bath, positive pole, is of value; also the vacuum electrode (H.F.) applied directly up and down the course of the nerve or nerves, with a very mild current. I have not found diathermy good in such cases. X rays over the spinal cells of origin are useful. This applies also in some cases of sciatica. Tender points should be sought for on the course of the nerve, and if found, should receive special attention. When pain is very acute, the 3000 c.p. lamp may give relief; and some writers have recently claimed good results from the "Simpson Light."*

As to *motor* troubles, the principles to be followed are precisely those laid down in the treatment of nerve injuries. No stimulation of muscles should be carried out so long as pain remains at all severe; but it is invaluable at a later time as a means of restoring full power to a limb. At this stage, also, the long high-frequency spark may be used.

Incontinence of Urine.—A very considerable number of men in the new armies suffer from this trouble. Unless they can be cured, it is generally necessary to invalid them, on

* See footnote to p. 158.

account of their being objectionable to their fellows. Often they are robust youths, good fighting material in every other respect. The possibility of cure is therefore worth considering from a military point of view.

Such cases should not be treated by electricity unless a surgeon has certified that they have no discoverable organic lesions. A great many patients seem to suffer from a lack of tone—sensory or motor, or both—in the urinary system. Rhythmical stimulation of the lower abdomen is the great stand-by in this condition. One pad is placed under the buttocks, and the other near the pubes. Any form of tetanizing current will serve. It is also advisable to administer high-frequency sparks and *small* doses of X rays over the lumbar spine. At the same time the patient is put on to a suitable time-table as to food, drink, and times of micturition. He is also encouraged to try to wake himself at night to make water.

The above treatment alone is successful in quite a respectable proportion of cases; but in others the habit is so ingrained that even the removal of any physical weakness does not cure it. Psychical treatment should then be given a trial. Suggestion is at first devoted to making the patient wake (every hour if necessary), and later to increasing gradually the interval which may be safely passed in sleep. In obstinate cases the suggestions may succeed only when the patient has been previously hypnotized.

Sometimes the most unpromising cases can be cured. For example, a boy of nineteen had had incontinence, both nocturnal and diurnal, ever since he could remember. He desired greatly to stay in the army, but was about to be invalided. By a combination of electrical and hypnotic treatment, he was cured in six weeks, at the end of which time he left with his regiment for foreign service. On the other hand, a man who wishes to use his disability to escape military service cannot be cured, or, at any rate, cannot be proved to be cured. Where every case is accepted for treatment, a great many failures are bound to occur—perhaps 60 or 70 per cent. But the successes will repay the trouble

taken. It is of interest to note that the electrical methods employed are those which have been found of use in treating enuresis in children.

Neurasthenia and Shell Shock.—Electricity can never play the sole part in the treatment of these conditions; but it is a valuable aid.

The full-body bath is employed first, with a mild sinusoidal current; also cerebral galvanism, positive pole on the forehead. This should be done only by skilled persons, and either a cell battery or a small earth-free generator must be used.

At a later stage the high-frequency spark up and down the spine has a bracing effect, and tends, amongst other good effects, to raise the blood-pressure, which is frequently low in neurasthenic patients.

Hypnotic suggestion is often of value.

Accurate Diagnosis.—In conclusion, a word ought to be said upon the importance, in electrical treatment, of an accurate diagnosis.* That which the patient gives is by no means always correct. "Lumbago" may sometimes mean renal calculus; while "sciatica" may conceal a pelvic carcinoma. "Neuralgia" and "neuritis" are at times more appropriately treated by mercury and iodide than by the electric modalities. "Rheumatism" may indicate bad teeth, a septic naso-pharynx, or a urethral discharge. Bladder troubles are among the first warnings of locomotor ataxia, and "neurasthenia" is a peculiarly ample cloak for ignorance. The X ray is a constant friend not only in treatment. It will discover the cervical rib which is causing pain or paresis in an arm; bring to light the *mus articularis* which keeps up a chronic joint trouble; demonstrate the abscess cavity amid the callus of an old fracture, apparently healed; and in a hundred ways make straight the path of those wise enough to use it, saving them from the gins and pitfulls which beset the feet of the unwary. If the physician in charge of a special department does not look to his diagnosis, his sins will surely find him out—at the hands of various colleagues to whom his failures ultimately drift.

* The term is here used in its general sense. The importance of electrical testing has already been referred to.

PART III

THE PROVISION FOR PHYSICAL REMEDIES

CHAPTER XII

PHYSICAL REMEDIES IN THE HOSPITAL

THE installation of which the ground-plan is shown in Fig. 54 was designed to provide in a compact form the most necessary methods of hydro-therapeutics. It was intended in the first place to meet the needs of wounded and invalid soldiers in military hospitals and command depots; but the same forms of treatment are applicable in civil cases, and it should therefore, *mutatis mutandis*, be suitable for civil hospitals and asylums. A single unit, such as is here described, will meet the needs of a very large institution. It should be so placed as to be easily accessible by wheeled chairs from all the wards.

A medical bath department is, indeed, advisable for all hospitals of a considerable size. By replacing the numerous separate ward baths and fittings distributed over the building, it effects an economy in *initial cost*, and in space, and probably also in *running expenses*, having regard to the cost of heating and attendance.

In those hospitals and asylums where therapeutic baths are habitually given, a properly equipped department, however small, may be said to become essential. Such treatment cannot be adequately given in the ward. In a well-warmed building there is no difficulty of transport. The great majority of the patients can be easily and safely con-

veyed to and from the baths and the wards. The only exception is presented by acute febrile cases, which must, of course, receive any treatment that is necessary at or near the bedside. Hot air or vapour baths for the entire body may

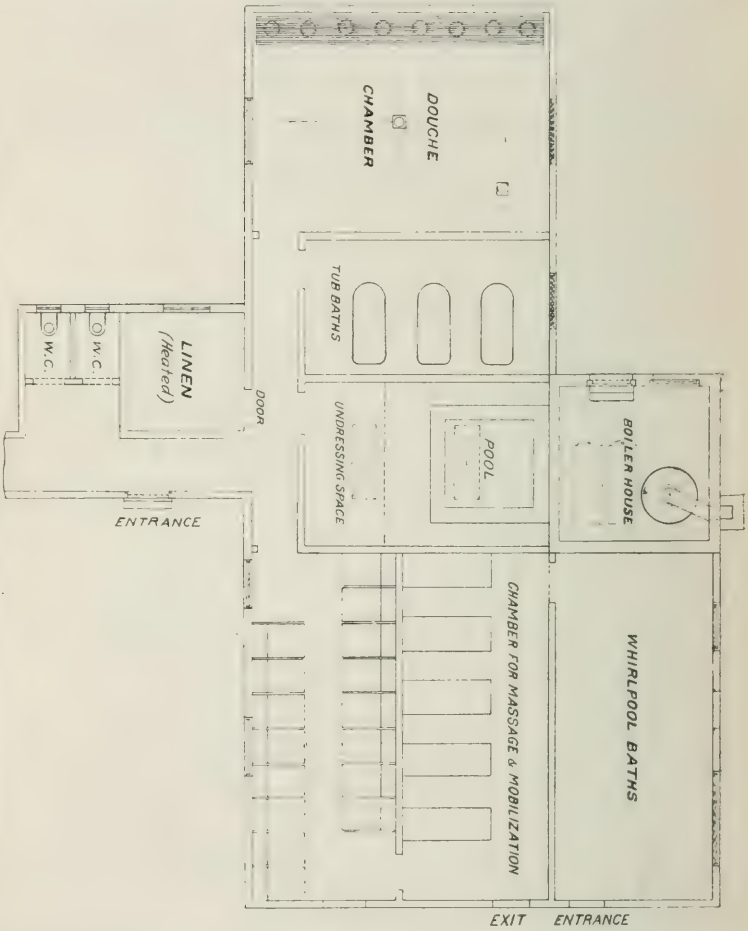


FIG. 54.—GROUND-PLAN OF HYDRO-THERAPEUTIC DEPARTMENT AT HEATON PARK COMMAND DEPOT.

be readily given in the ward, the patient being either seated on a stool or recumbent in bed. Figs. 55 and 56 show useful and inexpensive forms of apparatus for this purpose. The local arm and leg baths (Figs. 57 and 58), suitable for surgical cases, are usually given in still water, but can be

adapted for flowing water without great difficulty. With these exceptions, institutional hydro-therapy, like many other special forms of treatment, can only be adequately served in a special department. A proper hydro-therapeutic

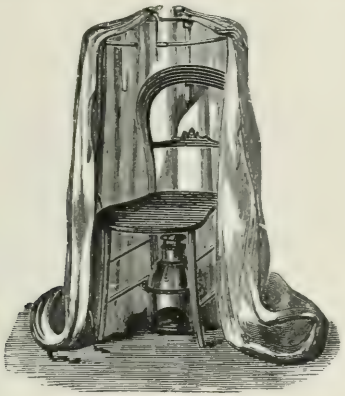


FIG. 55.—VAPOUR BATH (STEVENS).

department will, of course, be provided with trained and efficient attendants under expert medical administration.

It will be seen from the plan that the installation is arranged within the compass of a single hut (60 feet by 20 feet).

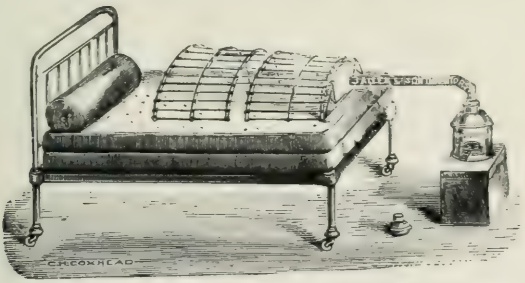


FIG. 56.—RECUMBENT VAPOUR BATH (STEVENS).

It represents, in fact, a *multum in parvo* of bath treatment. The building is warmed throughout by steam-pipes from the same boiler that serves the baths. It is intended that one attendant should take charge of the rooms, with the exception of those for the treatment of disabled limbs, which are

specially arranged for military cases. This latter department has a separate access and exit, so as to accommodate large numbers of men who pass in and out without any disturbance of the baths proper.

The installation should be placed in connection with, or at least conveniently near to, the hospitals or buildings where the men are lodged.

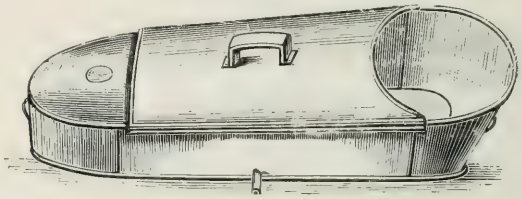


FIG. 57.—ARM BATH (STEVENS).

The **Pool Bath** will often be used in the evenings or at night, and those for whom it is prescribed ought to be conveyed, after the bath, to their beds with as little as possible of delay, fatigue, or exposure. In many cases it will be found

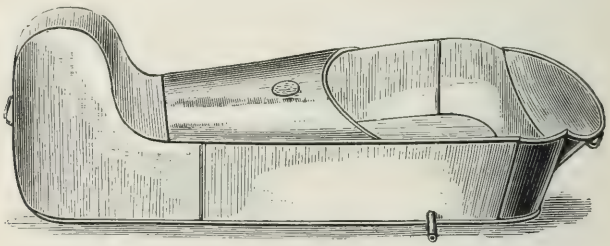


FIG. 58.—LEG BATH (STEVENS).

best that they should be wrapped in warm blankets, and taken in a wheeled chair from the pool room to the ward.

The **Douche Room** is fitted with a series of shower baths and a proper nozzle douche, with varying pressure and temperature, a needle bath, and a screen for the use of local douches to the limbs. In the adjoining passages are **cubicles** for dressing and undressing, and a closet for **linen,** heated by steam-pipes. An ample provision of hot bathing sheets

and towels greatly enhances the value of the baths, especially in the cold season.

The **Tubs** (three) for brine and effervescing baths, etc., are best served in a separate room.

The **Pool** is designed to give long-continued baths at a constant temperate heat. The pool chamber adjoins the boiler-house, has no external walls, and is well supplied with steam-radiators. By this means the temperature is kept at about 60° F. day and night. This bath is designed entirely for sedative treatments, and is therefore as quiet and undisturbed as possible. A waterproofed curtain divides the bath from the vestibule (for undressing), and serves to minimize draughts. The pool (8 feet by 8 feet) is of such a size that ten men can be comfortably seated in it. The water is flowing and constantly renewed, and is maintained at a uniform temperature (92° to 94° F.) by means of a calorifier fitted with a thermostatic valve.

The **Department for Disabled Limbs** comprises (1) a room for hyperthermal local applications—whirlpool baths, hot air or vapour or radiation baths; (2) a room fitted with tables for massage and manipulation. Simple apparatus for mobilization of the joints may be fitted up in this room.

The **Boiler-House** outside the hut supplies hot water at the required temperatures for all the baths, and steam-heating for the buildings.

Indications and Directions for Hospital Cases.*

The above installation is designed to provide—

(*a*) **General Treatment**: (1) Tonic; (2) sedative.

(*b*) **Local Treatment,** for disabled limbs.

(1) **Tonic Treatment.**—A variety of tonic treatments for convalescent patients, whether civilians or military, and especially nervous and mental cases, may be given in a large and commodious douche room. Brief and refreshing **shower baths,** beginning warm (95° to 100° F.), and finishing cold

* See the author's paper in the *Journal of the Royal Army Medical Corps*, May, 1916.

after one or two minutes, can be given daily to large numbers of men. Provision is here made for operating nine such baths simultaneously. They may be freely ordered as a daily treatment for men out of condition, in whom the circulation is slow and feeble, and nervous reactions are sluggish and depressed—neurovascular atony. Cold after heat in this form stimulates oxidation, and so increases bodily warmth, invigorates the heart and circulation, and powerfully stimulates the nerve centres. Like other tonic baths, cold showers are contra-indicated when the heart's action is too frequent, and when the nervous reactions are exaggerated—neurovascular irritation.

A more powerful tonic bath is the **nozzle douche,** the stimulant effect of which can be heightened by increasing the pressure of the water. The douche should always begin warm, and finish, after one or at most two minutes, as cold as can be comfortably borne.

For very atonic subjects, two jets (at 100° F. and cold respectively) can be used simultaneously, or better alternately. To this procedure the name *Scottish douche* has been given. By means of this bath rapid alternations of temperature are applied to the limbs and spine. The alternating or Scottish douche is indicated for chronic neuralgias and for atonic and spinal neurasthenia, as well as to promote the absorption of chronic effusions in and about the joints; also for mental depression and malingering.

Tonic and Sedative.—Tub baths are commonly given at 98° to 102° F., with a duration of ten to fifteen minutes. Where a long-continued bath (half an hour to two hours or more) is desired, the temperature should be lower (94° F.), and regulated by the attendant. Such continued baths have been found beneficial, *inter alia*, for imperfectly healed and painful wounds.

Very brief **hyperthermal baths** (105° to 115° F.) may also be given in the same room, in cases of sluggish circulation, "fatigue fever," and "muscular rheumatism." The first effect of very hot baths is to stimulate the heart and to dilate the superficial arterioles. They restore the normal course

of the circulation in many painful conditions of vascular stasis, and so sweep away the accumulation of waste products. It is of great importance not to prolong the duration of a hyperthermal bath beyond two or at most three minutes; otherwise the first stimulant effect of heat will be followed by debility, and the good effects be lost. Moreover, all hot and very hot baths should be terminated by a momentary affusion with cold water. For this purpose a small hand bucket should be filled at the cold tap, and poured over the chest and spine of the patient before leaving the bath.

Brine baths and effervescing (carbonated) baths are also given in this room, the former in cases of muscular and tendinous "rheumatism," and the latter for cardiac debility.

(2) **Sedative Treatment: Sedative Pool Bath.**—This bath will be found helpful in many conditions of neurovascular irritation, from the psychical level downwards. The patient is seated in gently flowing water at a temperature nearly equal to that of the skin. The sedative effect is, within limits, proportional to the duration of the bath, which may be extended to several hours. These prolonged and "subthermal" baths have a wide medical application. They are indicated in cases of mental disturbance, with depression and irritability, due to exhaustion of the nerve centres; also in insomnia and restlessness; and in shock, peripheral neuritis, and neuralgia. They may also be prescribed with much advantage for the slighter forms of Graves' disease, and for many cases of heart strain, with dilatation and tachycardia. The massive, equable impression of the water, at a constant temperature, allays irritation, slows the heart, and favours sleep. (See Chapters I., IV. and V.)

Local Treatment of Limbs disabled by Wounds.—This, which is essentially a combined treatment by heat, moisture, manipulation, and movement, is described in greater detail in Chapters II. and XIII.

In the first chamber are installed the **whirlpool baths** for the arm and leg respectively. In these the limb is subjected to a rotatory current of water, rising in temperature from 110° to 115° F., or even 120° F., according to the require-

ments of each case and to individual toleration. The duration of these baths, which are usually given daily, is from fifteen to forty minutes.

Following these applications of heat, the limbs are submitted in an adjoining room or rooms to massage and mobilization, and treatment by mechanical apparatus.

A complete therapeutic bath department constructed according to the above plan, including sedative, tonic, and local baths, was opened at the command depot at Heaton Park, Manchester, in July, 1916 (Fig. 59). The accommoda-

FIG. 59.—HYDRO-THERAPEUTIC HUT AND BOILER-HOUSE, HEATON PARK, MANCHESTER.

tion provided in this very limited space proved, however, too small for the large number of cases under treatment, and it has been found necessary to erect and furnish an additional building.

The first pool bath employed in military cases in the British Islands was constructed, at the writer's suggestion, at the command depot at Tipperary, and taken into use in April, 1916, together with a service of tonic showers and douches. All these have been extensively used by wounded and convalescent men, especially the pool bath, 12,628

baths of all kinds having been given up to November 12, 1916. The pool is a large one (12 feet by 8 feet), and can

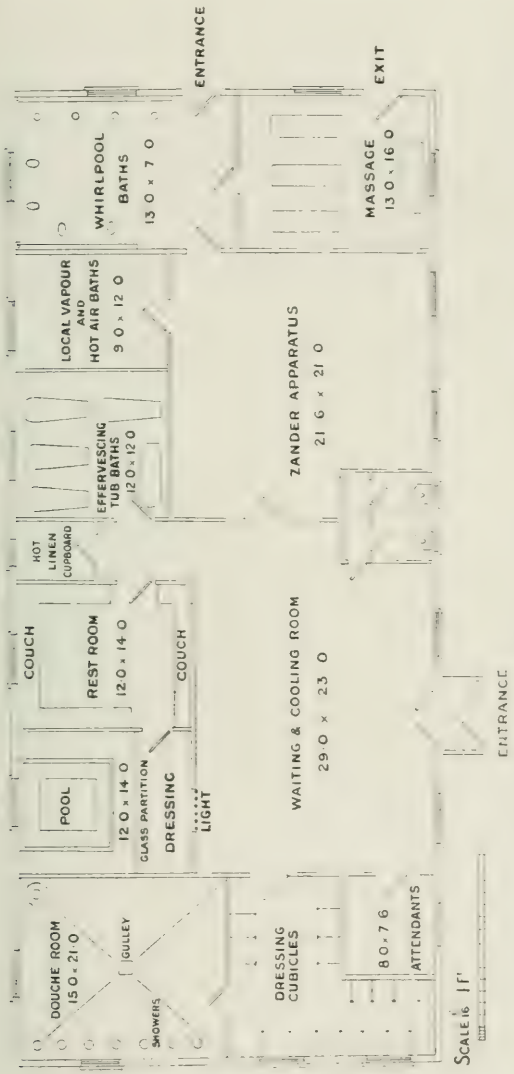


FIG. 60.—GROUND-PLAN OF DEPARTMENT FOR PHYSICAL TREATMENT, MILITARY ORTHOPÆDIC HOSPITAL, BANGOUR, MIDLOTHIAN.

easily accommodate twelve or fourteen men at the same time.

Medical bath departments are also in course of construc-

tion at some of the military orthopædic hospitals—for example, the great hospital at Shepherd's Bush, and that at Bellahoustoun, near Glasgow. Experience gained at the two command depots already mentioned shows the importance of ample *rest room* accommodation in connection with long-continued and pool baths and other sedative treatments, and brings out other practical details, such as the necessity for providing for cleansing baths, and for dealing with the muddy boots and clothing of the men in special cloak rooms. Soap is not used in medical baths. Before entering the department the men should be furnished with canvas shoes and washable gowns.

Fig. 60 represents the ground-plan of a department for physical treatment designed for the Military Orthopædic Hospital at Bangour, in Midlothian, with 2,300 beds. On the medical side, in addition to a douche unit and pool bath with adjoining rest room, there is a room for effervescing or aërated baths. For convenience of service of steam and hot water, all the baths are disposed on one side of the building. The pool bath is fitted with an inlet of air under pressure, distributed round the bottom of the pool. On the surgical side local bath treatments are provided, in three forms (viz., whirlpool and hot air and vapour baths), and there are special rooms not only for massage and manipulation, but for mechanical treatment. The building (80 feet by 36 feet) accommodates all the most necessary forms of physical treatment with the exception of electro-therapeutics, which were separately provided for.

CHAPTER XIII

THE PHYSICAL CLINIC

PHYSICAL treatment is too often given in fragments. Many facilities exist for specialized and particular forms of treatment: for baths of one kind or another; for different sorts of electrical treatment; for applications of hot air or light or other forms of radiant energy; for manual exercises; for mechanical treatment. It is to be feared that this over-specialization may sometimes give an appearance of rivalry which has no foundation in fact, but which nevertheless is injurious to the public interest and bars the way to real progress. A little reflection will show that all these several remedies are allied and interdependent. The gathered fragments make up one whole.

The modern movement towards the scientific use of physical remedies is already evident in the practice of the British hospitals. In the better organized of these institutions, electricity and the various forms of radiation, including the use of Finsen light, Röntgen rays, and radium, are now provided, as well as skilled massage. There is, however, but scant provision as yet for hydro-therapy, for mechanical treatment, or for remedial physical exercise. It must also be borne in mind that the physical departments of the civil hospitals, by their constitution, are not available for the use of medical men in general for the benefit of private patients. For this reason those methods of treatment, where provided, are necessarily restricted in their application.

Various methods have been proposed for getting over this difficulty. In some other countries it has been found pos-

sible in one way or another to make the installations for physical treatment and the service of an expert hospital staff available for the medical profession and for the public at large. The practitioner is invited to make use of the department, and to consult freely with the specialist medical officer in regard to the treatment of his patients. The department becomes in this way a centre of clinical study for all who are interested in either the scientific or practical side of this form of medical treatment. In spite of obvious inconveniences, it cannot be denied that much good has resulted from endeavours of this kind to enlarge the scope of hospital practice.

Now that the wide need for physical remedies is recognized in the British Islands, and also the necessity that they should be applied with skill and precision, it may be considered desirable that a similar development should take place in some of the British hospitals, such of them as are adapted for meeting this special want in the great centres of population. On the other hand, it is possible that, at all events in many localities, new needs will in the long-run be best met by new institutions. In any case it is for the medical profession itself to provide and administer the necessary facilities.

Apart from the hospitals, at the present time the means for physical treatment are confined to private sanatoria and to the spas and other health-resorts. It is true that at some of these a wealth of physical remedies is to be found, but the fact remains that the medical practitioner who wishes to employ a systematic physical treatment must needs recommend his patient to a sanatorium or a health-resort.

This deficiency has been sharply accentuated by the war. It has been found that many thousands of soldiers stand in need of physical treatment which they cannot obtain in the hospitals. It is impossible to send them all to the health-resorts, and even these lack the methods and machinery necessary for such large numbers. In many of these cases experience has shown that piecemeal physical treatment is of but little value; that massage alone or electricity

alone, or even these in combination, are insufficient, and that, to obtain the best results, a prolonged course of systematic and combined physical treatment is necessary.

The object of a **physical clinic** is to supply that want, to provide for the use of the practitioner all the necessary elements which make up one entity. Disjointed they are insufficient; united they have a great and enhanced value. The several physical agencies employed—heat, cold, electricity, radiation, movement—are adjusted and propor-

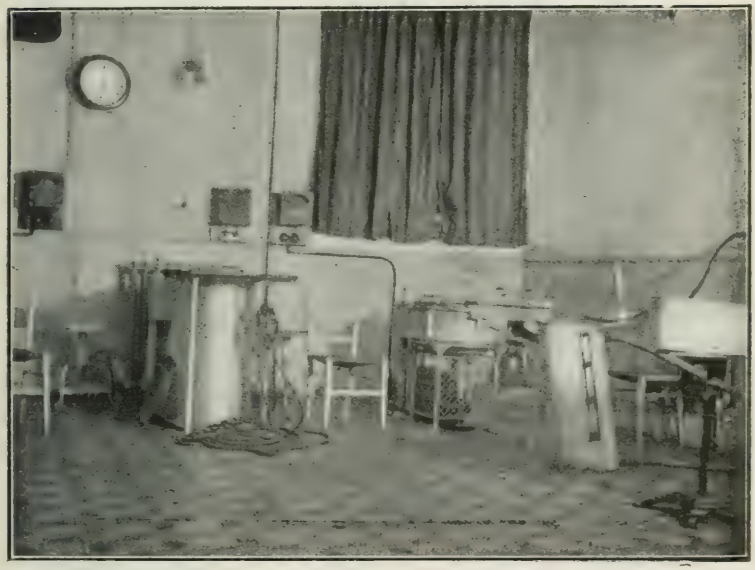


FIG. 61.—WHIRLPOOL BATHS AT THE RED CROSS CLINIC, LONDON.

tioned to the needs of each case. They reinforce and succeed one another in a natural sequence, producing a gradual and cumulative effect.

An out-patient department, or clinic, is naturally intended for subacute or chronic and local disorders. It will therefore be unnecessary to provide many procedures that are applicable to acute and febrile cases in medical and surgical wards (see Chapters II., III. and XII.) It will be convenient to consider in this place the *methods of treatment*

proper to a clinic of this kind; the *sequence in physical treatment*; the necessary system of *measurement and case records;* the procedure for *diagnosis and administration;* the *therapeutic results* which may be anticipated; and the *economic results.*

I.—Methods of Treatment.

The several methods and their application to both medical and surgical cases have been already discussed in previous chapters. But as the equipment and objects of a physical clinic are to a certain extent novel, a short account of the actual practice in such an institution may here be given. In considering methods, it must not be forgotten that physical treatment is threefold, both theoretically and practically, a truth that has been too little understood. If, as often happens, one or another of the three elements that are necessary to its completeness is overlooked, it fails of its purpose, or at best an incomplete remedy will have an incomplete result. It is therefore well to make clear what are the essential factors of physical treatment, and in what manner the different methods that are employed may be in practice combined. As has been already stated, the three cardinal elements are—

1. **Hydrological,** in which it is convenient to include the use of heat and cold in solid and gaseous media.
2. **Electrical and Radiant.**
3. **Mechanical,** which includes movement and exercise in every form, as well as manipulation and massage.

Hydrological Remedies.—Bearing in mind that hydrological remedies are (1) stimulant, (2) sedative, (3) local, the clinic should be furnished, not with a profusion of similar apparatus, but with a *judicious selection.* Stimulant, sedative, and local treatments are adequately served by a group of comparatively few and simple methods. Experience will suggest modifications and additions, but it is well to master a few tools before attempting to use many. The apparatus, and to some extent the methods, will depend upon the class of patients to be treated, whether military or civilians, and whether mainly surgical or medical. A

patient will sometimes be brought to the clinic in an ambulance, and it is necessary to have couches for rest before and after treatment.

The following appliances may be considered necessary (for a more detailed description of remedial baths, see Chapter I.):

1. *Douches,* both with and without pressure.

FIG. 62.—SEDATIVE POOL BATH AT THE RED CROSS CLINIC, LONDON.

2. *Manipulation bath,* for movement and massage under water.

3. *Effervescing or aëration baths,* for cardiovascular and nervous affections.

4. *A pool bath at constant temperature,* for long-continued immersion in flowing water.

5. *Local baths* of flowing or agitated water, usually at high temperatures. These form a necessary part of the equipment for surgical and military cases, as well as for civil injuries, arthritis, and rheumatism. They include *hyperthermal pediluvia* and some form of the *whirlpool bath.*

6. *Local hot air or electric light bath* (dry heat) or *vapour bath* (moist heat). One or other of these should be added for applications to the trunk or shoulder, for which local baths of water cannot be used.

Electrical Remedies.—Electro-therapeutics and electro-diagnosis form a necessary part of the equipment of the clinic. For a detailed account of electrical remedies, and the

FIG. 63.—DOUBLE ARM BATH AT RED CROSS CLINIC, LONDON: WHIRLPOOL OF AIR AND WATER.*

indications for their use in surgical and medical cases, the reader is referred to Chapter XI.

Mechanical Remedies.—Skilled *massage* is the chief of these, including manipulation under water and in the douche. *Frictions* and also *switching after hyperthermal baths*, given as in Russia, form a highly stimulating surface treatment. An installation of *mechanical apparatus* for mobilization of the joints and muscles is a desirable adjunct, and indispensable where wounded soldiers are treated (see Chapters VIII. and IX.).

* For this and the two previous illustrations the Author is indebted to Dr. C. F. Sonntag, Medical Officer to the Clinic.

II.—Sequence in Physical Treatment.

The reader's attention has been already called to the fact that physical remedies are so many correlated elements, which must be associated in order to produce their proper effect. The great object of physical treatment is, therefore, the judicious combination and sequence of its elements.

According to the case in hand, the procedure commonly begins with heat: either a brief stimulation at high temperature, a more prolonged sedative application of subthermal heat, or, again, a stimulant action at a cooling temperature. The nicest judgment is sometimes required to determine which of these phases of heat should be first employed. When high temperatures have been applied, the treatment proceeds to another phase of temperature, evoking a further reaction in the body. Following these applications of plus or minus heat, and sometimes associated with them, come the mechanical remedies—frictions, massage, movements, in an ascending scale—graduated carefully to the requirements of each patient. For example, the gentle and gradual massage given in the douche, or after effervescing baths, upon the couch, in cardiovascular disorders, is very different from the firm and vigorous kneadings and manipulations used after thermal baths in fibrositis. The movements of the limbs given after whirlpool and other local baths of high temperature are often of the gentlest at first, but can be increased as the limb becomes less sensitive. Whether by the hand or by apparatus, movement should be cautious, gradual, and tentative. To these hydrological and mechanical methods are naturally added, in many cases, the appropriate electrical remedies.

It is a guiding principle that physical remedies thould be made to reinforce and supplement one another. They must never be used in a contrary sense. In their successive use the new actions and reactions must confirm or establish those already produced. A striking example of the value of this principle is furnished by the systematic "combined

physical treatment " instituted at the Grand Palais Hospital in Paris in 1915 for soldiers returned from the war.* A *series* of impressions is brought into play; it is continued and increased from day to day, according to the reactions produced in each case, and slowly but surely produces its cumulative effect.

III.—Measurement and Case Records.

It is the duty of the medical officer to take the history of each case upon a *case-record card* (see p. 273). Such a card was prepared and issued in March, 1915, by the Section of Balneology and Climatology of the Royal Society of Medicine, and has been largely used for military cases. It answers reasonably well for health-resorts, as well as for hospitals and clinics where physical treatment is employed.

Where the limbs are injured or there is local disability from arthritis, neuritis, or palsy, the patient proceeds to the *measuring room*. Here the mobility of the joints and the power of affected muscles are accurately tested and recorded. Many instruments have been devised to register the amplitude of movement of the various joints. Fig. 64 represents a *goniometer* designed for the Red Cross Clinic for Physical Treatment in London, and Fig. 65 the apparatus for measuring supination and pronation. The mobility of the elbow, ankle, wrist, and finger-joints is measured by the *fleximeters* shown in Figs. 66, 67 and 68. The *arthrodynamometer* of Amar (Fig. 69) is designed to record not only the range of movement of the several joints, but the power of the flexor and extensor muscles. Other instruments, such as the *dynamo-ergograph* of Camus, may be used with much advantage where it is desired to record graphically the force, rapidity and amplitude of movement, and the fatiga-

* " Convinced of the necessity of employing *combined treatments* for the *sequelæ* of wounds, I have endeavoured to group them harmoniously, establishing an *entente* between the different departments, and to co-ordinate them by the use of uniform record cards and a central control " (Professor Jean Camus, Director of Physical Treatment for the Military Government of Paris).

bility, of injured limbs. Amar's "Dynamographic Pear" (Fig. 70) is an ingenious apparatus for registering the power of a partially paralyzed hand, grasping a pear-shaped ball.

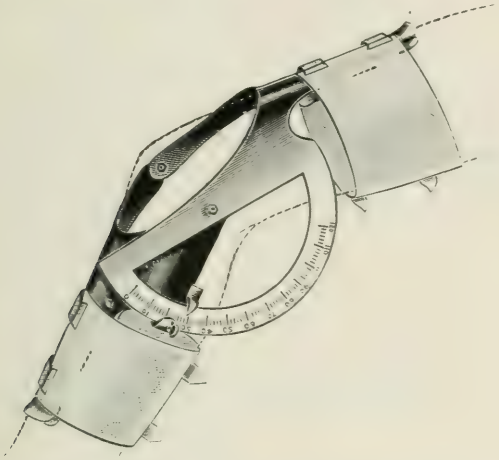


FIG. 64.—GONIOMETER: RED CROSS CLINIC.*

Graphic records have an additional use in providing a valuable test in cases of possible malingering.

The examination of the initial defect having been made,

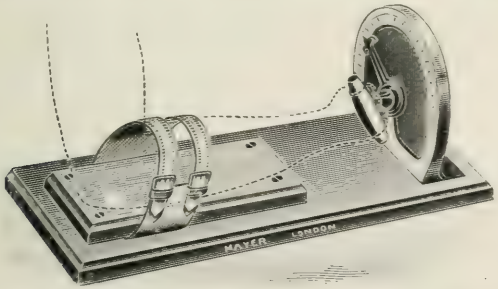


FIG. 65.—FOR MEASURING SUPINATION AND PRONATION.
Presented to the Clinic by Mr. S. Alexander Fox.

it is duly entered upon the case-record card or on the figured chart (Fig. 71). It will be readily understood that

* Many of the measuring instruments employed at the Red Cross Clinic are manufactured by Messrs. Mayer and Meltzer, to whom the Author is indebted for drawings for Figs. 64 to 70.

this record forms a useful guide during the progress of the case. The measurements are repeated at intervals during the course of treatment.

IV.—Diagnosis and Administration.

After the history has been taken and the initial measurements made, in the case of a military clinic, the soldier patient passes on for examination by a specialist physician. Simple cases may be at once referred for treatment. Cases

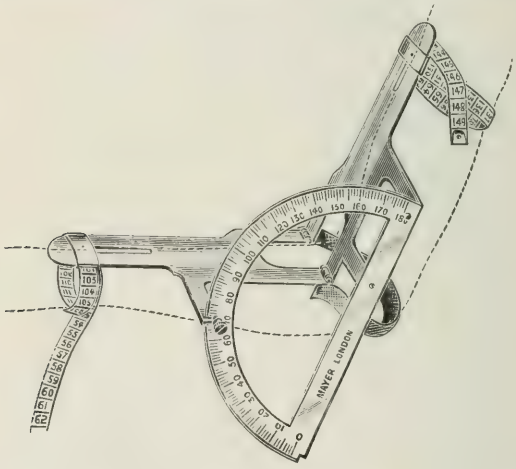


Fig. 66.—Fleximeter for Elbow Joint, from the Grand Palais Hospital, Paris.

unsuitable for physical treatment are rejected. Others more suitable for treatment at one of the health-resorts are referred to the appropriate station. For more complicated cases an examination by X rays or an electric diagnosis may be ordered; and other members of the consulting staff, a physician, surgeon, or neurologist, according to the case in hand, are requested to assist in the diagnosis.

The presence and co-operation of the medical man who recommended the case to the clinic are always invited and welcomed, especially at the first examination. The diagnosis having been made, the treatment is ordered on a *treat-*

ment card. These are stamped with the day stamp, and all treatments entered and initialled by the clinic attendants.

Every week during the continuation of the treatment, the patient reports himself to the medical officer or director

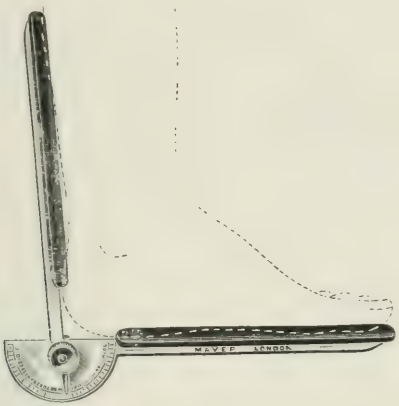


FIG. 67.—THE AUTHOR'S FLEXIMETER FOR ANKLE AND WRIST.

for further examination and revision or confirmation of the treatment. The observations of the physician or surgeon are duly entered on the case cards. It is the duty of the

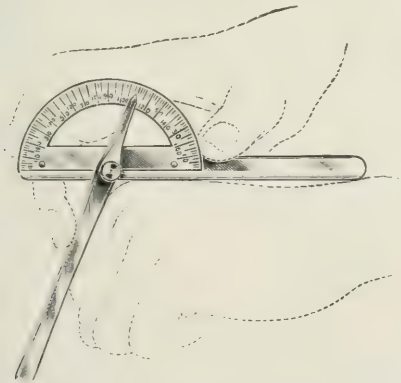


FIG. 68.—FLEXIMETER FOR FINGERS.

medical officer to exercise a general surveillance over the different forms of treatment, and over the progress of patients in the intervals of their weekly examination.

At the conclusion of the course of treatment a note is added to the card, stating the result obtained, and a final mensuration of defect is made and recorded. This may be conveniently set down in the form of a percentage of total disability, according to one of the accepted scales.* The figure thus arrived at after an adequate course of treatment has been found an important *datum* for purposes of accident insurance, and in military cases for the determination of pensions (see pp. 218 and 273).

The methods above described may be regarded as adequate for a small installation for officers. It is obvious

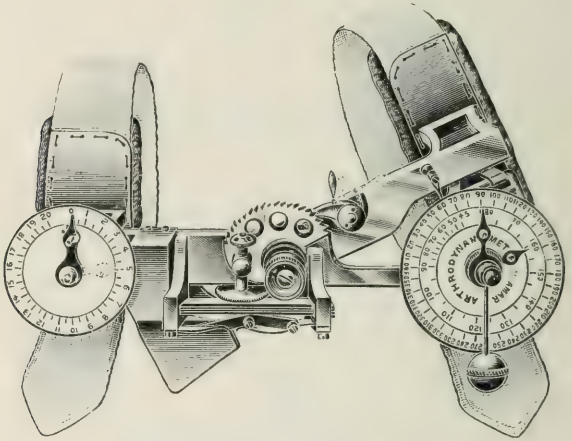


FIG. 69.—ARTHODYNAMOMETER.

that the medical administration and procedure followed must vary with the nature of the work that has to be performed. In the case of a large military clinic, like those serving the French and Belgian armies, the medical director is given the requisite military authority, and it will be a part of his duty to report on the degree or percentage of invalidity remaining in each case at the termination of the treatment. He will also, with two of his medical colleagues, form a *medical commission* or *board*, which will at periodical

* See the "Guide-Barême des Invalidités," giving the official figures as fixed by the Ministry of War, Paris. Édition militaire, Henri Charles La Vauzelle, 124, Boulevard St. Germain, 1915.

intervals pass all cases under review and furnish official returns of the results of treatment. These reports show at a given date the names of the men who are fit for active service, those who are fit for the auxiliary services, those who are unfit for service, as well as those who should continue treatment or suspend it for a prescribed period and report.

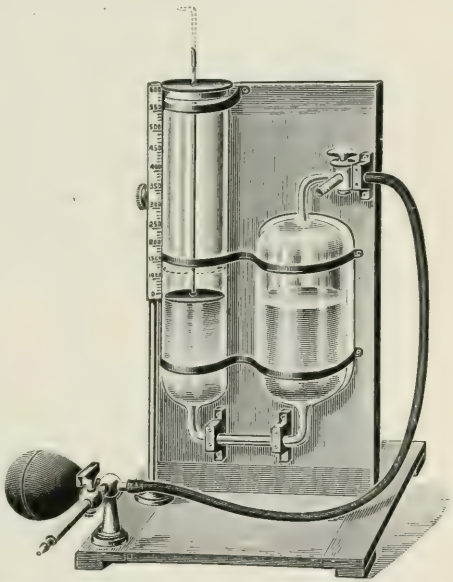


FIG. 70. — THE PNEUMO-DYNAMOMETER, OR "DYNAMOGRAPHIC PEAR."

It must not be forgotten that the object of the physical clinic is not only to apply physical remedies, but to observe and record their effects. The actions and reactions that attend upon their use cannot be allowed to go unobserved. Here again method and system have their necessary place. This field of medical observation is but little cultivated, and the present is an exceptional opportunity for fruitful research.

The case-record cards of military cases are ultimately filed, and will be available as *data* for the medical history of the war.

V.—Therapeutic Results.

Although the operation of physical remedies is more often gradual, an almost immediate improvement and relief may be experienced in some cases of nervous shock, insomnia, tachycardia, and in recent traumatism. But for stiffened or wasted limbs, painful scars, and for the great bulk of

chronic nervous and circulatory disorders, whether local or general, no such rapid results can be anticipated. It has been stated that in military cases the average duration of treatment is forty days. This limit is very often exceeded. Many months of patience and perseverance may be required, with occasional modifications or intermissions of treatment. The therapeutic results greatly depend upon the precision

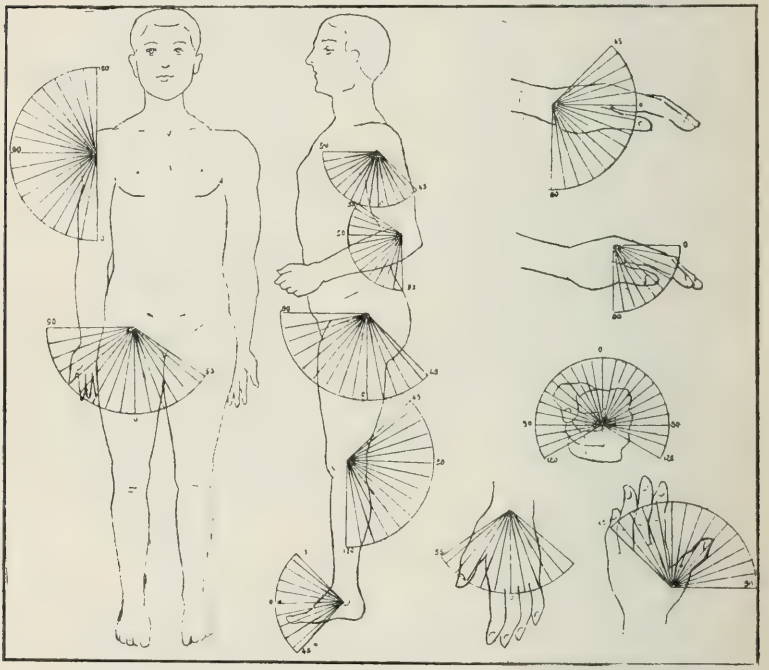


FIG. 71.—CHART FOR RECORDING MOVEMENT OF JOINTS: DR. COLOLIAN, CENTRE FOR PHYSICAL TREATMENT, VERSAILLES.

and regularity with which the treatment is conducted. The early experiences of a famous clinic for disabled soldiers convey a useful warning. Within certain months 5,571 men were examined and inscribed for a course of voluntary treatment. Of these, more than 1,000 disappeared without entering upon it, and more than 1,200 others so far interrupted their treatment, in spite of all persuasions, as to lose in great part the benefit of it. An alteration was then made,

and a system devised in which the disabled men are formed up into special corps for treatment and training. More than 2,000 cases are now treated daily, with absolute regularity.*

It has been conclusively established that far better results are obtained when the *sequelæ* of wounds are *promptly* treated by physical remedies than when the same treatment has been employed after a period of delay. Every month lost diminishes the prospect of a good result. A considerable proportion—indeed, the majority—of the men who have been hitherto treated at clinics of this kind have been already for a long period in hospitals and convalescent homes. Some of them are more or less "hospitalized," and, from

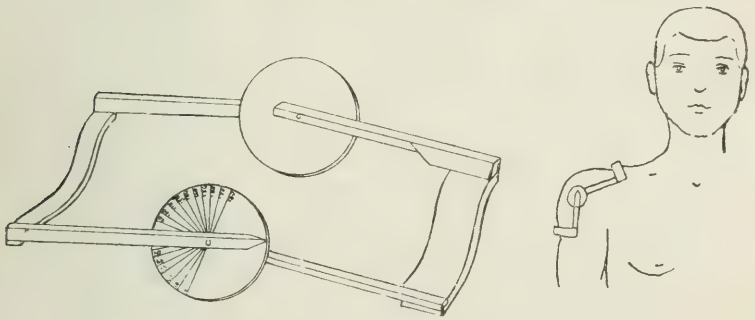


FIG. 72.—APPARATUS FOR MEASURING ELEVATION OF THE SHOULDER (COLOLIAN).

one cause or another, have acquired a physical or psychical habit against which it is difficult to contend. The substitution of a normal for an abnormal bodily and mental habit is one of the problems that has to be solved at the clinic.

The following statistical results have been published, and may be quoted:

A total number of 3,348 soldiers suffering from disability of all kinds received a full course of treatment, and were discharged from the hospital within a period of six months. Of this number, 2,676 (80 per cent.) were cured, or so greatly ameliorated as to be sent to their depots; 457 were recom-

* See Professor J. Camus, "Corps de Ré-education physique" (*Archives de Médecine et de Pharmacie militaire*).

mended for the auxiliary services, and 215 for discharge from the army.*

Figures have also been published with reference to the Anglo-Belgian Hospital at Rouen.† Of 2,020 convalescents discharged after a course of physical treatment, 1,170 (or nearly 58 per cent.) were completely cured and rejoined their depots; 670 (or 33 per cent.) were recommended to the military institute for industrial training, and 180 (or 9 per cent.) to homes for invalids.

The same authority‡ quotes some earlier statistics showing the result of physical treatment and training of men disabled by accidents in civil practice. They included many cases of the most serious forms of crippling. The figures cited show that about 80 per cent. of the total number have partly or wholly recovered their power of work. Of this 80 per cent., more than one-half (45 per cent.) were able to earn their livelihood after a course of training, either in their former occupations or in others better suited to their disability. The remaining 35 per cent. could only work in a fragmentary and occasional way.

Dr. Deltenre thus summarizes the surgical indications for treatment at the Institute for Physio-Therapy and the Orthopædic Hospital at Bon Secours, near Rouen: (1) Simple or compound fractures, dislocations and arthritis, and relatively recent anchylosis; (2) union of bones in bad positions; (3) cicatricial and tendinous contractions; (4) paralysis and nervous lesions; (5) cases of amputation, for a treatment of the stump preparatory to fitting an artificial limb. He emphasizes the importance of cases being sent by the army medical officers direct from the hospital to the institute, without intervention of intermediary hospitals, and he prefers that cases should arrive before the cicatrization of their wounds is completed, so long as septic complications are no longer to be feared.

* Camus, *loc. cit.*

† "L'Hôpital belge: Institut de Physio-thérapie et d'Orthopédie de l'Armée belge," Dr. Armand Deltenre.

‡ Deltenre, *loc. cit.*, p. 8.

It must be remembered that physical treatment of this systematic order is a new thing in military medicine, and the published records are at present few. Careful observations made upon a considerable number of cases under such treatment in the United Kingdom have, however, confirmed the general truth of the above conclusions, both as regards the methods that should be applied and as to the favourable results that are to be expected from them.

VI.—Economic Results.

This is not the place to set forth the economic results that may be expected to flow from the even partial restoration to active life of so large a percentage of the men crippled by wounds in war. The argument is partly financial and partly economic. As regards the financial aspect of the question, figures have been published in France showing that an average reduction in the mass of physical disability of, say, 20 per cent., which is not an extravagant claim for a properly organized physical clinic, has effected an automatic saving to the State, in the charge for pensions and gratuities, of nearly two millions sterling per annum. On the economic side, the saving of men for the industrial life of the nation may be even more important.

NOTE.—The foregoing account of the methods and administration of a physical clinic is partly based upon the great work that has been accomplished for disabled soldiers in Paris and Rouen by Professor Jean Camus and Dr. Armand Deltenre and their respective colleagues. The British Red Cross Society's Clinic for Physical Treatment of Wounded and Disabled Officers in London has been founded upon the same general lines, with such modifications as the different conditions have suggested, in the hope that after demonstration of the value of physical remedies, properly applied, similar clinics would be set up in other centres.

CHAPTER XIV

PHYSICAL REMEDIES, RE-EDUCATION, AND WORK

In previous chapters it has been shown that physical remedies form an indispensable link in the long chain of treatment for disabled men; that by their means it is possible to take up the cure of disability where, as is too often the case with discharged soldiers, it is broken off with its task half done, and that it may be said to begin where ordinary hospital treatment for the most part ends. In the Orthopædic Hospital, at Convalescent Camp or Depot, and at the Physical Clinic, the slow process of restoration is carried on and continued. It has for its special object to prepare the soldier either for return to military duty or to the occupations of civil life. And it is usually the most protracted phase of the whole course of medical treatment.

It has been often pointed out that many of these convalescents are not ill in the ordinary sense of the word. Whatever *diminishes the tedium* of the long convalescent period, especially if it provide some possible form of occupation, will promote and hasten the restoration both of body and mind. All thoughtful observers are agreed as to the depressing effects of idleness and invalid surroundings upon men who are no longer fit for military duty, and as to the bracing and even ennobling effect of work and of training for work. New activities rouse the dormant energy and prepare the injured man for taking up the labours of civil and industrial life. When the disabled limb and the will also are brought to the point of being able to *do something*, the last stage of treatment has been reached. It is a great advantage that both the patient and the medical man should realize that this is the aim and goal of their endeavours.

The object of the physical treatment of disability is preparation for work.

It is unnecessary to dwell upon the new value in life which begins when mind and body are able to co-operate in a useful purpose. Even to have a definite, though far-off, end in view, and to begin to train and to prepare oneself for it, is a great stimulus; and nothing can be more encouraging to a disabled man than to find himself acquiring new powers and a new value. It is impossible, and also unnecessary, to attempt to draw the line where treatment ends and work begins. Work may, indeed, be the best form of treatment. The remedial value of work is acknowledged in such modern expressions as " curative workshops " and " therapeutic work."

In order to be curative, work must be, not only of the right *kind*, but given in the right *amount*. It is easy to overtax an injured limb or brain by attempting the wrong kind of exercise, and a nice judgment and expert knowledge are requisite in apportioning the return to work, especially at first.

The connection between physical treatment and occupational training is a very intimate one in the case of disabled soldiers. For most of these men there comes a time when some form of *remedial work* is the appropriate medical prescription. But it presupposes a sufficient restoration in the function of the limb or stump, and an expert examination and measurement of aptitude and capacity, not only as regards the injured limb, but as regards the general condition of the individual and his previous experience. When the necessary tests have proved satisfactory, some occupational employment or training may begin. Practical experience has shown that in this trial of restored power, and for some time thereafter, medical care and guidance are as necessary as in the earlier stages of treatment, and periodical measurement of power and movement in the affected limb should be continued for a considerable time.

It will be found to be of great practical importance that the nature of an occupation should be precisely adjusted

to the individual condition of disablement, and should as far as possible take advantage of each man's natural bent as well as his skill and experience in his previous occupation.

Some common experiences at the Red Cross Physical Clinic in London may serve to illustrate the place that work may, and, indeed, at the proper moment *must*, occupy in the process of treatment. An officer whose femur had been fractured came under treatment by baths, massage, and mechanical exercises for stiffness of the knee and wasting of the associated extensor muscles. In two months the movement and muscular power were much increased, but the limit of benefit appeared to have been reached. When he returned home and began rough walking over his property in Scotland, the limb was still further improved. Another officer, after a course of treatment for a stiff knee, found great benefit from working with a scythe; and a third, recovering from immobility of the shoulder-joint following fracture near the head of the humerus, from daily sawing logs of wood. It is worthy of remark that the wounded officer is in one respect at a serious disadvantage in comparison with the private soldier, since he is usually unacquainted with manual occupations. He is therefore cut off from one of the most effectual remedies, in the last stage of treatment, for restoring the function of disabled limbs.

The Principle of Movement—Games.

It is a familiar fact that immobility of a joint—for example, that of a knee affected with synovial effusion—causes in a few days wasting of the muscles related to it. The more prolonged the immobility, the more complete the atrophy. The converse is also true. A return of movement in a stiff articulation is the first step towards restoration of the muscles. Even a passive movement is a stimulus to the muscles, by giving the *idea* of exercise. From the beginning the return of function goes on *pari passu* in joint and muscle. In every case there is a moment, usually at quite an early stage, when active movements and exercises of the limb ought to replace those that are merely passive. So at a

later stage there is a moment in all cases when the active exercises of the gymnasium ought to give place to work. It is a waste of good energy for a man to go on moving mechanical apparatus when he could turn a lathe with his foot or handle a tool in the workshop or the field. But the ruling principle from first to last is *movement*.

In describing the successive methods of treatment at a Command Depot (see Chapter IX.), Major Tait Mackenzie lays emphasis on the importance of open-air exercises and games. Nothing is more familiar than the value of games for recreation in convalescence. It was well said long ago that they introduce three good and stimulating elements—the exercise of skill, emulation, and surprise. If physical and mental stimulation is needed by the ordinary convalescent, it is still more needed by the wounded soldier. At all stages of his convalescence games of one sort or another may well form part of the day's programme. But active games come in very well in point of time between the gymnasium and the workshop. Thus, the writer has seen men who are still unfit for work, after treatment for arms or knees stiffened by wounds, playing bowls and quoits in mid-winter, under the spacious roof of a "crystal palace."

Different Types of Disablement.

It may be useful to consider to what degree the different types of disablement are amenable to physical treatment and to functional and industrial re-education.*

1. A certain proportion of the total number of wounded are, unhappily, so disabled as to be incapable of any further work. Such invalids will, naturally, in course of time, either return to their homes or be cared for in special institutions.

2. A more numerous class of disabled men have lost one or more limbs, but can still be restored, wholly or partially, to an active life. It is, perhaps, not generally recognized that physical treatment can be of good service in promoting

* The number of disabled men under the charge of the Ministry of Pensions on March 6, 1917, was 140,275 (Mr. Barnes, Pensions Minister, Parliamentary Reports, March 7, 1917).

the sound healing and relieving the pain of stumps, and also in developing the muscles and muscular sense upon which the work of the artificial limb will depend. As will be noticed immediately, great importance is now attached by some good authorities to the development both of muscular power and perception in a stump by means of a special course of physical re-education. All these cases are capable in one form or another of functional and occupational re-education. A man who has suffered the loss of a leg has to be taught to walk again, and usually to be trained in some manual work, and those who have lost the right hand must learn to do many things with the left. The use of the artificial substitute has to be mastered, but the sound limbs have generally something new to learn.

3. The third and largest class of disabled soldiers is made up of men suffering from more or less functional disablement of one or more limbs. For this kind of disablement physical treatment is peculiarly appropriate, as such treatment is directed to the relief of contractions and scars and the restoration of movement and muscular power. In these cases the functional re-education of the limb by means of special exercises and remedial work forms an integral part of the treatment. Treatment and training up to this point are, in fact, concurrent and inseparable. When the functional restoration is completed as far as possible, and the man proceeds to industrial training, medical guidance may still be of great assistance. The choice of occupation in a case of this kind must depend not only on the condition of final disability of the limb, but also on the man's mental aptitudes and natural bent.

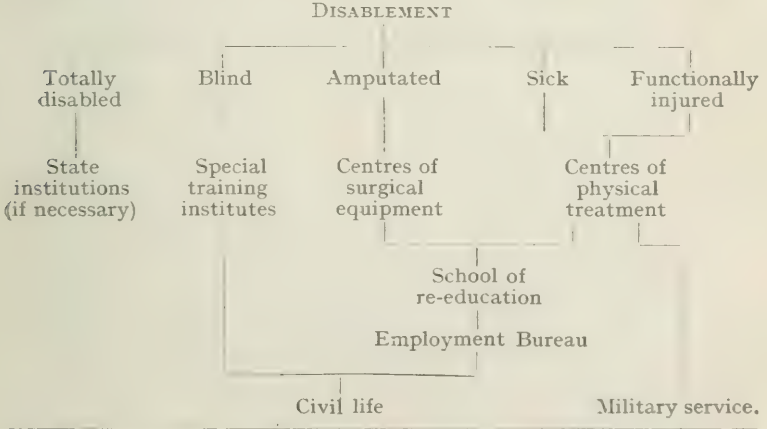
4. The blind make a class by themselves, and for them the need for re-education is, happily, well recognized and provided for. Physical remedies, especially those of a tonic and stimulant nature, are helpful in certain cases.

5. In a final class may be grouped those who are disabled by maladies rather than by wounds, such as nervous and mental affections, rheumatism, and disordered action of the heart. The application of physical treatment to these

various conditions has been dealt with in previous chapters. As regards occupational training, it may be noted that many men suffering from nervous and mental strain are quite unable, at all events for a long period, to return to industrial or business life, but are physically strong and well able to follow manual and open-air pursuits. Many of them may with great advantage be re-educated for agricultural work.

It will be observed that as a rule all cases of disablement under proper treatment and training will pass through a period of what may be called **"experimental curative work."** It is the first stage of occupational training, and serves two essential purposes. In the first place, the exercise of the limb and the different kinds of work that it performs are selected and prescribed with a view to the utmost development of the deficient powers. Secondly, the degree of capacity and incapacity of the injured limb, as well as the man's individual aptitude and preferences and general fitness, are discovered. This testing period, which may occupy several months, and during which periodical records of mobility and power and aptitude are recorded, should be of much value in determining the nature of a new occupation.

The different forms of disablement and their relation to treatment and training may be shown in tabular form as under.*



* Suggested by Sir Henry Norman's classification of casualties in his report (*vide infra*).

Re-Educational Work in the British Islands.

Many efforts have been made in the British Islands to meet the need of disabled soldiers and sailors, both for functional and vocational re-education.

For Amputation Cases.—The workshops at Queen Mary's Convalescent Auxiliary Hospitals for Limbless Soldiers and Sailors at Roehampton were among the first (March, 1915) set up in connection with convalescent hospitals in England. This example must be attributed to the foresight and energy of Mr. C. H. Kenderdine, the Honorary Secretary and Treasurer of the hospital. Excellent re-educational work has been done at Roehamptom for a large number of men who have undergone amputation. Nearly 6,000 men have passed through this hospital up to March 6, 1917. Artificial limbs of approved types are made on the premises, and a special point is made of training the men in their use. The trades taught include motor mechanism and engineering, electrical fitting and metal work, carpentry, wood-turning and leather work, and there are classes for commercial training and poultry-keeping. The Employment Bureau attached to the hospital has (to the end of February, 1917) secured situations for 1,216 men, a considerable number of whom have obtained training in the shops.

The Pavilion Royal Military Hospital at Brighton cares for the same class of wounded after amputation, and before they are fitted with an artificial limb at Roehampton. Queen Mary's Workshop (see Fig. 73) at this hospital was opened in August, 1916, and comprises motor-engineering and metal-turning, elementary electrical work, wood work and commercial training. The patients who are capable of it are invited to engage in one or other of these branches of work during their sojourn in the hospital. The Superintendent of Trade Instruction, Mr. A. G. Baker, states (February 26, 1917) that there is an average daily attendance of ninety men, and that nearly half of them have joined the bookkeeping and commercial classes. Sedentary occupations naturally appeal to men suffering from the

FIG. 73.—CARPENTERS AT QUEEN MARY'S WORKSHOP AT THE PAVILION MILITARY HOSPITAL, BRIGHTON.

serious and permanent forms of disablement. Many men have lost the right hand, and remarkable results have been obtained in teaching them to use their left hand in writing and other ways. An additional building and means of training in shoemaking and tailoring will shortly be provided.

Many ex-soldiers discharged upon leaving Roehampton proceed for a further period of training to the workshops of the London Polytechnic, where (March 1, 1917) forty men were in daily attendance. Places are found for all men who have gone through these shops. It is remarkable that, considering the serious nature of their disablement, they are many of them capable of well-paid work. Major Robert Mitchell was good enough to show the author a "Roll of Discharged and Disabled Men fitted with Artificial Limbs," who after a course of instruction at the Polytechnic have been placed in situations. The average weekly earning of sixty-two men on this roll was 34s. Comparing the upper with the lower limbs, the relative earning capacity after amputation and training was as follows: Loss of one or both legs or feet, 35s. 3d.; loss of one or both arms or hands, 32s. 9d.

As regards occupations, 37 of those injured in the lower extremity were trained as follows: As electrical workers, 16; cinema operators, 8; telephone workers, 3; switchboard attendants, 3; motor engineers, 2; munition workers, 2; carpenters, clockmakers, and salesmen, 1 each. Of 25 men who had lost arm or hand, 11 became electrical workers, 9 switchboard attenders, and the others a telephone worker, a carpenter, a storekeeper, a laboratory assistant (see Fig. 74), and a house engineer.

In Scotland there are two institutions for this class of wounded: the Princess Louise Scottish Hospital for Limbless Sailors and Soldiers at Erskine House, near Glasgow; and in the East of Scotland Edenhall Hostel, Kelso, established by Lady Isobel Douglas-Home. At Erskine House there are workshops where soldiers can get a certain amount of training during their stay; but, as this is not of long duration and does not extend beyond the period of fitting the limb,

nothing in the way of complete occupational training can be given. The soldiers, of course, get instruction in the use of their artificial limbs. The same holds good with Edenhall Hostel at Kelso.*

For the Wounded Generally.—The Lord Roberts Memorial Workshops for Wounded Soldiers are founded upon the basis not only of training disabled men, but of giving them permanent employment. A manufacturing business has thus been set up for their benefit, to some extent on co-

Fig. 74.—Laboratory Assistant in the Physical Laboratory at Eton College.

operative lines. A large factory was acquired in Britannia Road, Fulham. There are now (February, 1917) 250 men engaged in making wood work, furniture, and toys, at the central workshops in London. Various branches have been established in the country, including a branch for metal work in Birmingham and for printing in Bradford.

* For this and other information relating to the provision made for disabled soldiers in Scotland, the author is indebted to Sir George T. Beatson, M.D., K.C.B., Chairman of the Scottish Branch of the British Red Cross Society.

The plans of the Roberts Memorial include basket-making at Brookwood in Surrey, poultry appliances and porcelain-brick making at Colchester, and a complete installation of brush-making machinery in the workshops at Edinburgh; also the manufacture of wooden articles and toys at Belfast and at Brighton (see Fig. 75).

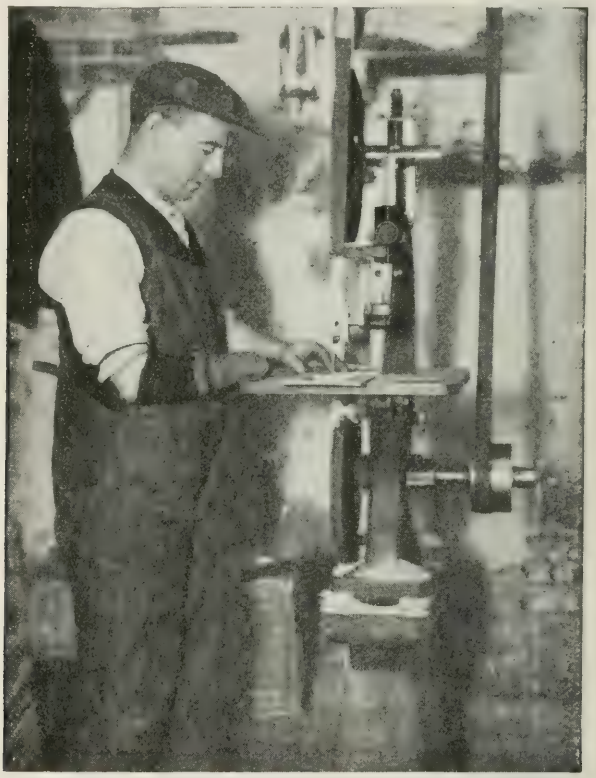


FIG. 75.—FORMERLY AN ENGINE-CLEANER: RIGHT HAND AMPUTATED; EARNING THIRTY-FOUR SHILLINGS WEEKLY ON BAND-SAW.

The Cordwainers' Company and the Worshipful Company of Carpenters have organized special courses of training, and the Institute of Electrical Engineers has started a special class of work for switchboard and sub-station attendants at the Northampton Technical Institute in Clerkenwell. Many existing educational institutions and technical

schools under local authorities have opened their doors to disabled soldiers, and private firms have also received men for training.

Very good work on a small scale in the agricultural training of discharged soldiers is being done under the direction of Mr. T. J. Young at the Holmes Chapel Agricultural College in Cheshire. Early in 1916, Sir Harry Verney's committee entered thirty men for a course of training in field and farm work, including non-commissioned officers and privates. The frontispiece represents a number of them engaged upon the potato harvest. The college, which is a public institution, and is under the joint administration of the University of Manchester and the Cheshire County Council, gives every facility for theoretical and practical training in all branches of agriculture, estate management, and forestry. There is a college farm with live-stock, poultry, and dairy, a garden of seven acres in which the students work, as well as a carpenter's shop and apiary. Mr. Young states that the work has been on the whole satisfactory. He recommends that a selection of men should always be made for work of this kind, and that those who do not promise well for it should be weeded out. It is necessary to provide an adequate staff of teachers, including a specialist who should devote himself to the care and training of the men, and he adds that a number of them require " concurrent treatment and education."

In Scotland, the Veteran Gardeners' Association is providing comfortable houses at a moderate rent for retired soldiers who are sufferers from the war. A block of these houses has been built and formally opened at Longniddry, between Edinburgh and North Berwick, and others are in prospect.

In none of the workshops or places of training above-mentioned, so far as the author is aware, is there any system of measurements in use, by means of which the capacity or incapacity, either of the man as a whole or of his injured limb, is checked and recorded, nor is physical treatment seriously associated with the period of training.

For the Blind.—A magnificent provision has been made for the care and occupational training of those who have been disabled by loss of sight. St. Dunstan's Hostel for Blinded Soldiers and Sailors was founded in Regent's Park by Sir Arthur Pearson, and opened March 25, 1915. There are class-rooms and workshops for instruction in boot-repairing, mat-making, net-making, basket-making, simple joinery, poultry-farming, market-gardening, and massage. The hours of work are two in the forenoon and two in the afternoon, and it is noticeable that games form an important part of the programme, as well as rowing and swimming for those able for them. Some of the teachers are themselves blind. The number of men under care and instruction (February 27, 1917) was 290. There is a branch establishment for officers, as well as annexes at Brighton and Torquay.

Canadian Work.—For a striking illustration of combined treatment and training, the reader may be referred to the "therapeutic work" carried on in the hospital and workshops of the Canadian Military Hospital at Ramsgate. Captain D. A. Clark, C.A.M.C., has described* the methods of the medical service at this hospital, which receives many cases of disablement of great chronicity, some of which have long resisted treatment and passed from hospital to hospital. A series of rooms is equipped with therapeutic apparatus, comprising various forms of electricity: "eau courante," needle, shower, plunge, and Scotch douche baths; and appliances for radiant heat and light. Massage is given under the supervision of the medical officer in charge.

The educational department comprises workshops and a gymnasium, as well as light duties of various kinds, athletic sports, and indoor recreations. The gymnasium is provided with a complete equipment of mechanical appliances and some original devices for the special education of individual muscle groups. The patient is placed under trained instructors with medical supervision, and enters one or more of the special classes or undergoes general exercise or Swedish drill. In the light duties he is encouraged

* Transactions of the Royal Society of Medicine, January, 1917.

to undertake some work suitable to his disability and agreeable to his personal inclinations. He may choose the ordinary hospital light duties, such as clerical work, ward duties, etc., or take a position in one of the departments of arts and crafts—the machine shop, carpentry, cabinet work, wood-carving, cigarette-making, printing, tailoring, cobblery, saddlery, market or landscape gardening, etc. Dr. Clark adds: "Apart from its therapeutic value, the educational department makes the hospital largely dependent on its own supplies. The splints, surgical appliances, and a large part of the gymnasium apparatus, are constructed by the patients, and the carpentry and cabinet work, electrical and motor repairs, etc., are carried out by them. In this way the patient's interest is diverted from himself, his aches and pains; he is happier and more contented, and his recovery is all the more rapid."

Military Orthopædic Hospitals.

The same invaluable principle of combining treatment with training has been introduced in the new military orthopædic hospitals under the direction of Colonel Robert Jones. With this movement throughout the country H.M. King Manoel is honourably associated, and the disabled soldier owes much to his tireless energy and devotion. At the great Military Orthopædic Hospital at Shepherd's Bush, the writer was shown a man who had been a smith before the war, and was recovering from a gunshot wound of the right shoulder, but still unable to abduct his arm. He was welding iron at the anvil (Fig. 76.) Another with an injured arm was making splints (Fig. 77); and others with dropped foot were working with the lathe. In addition to the workshops, the ordinary work of the hospital may be made to provide employment for partially disabled men. For example, at Shepherd's Bush on November 24, 1916, no less than 406 of the patients were so employed.

The workshops at Shepherd's Bush were opened on October 16, 1916. The average daily attendance of men

(February 28, 1917) was eighty. The shops include carpentry and fret work, leather work and boot-making, tailoring, painting, plumbing, electrical work, and engineering, a smithy, and an orthopædic workshop for the manufacture of splints and appliances. Workshops for " curative manual treatment " are also being erected at the military orthopædic centres at Cardiff, Bristol, Leeds, and Liverpool; in Ireland at Dublin and Belfast, and in Scotland at Ban

FIG. 76.—WOUNDED MEN AT WORK IN THE REMEDIAL WORKSHOPS, MILITARY ORTHOPÆDIC HOSPITAL, SHEPHERD'S BUSH.

Smith with gunshot wound of shoulder-joint.

gour, near Edinburgh; at the Scottish National Red Cross Hospital at Bellahoustoun, near Glasgow; and the Old Mill Hospital, Aberdeen.

It is important to observe that the above workshops are not for *occupational* training, but simply for the *functional* restoration of injured parts, in accordance with the now recognized view, that not only does properly selected work assist the recovery of the limb, but that the mental influence it brings to bear helps to expedite recovery.

Re-Education of Disabled Soldiers in France.

Considering the vast size of armies at the present time, and the variety of peace-time avocations that they represent, it is obvious that any efficient scheme of training for occupations must needs be, not only almost national in conception and extent, but very wide and elastic in its scope. The same urgent problem presents itself on both sides of the Channel, and the experience both of England and of France

FIG. 77.—SPLINT-MAKER WITH STIFF ELBOW AT SHEPHERD'S BUSH.

cannot fail to be helpful to all who in either country are called upon to deal with it. In a recent visit (January 1917) to the chief centres for physical treatment and training in the neighbourhood of Paris and Rouen, the writer was struck by the admirable efforts that are being made to cope with this matter. As in England, they date chiefly from 1916. It is noticeable that they impartially include in their scope both discharged men and the wounded soldier; that many men are in the course of their convalescence referred to the workshop or to open-air work, who

afterwards are able to return to military duty; that the training is for the most part entirely voluntary; and also, which seems to be of primary importance, that the training itself is very varied in character.

The French scheme of re-education may be illustrated by a short description of four of the centres in and around Paris. They are the work of a voluntary society, in close co-operation with the military government of Paris. The former supplies the money and organizes and administers the training; the state provides medical care and supervision.

The evolution of these centres may also show the growth of the idea of re-education in France, an idea which is now held to contain a solution of the problem of the disabled soldier by providing for his future security and happiness.

Early in the war a society came together called the Union des Colonies Etrangères en France en Faveur des Victimes de la Guerre, composed, as the name suggests, of people from all nations who had made their home in France, and who wished to show their gratitude to her wounded soldiers in a practical and constructive way. They began by starting a bureau for placing disabled men in situations, at the same time maintaining and educating certain others in technical schools. It soon became evident, however, that something much bigger than this was needed to meet the need. By good fortune, at this juncture they met with the active co-operation of M. Justin Godard, the Under-Secretary of State in charge of the Army Medical Service. A wing of the Grand Palais, at that time a vast hospital, was lent by the Service de Santé Militaire for workshops, in which technical and intellectual education could be added to the physical treatment already there provided, so as to insure for each man a new start in life, not only with all possible restoration of his physical powers, but with a training of his hand or mind which should launch him anew in some self-supporting occupation.

The workshops at the **Grand Palais,** of which there are now about twenty-four, were opened on June 15, 1916,

and training is given in the following branches of work, among others:

1. Industrial: Shoe-making, soap-making, harness work and saddlery, hair-dressing, wig-making, furriery, carpentry, tinsmith's work, joinery, printing, tailoring, engineering, retouching and enlarging of photographs.

2. Intellectual: Shorthand, typewriting, bookkeeping, drawing, writing, English.

The workshops are under the medical care of Dr. Vallée.

Some months later, as it was considered desirable that many of the men should live, not in the city, but outside it, another centre for re-education for men who had lost one or more limbs was opened by the same committee at **Maison Blanche,** Neuilly-sur-Marne, under the care of Dr. Kresser. The classes and workshops are very similar to those at the Grand Palais, and include basket work, leather work, wood-carving, French polishing, wood-turning, and training as shepherds. The last three are original to Dr. Kresser, who believes greatly in having many different occupations to attract men of all tastes. He hopes also to teach oxy-acetylene welding. The average length of stay at the hospital is only two or three months, after amputation and before artificial limbs are fitted, and attendance at the school is entirely voluntary.

Discharged soldiers who either have no families or who come from the invaded regions of France are dealt with at the Quai Debilly, Paris, where the committee later on opened a hostel. More than half of these men attend as out-patients at the Grand Palais, where they take courses of functional and occupational re-education.

Last but not least important of the valuable efforts of this committee is the agricultural school of re-education which was opened at **Juvisy** in July, 1916. I tstands on high ground about twenty miles south of Paris, and consists of a farm with 112 acres of fertile land, with more land available. It is intended to accommodate 500 selected men. The usual physical treatment by baths, electricity, and exercises, is provided in a large central hall (see Fig. 78), and

side by side with this a full training is given in all agricultural and open-air pursuits. The medical treatment occupies, perhaps, one hour a day, and the rest of the time is given to agricultural training. The place is by no means complete, but when finished will include dog-rearing, the care of horses, cows, pigs, poultry, game; cheese-making and dairy work; raising of fruit and crops; bee-keeping; market-gardening and intensive horticulture; the study

Fig. 78.—Physical Treatment at Juvisy.

of agricultural motor tractors, etc. Figs. 79 and 80 represent a number of wounded men digging. Fig. 81 shows some of the hutments for the men.

By the courtesy of M. Louis Asscher, of the Union des Colonies Etrangères en France, the author is permitted to give the following figures showing the number of men under re-education at the above four centres on December 31, 1916: At the Maison Blanche, 309; at the Quai Debilly, 98 discharged soldiers, of whom about 50 attend at the Grand Palais; at the Grand Palais, 355, not counting the

men from the Quai Debilly; at Juvisy, 76; in all, 738. To this figure may be added 1,094 pupils already re-educated and returned to civil life, making a grand total of 1,832. The Committee's Labour Bureau had, up to the date just mentioned already placed 655 men.

The scheme of re-education followed at the foregoing centres is under the general medical supervision of Dr. Jean Camus, Director of Physical Treatment under the Military Government of Paris, and enjoys the enthusiastic support

FIG. 70.—WOUNDED SOLDIERS AT JUVISY.

and co-operation of him and his colleagues. Some general features of these centres may be briefly mentioned. Though all the authorities concerned seem to be unanimous in their wish that the training might be compulsory, in practice this has been found too difficult, and the scheme rests upon a voluntary basis. Men are encouraged to train, but they are not forced. It has been found that one of the best ways of securing new students for the classes is to get some enthusiastic pupil, possibly a man who has lost his leg or arm, to go among his comrades in the hospitals and do a

little propagandist work. They will listen to him, and believe him disinterested, though they might not be so sure of others, especially civilians. Naturally, under a voluntary scheme, there are some men—perhaps 20 per cent.—who fail to attend regularly. Little or no notice is taken of a first or second offence, but after a man has been absent a third time he is dismissed from the school, unless he has some satisfactory explanation to offer.

FIG. 80.—WOUNDED SOLDIERS AT JUVISY.

There are, of course, many in the hospitals who have acquired habits of idleness, and who never even enter their names for training. Only about one-third of the soldiers in the Maison Blanche, for instance, take advantage of the opportunities so freely offered, in spite of all efforts to attract them. The rest live a demoralizing life of idleness or worse after the daily medical treatment is ended. To prevent as many men as possible from following in this disastrous path, the subject of re-education is in France kept well

before the disabled soldier by means of posters, illustrated lectures, photographs, etc., and on discharge from the army every man is given a booklet, drawn up either by the Ministry of War or by the Ministry of the Interior, containing lists and details of all the schools of re-education in the country to which he can apply for training, and exhorting him to avail himself of one of them.

Many of the workshops above described, such as the soap-making class, are self-supporting, or nearly so, as the pro-

Fig. 81.—Hutments at Juvisy.

ducts have a good sale in the open market. For example, £60 worth of soap from the Grand Palais shop was sold in one month. Others are run at a considerable expense, but this is considered well worth while. Each pupil is paid a small sum for his work, beginning at 10 centimes (1d.) per hour. At the Maison Blanche 1 franc a day is given. The teachers, who are themselves often maimed soldiers, receive 5 to 6 francs a day and board. As an inducement to save, a plan has recently been carried out by the committee, by which 25 per cent. is added to a

man's money if he allows it to accumulate. In this way he often has quite a substantial sum laid aside at the end of his training, with which to start in his new trade or profession. The hours of work in the schools are from six to eight per day.

In France special effort is made to place a man, so far as possible, in his previous work, or in employment nearly allied to it. If he has lost his right hand, he often learns to do the former work with the left hand. It is thought in this way to disturb local industries as little as possible, and it is also considered a great advantage to keep a man in his old home and his familiar trade. In the Belgian institutes, as will be noticed immediately, the principle of free choice holds a more important place. One cannot speak of the French re-education as "vocational" in the same sense as the Belgian work may be so described.

Medical care is considered a very important factor in this work, especially, perhaps, at the Grand Palais. Each man on arrival at the hospital, and at intervals afterwards, is most minutely measured in respect to the degree of his general or local incapacity. The angles of movement of the affected joints are marked down, and graphic records are made by means of the dynamo-ergograph, which records the force, rapidity, and amplitude of movements of the joint or muscle, together with fatigability. This information is considered to be of much help in deciding the nature and amount of work a man should undertake in combination with his other treatment, and in deciding also whether he has reached the stage when a trade training should be recommended. At the Grand Palais the men are still under military discipline, so that work can be prescribed on medical grounds. It can be truthfully claimed that re-education is carried out not only methodically and on a large scale, but scientifically. From the medical point of view, the best results in restoration of function to the limbs would undoubtedly be obtained by compulsory training combined with physical treatment.

It may be added that in France no soldier's pension, once

granted, is subject to reduction if he learns to become self-supporting. But the disabled soldier whilst awaiting final discharge from the army receives a provisional pension (*gratification*). He comes up for periodical medical examination, and his *gratification* may increase or diminish according as his physical infirmity becomes more or less serious * (see p. 193).

It may be here noted that in England disabled men are discharged from the army before their treatment is completed and therefore when the condition of ultimate disability is still doubtful. It may well be asked, Why should a fixed and final pension be allotted for a doubtful disability? Inasmuch as in most cases the mind as well as the body is temporarily disabled to a greater or less extent, there is every reason why the wounded man should be given the strongest possible motive to exert and develop his powers. A final pension stamps the incapacity as final, and may put a serious obstacle in the way of recovery. On medical grounds it would surely be better to grant a minimum pension or gratuity in all cases, and to increase it at intervals, especially when, upon examination, improvement under treatment and training had been obtained. In this way the will-power, which is often uncertain in its operation, would be enlisted on the right side. By some such method the help of the State would be given not only to the *helpless*, but, which is equally important, to those who *helped themselves*; and these are the men that need encouraging.†

It is regarded as a disquieting symptom in France that more and more countrymen disabled in the war are choosing occupations in the towns. These Frenchmen realize for one thing that it has been they who have largely manned the trenches and done the actual fighting (60 per cent. of

* See report by Sir Henry Norman, Bart, M.P., on the "Treatment and Training of Disabled and Discharged Soldiers in France." H.M. Stationery Office, 1917, p. 6.

† Since this chapter was written, Mr. Barnes (Minister of Pensions) has foreshadowed a scheme under which it is proposed that the payment to a disabled man of his full pension will be contingent on his following the treatment prescribed for his disability.

the maimed are agriculturists), while the town dwellers often did less dangerous and more lucrative work at home, such as making munitions. They are also attracted by the more lively town life, with its companionship and cinema entertainments. Special efforts are therefore being made in some quarters to keep agriculturists on the land. For example, if a farm labourer has lost his leg or arm, and can no longer dig, he is taught bee-keeping, market-gardening, or some other work on the land for which he is still fitted. Instruction is also given in motor mechanics, so that these men will be able to drive and mend their own agricultural tractors.*

There are in France now over 100 centres of occupational re-education, twenty-six of which are under the Ministry of Agriculture. Besides these, ten special centres of " surgical equipment and re-education " are being organized by the Ministry of War for men *before their discharge from the Army*. The centres of occupational re-education are at present still under diverse authorities, although a co-ordinating scheme was planned as long ago as March, 1916, and a central authority created, the National Office for Mutilated and Discharged Soldiers (95, Quai d'Orsay). The aims of this central body, not yet fully realized, are stated as follows by Sir Henry Norman:

" 1. To keep a register of every soldier who by reason of wounds or illness resulting from the war has thereby suffered an important and permanent diminution of professional capacity; his civil status, his military situation, the nature of his invalidity, his previous occupation, and the new occupation he may have adopted because of his invalidity.

" 2. To maintain a list of work and employment available to disabled soldiers, distinguishing the kinds of employment suitable for each type of invalidity.

" 3. To co-ordinate all information received from institutions dealing with disabled soldiers, and keep a statistical record of situations filled by them.

" 4. To collect all legislative and other documents re-

* Sir Henry Norman, *loc. cit.*

lative to the treatment of disabled soldiers in France and abroad.

" 5. To unite in a common effort all departmental and local organizations for the welfare of disabled soldiers."

Many schools of re-education have been founded and are supported by the state. The Institute of **Saint-Maurice** on the Seine is one of the most important of these. It is under the Ministry of the Interior, and consists of two parts: (1) A military hospital with centre of surgical equipment; (2) a school of re-education for the disabled of the war, opened on May 1, 1915, under the directorship of Dr. Bourrillon.*

" This school is attended by the men who are undergoing treatment in the adjoining hospital, but it is also freely open, so far as its accommodation permits, to all discharged soldiers and sailors recognized as incapable of returning directly to their previous employment. They may come as boarders or as day-scholars, the latter being those whose families live in the neighbourhood. During this time, those who are in receipt of a provisional pension of 1·70 francs per day pay 1·20 francs of this to the school, keeping the remaining 5d. as pocket-money. When they receive their final military discharge and pension, they are admitted gratuitously. Boarders are provided with board, lodging, washing, lighting, and heating. Day-scholars receive 5d. a day, and keep their pension as well. Half of all pensions is retained, to be given in a single sum when the student leaves. The hours of work are eight per day. When men produce goods which are sold, they receive the balance, less 10 per cent. left after deducting the cost of raw materials. Prizes are given for special diligence, and these often take the form of an outfit of tools for the trade which has been learned. The disabled man chooses what trade he will be taught, and may change to another if he thinks he could do better at it.

* In compiling the following brief account of Saint-Maurice, Lyons, and Ondes, as well as that of the French School for the Blind, the author by kind permission of Sir Henry Norman, has made free use of his report already referred to.

Any man is free to leave at any moment, only moral pressure being applied to induce him to stay until he is really equipped to earn a living. The punishments for idleness or intemperance are deprivation of leave, of pocket-money, and (what is especially felt) of wine at meals. Incorrigible laziness or intemperance is punished by expulsion. Diligent work is required. 'The institute is a place of instruction, and not a refuge for the idle.' The occupations taught are those of commercial clerk, tailor, bookmaker, leather worker, tinsmith, architectural and mechanical draughtsman, land-surveyor, and mechanic to drive or repair agricultural motor-tractors, etc. Every effort is made to persuade a man to be trained to resume his former trade, or one resembling it, where his special knowledge would be of value, but the Director will not have men trained as chauffeurs. He holds that far too many men are seeking this employment, and that the employment of men with disabled limbs for this job will inevitably result in serious accidents."

Brief reference must also be made to the remarkable and important **Ecole Joffre** at Lyons, which was the first school of re-education to be founded in France, and which was opened under the authority of the Municipal Council on December 16, 1914. It is chiefly due to the vision and practical ability of M. Edouard Herriot, Senateur du Rhone and Mayor of Lyons, who at the beginning of the war formed a committee to consider the future of the disabled soldier, and immediately set about putting into practice the decisions arrived at. This pioneer school is under the Ministry of War, and receives a State grant of 3·50 francs per man per day (total cost 5 francs, per man). Only men awaiting discharge from the army are admitted—that is to say, those for whom medical treatment can do little more. Most careful examinations are made at the school to make sure (1) that the man cannot by medical treatment be made fit to resume military duty, and (2) that he is fit to stand the work of the school. Men suffering from tuberculosis, alcoholism, and syphilis, are rigorously excluded, as also are those whose mental and moral qualities make them

unlikely to prove serious and satisfactory students. In spite of these severe conditions of admission, there are more applicants than can possibly be received.

The training is long—sometimes as long as fifteen months—and most thorough. The specialities are book-keeping, making of artificial limbs, furriery, toy-making and wireless telegraphy; but many other branches are taught, including agriculture at the newer and allied Ecole de Tourvielle, a pleasant estate of 17 acres not far away. As the pupils have no pensions, the school authorities at present make them a grant of 1·25 francs a day, and they can also earn money by the sale of their work. Those who have been longest in the school, and are most proficient, receive two-thirds of the latter money, the rest one-third. It is to the interest of all that output should be as large as possible. At the end of his training a man receives a diploma, which guarantees his having reached a certain standard of efficiency in the work studied, and when he leaves he usually takes a very good place in his trade or profession. The Ecole Joffre accommodates 100 soldiers: the Ecole de Tourvielle 185 (at December 1, 1917).

Typical of a State School of Agricultural Training is that at **Ondes,** in the Haute Garonne. "This has ninety beds, the course of instruction lasts three months, and 300 men per year receive an agricultural training. A hospital and small equipment of physio-therapy are attached. The agricultural allied subjects taught are farm and vine-yard work, nursery-gardening, horticulture, blacksmithing, carpentry, and basket work. Both written and oral examinations are held, and a diploma is given. Of 66 disabled men, 39 presented themselves for examination, and 37 obtained the diploma. The examiners expressed their satisfaction—indeed, their astonishment—at the scope and accuracy of the knowledge acquired. An Employment Bureau has been established, and not only have all the re-educated men who desired it been placed in situations, but there are many more places offered than men to fill them. But the Director's report to the Ministry of War contains

the following strong passage to the same effect as opinions already quoted from other schools: ' It appears to us indispensable that the disabled man should be re-educated while he is still a soldier—that is, while still subject to military discipline. Once become a civilian, the disabled man, almost in spite of himself, has but one wish—to return home, even if he vegetates there.' "

A few words must be added about two schools for the re-education of blinded soldiers in Paris.

1. The **Maison de Convalescence,** in the Rue de Reuilly, was opened in March, 1915, by the Ministry of the Interior, though it is also under the Ministry of War, some of the inmates being undischarged soldiers. It receives a State grant of 2·50 francs per man per day, and has 233 beds. The training is in some cases purposely long, as speed in work is aimed at as well as a knowledge of the trade. Many handicrafts are taught, as well as some recreations, such as music and fencing. Some original occupations, such as barrel-making and wireless telegraphy for fishing vessels, are also taught, and the Director (M. Emard) proposes to set up others (*e.g.*, the grinding and polishing of glass stoppers for bottles). About 300 men have already returned to civil life, trained in some self-supporting handicraft. A very personal element is added by the co-operation of a charitable society called L'Œuvre Les Amis des Soldats Aveugles, which supplies an outfit of tools and some raw material to every soldier who is leaving, and cares for his after-happiness and welfare in many ways.

2. **Le Phare** (Lighthouse) de France, in the Rue Daru, was started by Miss Winifred Holt, an American lady with long experience of work among the blind in the United States of America. It is supported with funds from America. Forty-three officers and men there live a happy family life in a pleasant neighbourhood, and twenty more come in daily for training. Besides some of the usual occupations, instruction is given in mathematics, foreign languages, weaving, artistic pottery, etc., by which blinded men who do not need to earn their own living can be trained to live an occu-

pied and happy life. The men are provided with light canes, and by means of these can move about quickly and easily without accident. It is hoped that other Lighthouses will be set up in other parts of France.

The Measurement of Disablement.—In a previous chapter (see p. 184 *et seq.*) some description has been given of the instruments employed for the periodical measurement of disabled limbs, and for obtaining graphic records of muscular power and fatigue.* No account, however brief, of the methods of re-education of disabled soldiers in France would be complete without a special reference to the work of Professor Jules Amar, Director of the Laboratoire des Recherches sur le Travail Professionnel at the Conservatoire National des Arts et Métiers in Paris. Before the war Dr. Amar had made many original investigations into what may be called the " physiology of work." Since the war he has devised ingenious apparatus for measuring and recording the muscular power and fatigue of disabled soldiers, and especially for educating the stump of an amputated limb, both in its motor and, what is equally important, in its sensory functions. Figs. 69 and 70 represent his *arthrodynamometer* and "*dynamographic pear.*" Other machines are designed to train a man, who has lost an arm, in the accurate use of various sorts of tools. Amar's specialized system of prothesis—that is, the provision and education in the use of artificial limbs or apparatus—has been followed at some of the French schools of re-education, and is stated to have been widely adopted in Italy and in Russia during the war.

The views of this pioneer in the scientific re-education of the wounded may be summarized as follows:

" Re-education is a question of science and method . . . it unites medical and technical knowledge. . . . We must provide a small laboratory attached to the training school. . . . It is in the laboratory that the analysis of the workman's movements is made, in relation to their regularity, direction, speed, and to the force that they expend. The

* For full account of graphic methods in use at the Grand Palais Hospital see Dr. Vallée's *Mensuration d'Impotences*, Paris, 1917.

measure of the man's physical incapacity, maladroitness, or disability, is deduced from impressions which have been gathered together in this manner, and which point out the method of training for which he is fitted. Furnished with his card of qualifications, the disabled man passes to the workshop, where experts instruct him in theory and practice. . . . In fine, all or nearly all of our disabled soldiers need vocational re-education, which will require the co-operation of the competent departments—the departments of Trade and of Commerce—which, in association with the medical staff, are charged with the duty of providing for an industrial situation of the highest importance.

"We must strive to overcome the tendency of the disabled man to indolence. He must be made to understand, and he will easily grasp the fact, that work alone is the regenerator and sole fortifier of his body and mind. It alone furnishes the material resources for a livelihood, and those moral resources which in him especially excite our admiration. *A too prolonged stay in hospitals and convalescent homes is the true cause of idleness . . . it deprives the man both of muscular power and of the will to work.* In the case of loss of a limb, the condition is accentuated by the atrophy of the stumps condemned to inactivity. The re-education of the joints and muscles, followed by exercises in his trade, designed to secure for each individual a maximum output of energy, must begin before medical treatment is finished. . . . Eighty per cent. of the maimed are capable of vocational re-education. . . . The restoration of lost power is only of value as a preparation for a useful work or occupation."*

Belgian Institutes for Re-Education.

The Belgian Government, since its temporary location in France, where the Belgians are engaged in "preparing the

* See "La Ré-Éducation Professionnelle des Blessés et des Mutilés de la Guerre," Jules Amar, *Revue de Métallurgie*, Paris, October, 1915; also statement by Dr. Amar in the "Special Bulletin of the Military Hospital Commission of Canada," Ottawa, April, 1916.

social and economic reconstruction of their country,"* has set up under the Ministry of War a centre for Orthopædic and physical treatment at Bon Secours, near Rouen. With this centre is closely associated the centre for vocational training at Port-Villez, near Vernon.

Hospital at Bon Secours.—This hospital, under the direction of Dr. de Marneffe, is beautifully situated on high ground overlooking Rouen. There are fifty buildings, each capable of accommodating thirty men. The physical treatment includes hydrotherapy, electro-therapy, and mechanical treatment, and great importance is attached to medical gymnastics on the Swedish system. In this last department the staff comprised in January, 1917, seven diplomates from Stockholm, five voluntary helpers (one medical man, and four medical students), under the general direction of Miss Loveday. About 300 men were at that time under daily treatment in the gymnasium, 400 were using the mechanical apparatus, and about 500 per diem had electrical treatments. The hydro-therapy comprises *eau courante* and vapour baths, and a good installation of douches. Fleximeters and dynamometers are used for measuring and recording the condition of the limbs. A large workshop attached to the hospital gives employment to seventy men. Among other things manufactured for the use of the Belgian Army are splints and artificial limbs and apparatus for mechanical treatment.

Institute of Re-Education at Port-Villez.—The great Institut Militaire Belge de Ré-Éducation Professionnelle des Grands Blessés de Guerre at Port-Villez, near Vernon (Ure), is regarded as a *unit of re-education* sufficient for an army of, say, 200,000 men. It is designed to accommodate

* See "Institut Militaire Belge de Ré-Éducation Professionnelle des Grands Blessés de Guerre. Reports by the Medical Director, Dr. Lejeune, and others; with an Introduction by M. Leon De Paeuw, Chief of the Civil Department of the Ministry of War, and Educational and General Inspector of Schools for the Wounded; August 21, 1916. To these reports and to M. De Paeuw's remarkable and interesting address at the conference held at the Ambulance of "L'Océan," at La Panne, January 15, 1916, the author is largely indebted for the facts detailed in this section.

1,500 men, and many of the convalescent wounded who are unfit to return to military duty are referred to it from Bon Secours.

The Belgian Government decided in November, 1914, that disabled soldiers should not be *discharged* during the war, but declared *candidates for discharge*, with a provisional pension of 2s. per day. Many who had been previously discharged were, consequently, at that time recalled to the army. By this means all disabled men were thenceforward kept under military regulations, although many are allowed out on probation and take situations. As regards occupational training, admirable private efforts were made, but it soon became evident that a large and national institute was necessary. A Belgian proprietor near Vernon offered his estate on a wooded plateau above the Seine. For convenience, healthfulness, and beauty, it would be hard to excel this site. It consists of forest land of 875 acres, with quarries of building stone. Water has been supplied by an Artesian well. The buildings have been erected in an open situation, and are five miles from the town, to which the men often go down in the week-ends. The absence of retaining walls gives the place an air of liberty. "How important," says M. De Paeuw, "are surroundings in their effect upon the minds and temperaments of men who have suffered, and perhaps been embittered by their sufferings! Life in the midst of Nature is good for them. Calm and regular work help to restore their balance. The beauty of the place penetrates them, despite themselves, and they submit to it unawares. The moral and the physical act and react one upon another." Furthermore, the men are removed from the unwholesome distractions and the bad counsel and kindly meant yet weakening commiseration to which they are sometimes exposed if dwelling in the towns; and they are placed in surroundings fitted to arouse the "primordial desire for work." The healthfulness of the air at Port-Villez is evidenced by the fact that usually less than 1 per cent. of the community is on the sick list.

The houses (Fig. 82) are eighty in number, in three parallel

rows. All are well warmed and ventilated, and two of the rows are devoted to general and physical treatment, with the educational and technical service and workshops, whilst twenty-eight buildings, each containing thirty-five beds, are reserved for accommodation of the wounded. The institute is under the general direction of Dr. Lejeune, who undertakes the medical supervision, and "whose mission it is to make sure that the wounded who are confided to his care shall receive a functional and occupational re-education as perfect and complete as possible." With him

FIG. 82.—VIEW OF THE INSTITUTE FOR RE-EDUCATION AT PORT VILLEZ.

are associated a School Director (Mr. Alleman) and a Technical Director (Captain Haccour). In the technical service are utilized about 350 men who are militarily unfit from age and physical causes, who serve as instructors in general education, as assistants and teachers in the workshops, and also as producers for the market.

The first disabled pupils entered Port-Villez in August, 1915. There are now (January, 1917) about 900, with a permanent official staff of 461. Within the first year 1,709 men were admitted into the institute.

Upon arrival at Port-Villez, the wounded man, after receiving a hearty welcome, goes before a board of doctors for a searching examination. Forms are filled in, showing his military and social position, the nature and extent of the lesion, the functional result to which it has led, as well as his general physical and mental condition. The treatment to be followed and sometimes the apparatus to be used or made, are also noted. As already mentioned, the artificial limbs are sent up from Rouen, but a large quantity of orthopædic apparatus is manufactured in the workshops at Port-Villez, including sometimes as many as sixty pairs of orthopædic boots in one month.

The new arrival then proceeds to the Educational Instructor, who records his condition as regards general education. He is advised to spend half a day looking round the shops, to make inquiries of other men and of the instructors, and to see what is being done and what he would like to do. Often a tour of the shops suffices to fix his choice. The following day he goes before the Committee of occupational Direction, which minutely examines the reports already made on his physical and mental condition. In the advice then given to each man, the committee acts on the following principles: (1) To keep him in his former trade if it was to his liking, if it is remunerative, and if his wound does not unfavourably affect his capacity for it. (2) If it is necessary to change it, to keep him as far as possible in an allied occupation. (3) If he is no longer fitted for industrial work, or if he has intellectual qualities which might be made more use of than formerly, he is advised to take up an administrative or commercial training, or to study as a teacher. Sometimes latent talents and tastes are discovered, and a true vocation is found, which the man has never before had an opportunity of following. It may even happen that a man's economic position may be better after re-education following disablement than in his former life. The strange discoveries often made show how great a waste of talent may take place in ordinary life by the haphazard and unconsidered choice of a career, to the detriment of the national industry and arts.

As at all centres of re-education, there are at Port-Villez two categories of wounded. The first class require physical treatment, but they also as a rule follow the work prescribed for them in the workshops. There are, secondly, a large number of men who have been wounded a long time, and who need only medical gymnastics and daily work and training.

Functional Re-Education by Physical Treatment.—The methods employed, under the chief direction of Dr. Govaerts, comprise mechanical treatment by means of a series of apparatus made up by the wounded at Bon Secours, electrotherapy, hot air and medical gymnastics, with massage and games. Each patient is first of all examined and submitted to physical tests to show the maximum effort which he can put forth without injury. Individual medical gymnastics are then commenced, following the system of Ling, beginning usually with passive methods, and passing on insensibly with a minimum of resistance to active movements. He then joins one of three classes for instruction in movement (1) of the upper limb, (2) of the lower limb, or (3) of the head or trunk. After two or three months of this preparatory treatment he has usually received the maximum amount of functional re-education of which his lesion permits. He then enters a class where group movements are taught. Games are chosen which develop the defective action of muscular groups. Throwing the disc, games of ball, fencing, running or jumping, may definitely fix the improvement already attained. In cases of paralysis or amputation, sports may be chosen which develop the sound member—for example, fencing with the left arm. Here and at Juvisy and the Grand Palais the writer was struck by the good provision made for re-education in walking, the crutches being discarded. First came bending and balancing movements; then the placing of the feet on marked planks, the toes being straightforward or turned out; then stepping over removable obstacles of any height, or up or down inclined planes, to bring about flexion and extension of the ankle. By such means not only the functions of locomotion,

but those of equilibrium, are re-established. Dr. Lejeune remarks that a special class exists for the training of men with an artificial leg, and these men, numbering forty, had made an excursion of four miles.

As respects the education of the stump of the arm or leg this is effected in the same manner as that recommended by Professor Amar. A willow sheath is fitted to the stump, and varying weights attached by a cord and pulley; so that flexion, extension, abduction, rotation, etc., can be practised to prevent atrophy of the muscles, and to train those that will hereafter move the artificial limb. In course of training the stump is practised with weights much heavier than the limb in preparation, so that when the artificial member is applied the man feels much ease in carrying it, and can use it without fatigue.

Functional Re-Education by Work.—The experience of Port-Villez confirms the opinion, everywhere met with in centres of re-education, that the good results obtained by physical methods are often promoted and increased by the man's own efforts in the workshop or the field. In his daily work,he continues to mobilize the defective parts, improves nutrition, prevents atrophy, and attains the completest possible functional repair. Without daily exercise in work the wounded limb is often left motionless for fear of pain. In lesions of both the upper and lower limbs excellent results are obtained *in the shops*. Fitting and carpentry encourage movement from the shoulder to the wrist; basket work, shoe-making and saddlery, develop the power of the fingers. In lesions of the lower limb there is a tendency to adopt sedentary occupations, but it must be remembered that this may result in permanent immobility and ankylosis. Many wounded in the lower limb have done well in occupations requiring prolonged standing, and even active locomotion, such as printers' composition, sabot-making, joinery, and the care of automobiles. Such men have also been found competent as telephone attendants, hall porters, etc.

Laboratory Investigations into Work.—Studies in the

scientific aspects of work and occupation are carried on by Dr. Nyns, and are valued as a guide to rational methods of training. Without such guidance much energy may be wasted by the worker. Useless and harmful efforts must be suppressed, and the best conditions found for each man's productive capacity. From this point of view it is often advisable for partially disabled men to be supplied with special machine tools. The graphic methods of Marey and some of Professor Amar's instruments (see Chapter XIII.) are employed in this research. Accurate measurements are taken of movement, muscular energy, and fatigability, both before and after therapeutic work.

Vocational Re-Education.—Large schools, says M. de Paeuw, with many sections and sub-sections, are preferable to small ones teaching only one or a few trades. A wide field of choice not only attracts many tastes, but is more likely to provide for all degrees of incapacity and disablement. A week usually suffices to show whether the man has chosen the right trade. The doctors closely watch the efforts, and note the fatigue and aptitude of beginners. The efforts made must not destroy the physiological balance, and muscular expenditure must be economized. Above all, the worker's interest must be aroused and maintained, and it is generally found that *useful* work is the most stimulating to the mind. Lessons are given on the nature of the materials used, their defects and purchase price, also on the tools and methods employed in a trade and the price of finished products. The educational and technical directors meet the monitors and heads of workshops each week. A lesson is given in some technical subject, and a discussion takes place in which fresh experiences and observations are brought forward and new ideas especially welcomed. Sometimes special workshops are opened as a result of suggestions by the workmen.

In the first twelve months goods to the value of 950,000 francs were supplied from the workshops of Port-Villez, by the activity of forty-eight trades. The average cost per pupil for instruction, keep, and medical care, amounts to

1·54 francs per day. There is an allowance of 43 centimes daily to each man, and those who work in the shops also receive wages of from 5 to 20 centimes an hour. Many men deposit a portion of their earnings in the bank of the institute.

Scope of Instruction.—The scope of instruction at present includes—Working in wood (carpentry, carving, making of walking-sticks, fret work, etc.); in iron (fitting, turning, casting); in leather (shoe-making, saddlery, and harness-making); in stone (quarrying, masonry, stone-cutting, sculpture); industrial design (handwriting, stained-glass work, sign-painting, engraving, sketching and painting from life, decorative painting, designing); typography (printing, lithography, linotyping, photography, photogravure, book-binding); besides basket work (coarse and fine), tailor's cutting-out, furriery, tanning of skins, leather-dressing and glove-making, tapestry and furnishing work, brush-making, electrical work, building and architecture, motor engineering, motor driving and repairs, hair-dressing, training as bakers, butchers, pork-butchers; general education (two hours a day); and bookkeeping. The accounts and bookkeeping of the whole school of re-education are kept by pupils in those branches of study—an excellent preparation for factory management on a small scale. English, typewriting, and shorthand, are taught, and pupils prepared for the public services—railways, postal service, Customs, and banks—and for provincial and communal posts. It is expected that public bodies will in future probably give preference to men who have suffered from wounds in war, and it is hoped that the training of so many wounded citizens may produce as one of its results an increased efficiency and thoroughness in public administration.

The Belgian authorities agree with the French in urging the importance of preserving the elements of country and village life by every possible means. For this reason trades that are needed in the village are especially encouraged. There is particularly good instruction in many branches of agriculture and horticulture—for example, in the breeding of cattle at a farm on the estate; the rearing of rabbits,

game, and poultry; bee-keeping: dairy produce and cheese-making; market-gardening; fruit-growing; landscape-gardening; the management of crops, etc.

In the winter season, when practical work is sometimes difficult, instruction is given in the theory of agriculture—on market-gardening in general; the growing of flowers, fruits, and trees; also on agricultural chemistry and the economic side of farming and gardening. Of the ground round the school, one-third is devoted to a nursery-garden, for which many French and English firms have given valuable gifts; the remainder is given up to allotments, landscape-gardening,

FIG. 83.—THE SCULPTURE ROOM, PORT VILLEZ.

and personal gardens for the men. The space between the huts has also been made particularly ample, so that there may be gardens there for the pupils, "for all soldiers without distinction take to gardening" (Fig. 84). The study of arboriculture and the practice of archery are favourite Sunday occupations.

A large public hall (270 by 97 feet), capable of holding 1,500 men, has been constructed by the men's own labour. It is designed for all purposes for which men come together. At one end is an altar and choir, which can be screened off; at the other end is a space for the orchestra and band, and a stage where cinema and other performances are frequently

given. The emblematical paintings and stained-glass windows were all designed and manufactured in the workshops. This room exhibits not only a deep national and artistic feeling, but much fertility of design. A winter-garden and reading room opens out of the hall, and commands a wide view of river and country.

The Ideal Place for Treatment and Training.

The writer has been led to touch thus briefly upon the great and urgent question of vocational or industrial re-education, because it is impossible, in his opinion, to resist the conclusion that physical treatment is in its very nature inseparable from it. The aim and object of physical treatment is the *preparation* of the wounded and mutilated soldier for work in the large acceptation of that term. And for this governing purpose all physical agencies — massage, electricity, medical gymnastics, mechanical treatment, baths and douches—not one or two of these remedies in isolation, but all of them in a natural and harmonious association, can operate with powerful effect.

Treatment and training have been found in actual practice to go very well together. Both are rather slow and tedious processes, making a considerable demand on time and patience. Both have the same purpose—the re-education and restoration of lost powers. Treatment alone for a period of months is a wearisome process. Training introduces an object and an interest, and a new value. And as treatment is aided by training and work, so training in a large number of cases is greatly facilitated by daily treatment. Baths, massage, or electricity, not only promote the general health, but also prevent the stiffness and pain that would otherwise result from fatigue in the injured limb. So far from being exclusive one of another, training and treatment for the wounded are supplementary and necessary one to another, like the two wings of a bird.

What, then, is the appropriate place or places for this last stage of recovery ? In an industrial country, the work-

shop naturally suggests itself. But large numbers of wounded come from the country districts. Are all these to be re-educated for the towns? Again, it will be desirable and necessary for many men, on grounds of health, to choose an occupation in the open air. This is another matter in which medical opinion may well have the deciding voice.

Quite apart from the economic and national considerations* involved, there is every reason on medical grounds to go beyond the workshops and re-educate men for occupations in the open air and on the land.

FIG. 84.—GARDEN SPACES FOR THE MEN, PORT VILLEZ.

Those who, like the present writer, have visited a great centre of treatment and training *in the country*, like that at Port-Villez or Juvisy, cannot fail to realize the powerful influence that such a centre must have on the future of the disabled soldier who is privileged to have a share in it. Not

* "Now I come to the third and perhaps the most important direction in which we can assist the country to overcome its difficulties, and that is the production of food-supplies. Twenty years after the Corn Laws were abolished in this country we produced twice as much wheat as we imported. Since then four or five million acres of arable land have become pasture, and about half the agricultural labouring population has emigrated to the Colonies. . . . Between 70 and 80 per cent. of our staple cereal supply has been imported yearly" (Mr. Lloyd George on home food production, House of Commons, February 23, 1917).

alone the actual treatment and training, but the atmosphere of the place and its surroundings, have a healing and soothing power over mind and body. To the more obvious elements of cure is here added another, which may sometimes be absent elsewhere—namely, that the *circumstances are favourable* to mental and physical recovery. Therefore it would seem that the choice of a locality for such a community is a matter of the first consequence. It is impossible not to hope that for the British soldier, also, the same skill and personal care may be made available, in equally favourable natural surroundings; and that for this purpose the State may yet provide, with the money and the skill at its command, a sufficient number of centres to restore to the country all who have been wounded and disabled in its service.

CHAPTER XV

PHYSICAL REMEDIES AT THE BRITISH SPAS

Considering that the chief spas in Great Britain and Ireland are not more than fifteen in number, and that some of these are as yet comparatively undeveloped, it is remarkable that so great an amount of work has been already accomplished by their aid in the physical treatment of wounded soldiers. Excellent results have been obtained from waters and baths, and from the accessory physical treatments which are usually associated with them. Many practitioners at the health-resorts have devoted themselves to the scientific application of these physical remedies to the cases, both surgical and medical, which have been referred to them in large numbers from the hospitals. At some of the spas, instead of a few scores of invalids of the wealthier classes, there are now many hundreds of disabled soldiers. The direction of the treatment of this new class of sufferers demands of the medical man not less care and skill and special knowledge than he was accustomed to use in times of peace. It is true of the spa practitioner as it is of medical men in general, that in dealing with the disabilities which result from war he must diligently seek for new methods or modify old ones to meet every exigency.

At the spas and other health-resorts circumstances have suddenly brought into prominence an unfamiliar department of special practice. That which in times of peace had been the chosen field of a few hydrologists has become in a few months the daily concern of a large number of practitioners. And they are called upon to advise as special-

ists in the use of hydrological and other physical remedies.

Such demands have never before been made upon the British health-resorts, nor upon those who minister to the sick resorting to them. The Section of Balneology and Climatology of the Royal Society of Medicine is the only scientific body in connection with the British spas and climatic stations. After discussion of the whole matter in January, 1915, it appointed a special Committee to prepare an authoritative statement on the employment of hydrological and allied treatments for wounded and invalid soldiers, to place the requisite information at the disposal of the War Office, and generally to promote the scientific application of these remedies to military cases in the British Islands. Among other publications, the Committee prepared and distributed a form of *case-record card* for use at all the health-resorts. In their opinion, the first requisite of scientific practice was an accurate measurement and record of cases according to a simple and uniform plan. After consultation with representatives of the Medical Research Committee, it was arranged that these cards should be agreed with other card records in general use, in order that it might be possible that the experience of medical men at the British spas should be collected and examined hereafter, and become the basis of a section in the " Medical History of the War." Such was the purpose with which the Committee, after consultation with representatives at the spas, made in 1915 at their own expense an issue of 20,000 cards. It will depend on those who are engaged in practice at the health-resorts, or in charge of mineral water hospitals, whether the scientific material at their disposal is preserved in a convenient and accessible form, and a worthy chapter on hydrological remedies is hereafter written.

The medicinal waters of the British Islands may be conveniently grouped as follows:

1. Thermal and subthermal waters: Bath, Buxton, Matlock Bath.

2. Salt-sulphur waters and sulphur waters: (*a*) Harrogate,

Llandrindod, Moffat, Builth; (*b*) Strathpeffer, Llanwrtyd, Lisdoonvarna, Lucan.

3. Brines and salt waters, some of the latter containing calcium, sodium, or barium salts: (*a*) Droitwich, Nantwich, Northwich; (*b*) Woodhall Spa, Bridge of Allan, Leamington. Ashby-de-la-Zouche, Llangammarch, Cheltenham.

4. Iron waters: Harrogate, Strathpeffer, Llandrindod, Tunbridge Wells, Flitwick, Trefriw.

5. Solvent waters, with small mineral content: Malvern, Pitkeithley, Coulsworthy, Church Stretton, and others.

A summary account of the several British spas, with notes of the indications proper to each, and of their service for wounded and disabled soldiers, is here given. It should be remembered that the climate of a health-resort modifies the effect of all treatment by baths.

1. Thermal and Subthermal Waters.

Bath (Somerset).

Waters.—Hot or thermal (104° to 120° F.), radio-active, containing a considerable proportion of calcium sulphate and carbonate, and nitrogen; tonic and diuretic. Well-appointed deep thermal baths and douche-massage, vapour baths, and accessory appliances. The premier thermal spa of the British Islands, and well adapted by climate for thermal and sedative treatment.

Climate.—Mild, equable, and sedative; in summer suitable for persons requiring a high thermal treatment, but well adapted for weakly and debilitated subjects in winter, autumn, or spring.

Indications.—(1) All forms of chronic rheumatism, fibrositis, and arthritis; (2) stiffness and diminution of movement after wounds and palsies; (3) neuritis; (4) wasting after lesions of the nerves; (5) traumatic neurasthenia; (6) frost-bite. Subinflammatory and congestive gouty states of the connective tissues are often relieved by the baths, and vascular and nervous degeneration may be arrested or mitigated.

War Service.—From the beginning of September, 1914, to February 8, 1917, 15,000 treatments have been given at the Bathing Establishment to 948 cases, mostly officers. At the Royal Mineral Waters Hospital 1,720 non-commissioned officers and men have been received for treatment, and 40,000 treatments given. A military hospital with a department for physical treatment was opened at Bath April 24, 1916.

Buxton (Peak District of Derbyshire).

In contrast with the thermal and sedative treatment of Bath, Buxton offers a more stimulating and subthermal treatment.

Waters.—Subthermal (82° F.), radio-active, containing bicarbonate of calcium and magnesium, and much nitrogen gas; diuretic and alterative; also a mild chalybeate. Bathing establishments well equipped for baths and auxiliary treatments, swimming and immersion baths, douches, effervescing and peat baths.

Climate.—More bracing than that of Bath, Buxton being the highest town in the kingdom (1,000 feet). Season, April to September, but the baths are open throughout the year. A stimulating spa, well adapted to conditions of weakness the result of chronic disease.

Indications.—(1) All forms of chronic rheumatism; (2) neuritis; (3) sprains and strains; (4) stiff joints after wounds; (5) gout.

War Service.—Since the beginning of the war, over 15,000 free treatments have been given to wounded and invalided officers and men. From October, 1914, to August 14, 1916, 1,926 cases were admitted to the Devonshire Mineral Waters Hospital, representing—rheumatism, sciatica, and neuritis, 80 per cent.; injuries, 11 per cent.; neurasthenia, 2 per cent.; trench foot, 1 per cent.; unclassified, 6 per cent. Up to October 7, 1916, the V.A.D. Hospital at Buxton has received 354 patients for spa treatment, who have had in all 5,812 treatments.

A Canadian Red Cross military hospital, the first colonial hospital set up in connection with a British spa, was opened at Buxton on May 16, 1916, for disabled Canadian soldiers, who were considered likely to derive benefit from the waters of Buxton. The following return, kindly furnished by Major Frederick Guest, C.A.M.C., the Officer Commanding, will be read with interest. Up to the end of August, 1916, 370 patients were admitted. These were classified as follows: Rheumatism and kindred complaints, 226; injuries, 126; neurasthenia, 4; trench foot, 4; unclassified, 10. The results as stated on September 30 were—Total number discharged, 173, of whom 103 were "successful cures," 197 remaining in hospital.

A minute of the Buxton Baths Committee, confirmed and approved by the Town Council on August 17, 1916, reads as follows: "All officers and men invalided or wounded, below and inclusive of the rank of Lieutenant, to be allowed mineral water treatment free; above the rank of Lieutenant, to be allowed same treatments half-price."

Matlock Bath (Derbyshire).

Water.—Subthermal (70° F.); feebly mineralized, chiefly with lime salts; well adapted for the douche-massage. There are three well-equipped bathing establishments: (1) The Royal Hotel and Baths at Matlock Bath, where the water has its source; (2) and (3) Smedley's and the Rockside Hydropathic Institutions.

Climate.—Mild, and suitable for treatment all the year round; situated in the beautiful valley of the Derwent.

Indications.—Rheumatism and neuritis; injuries of nerves, muscles, and joints; neurasthenia.

Free bath treatments are offered to officers, who are taken at reduced terms.

2. Salt-Sulphur Waters and Sulphur Waters.

Harrogate (Yorkshire).

Waters.—A large number and great variety of sulphur and muriated waters, in which the proportion of salt varies from 3 to 13 parts per mille. Some of these springs are therefore hypertonic with reference to blood-serum, which contains about 9 per mille of salines, and are consequently purgative in their action, like the Old Sulphur Well. Certain other springs, having but little salt, contain carbonates of calcium and magnesium, and exert, if anything, an astringent action on the intestinal mucous membrane. Associated with the sulphur waters are also chalybeates, in which the iron is found as carbonate, sulphate, and chloride. Sulphur, douche, peat, effervescing, vapour, and other baths, besides intestinal lavage. The equipment for hydrological and accessory treatments is on an unusually extensive scale. Baths open throughout the year. Season, May to September.

Climate.—Dry and bracing, the summer season being comparatively cool. Situation upon an open and elevated tableland (400 to 600 feet). A bracing spa, cold in winter. The cool, dry, and bracing air has an important influence in the treatment.

Indications.—(1) Muscular and articular rheumatism and gout, especially robust cases and those requiring increased elimination; (2) dietetic dyspepsia, constipation, hæmorrhoids, and disorders of the liver; (3) anæmia, and many toxæmias; (4) unhealed wounds.

War Service.—The total number of treatments given by the Harrogate Corporation since the outbreak of war, up to August 29, 1916, is 34,296. Of these, as nearly as possible 20,000 were given at the Royal Baths, and 14,296 at the Royal Bath Hospital. At the latter institution the various treatments are made up as follows: Sulphur baths, 6,667; needle baths, 2,883; massage douches, 1,110; douche baths, 1,636; Berthollet (local vapour) baths, 2,000. It is

stated that probably about half the total number of treatments were given for "rheumatism," sciatica, and neuritis. The treatment has been given free to non-commissioned officers and men, and at half-price to commissioned officers.

Llandrindod Wells (Mid-Wales).

Waters.—Salt and sulphur, some of them containing 1 to 14 volumes per mille of sulphuretted hydrogen gas. The proportion of chloride of sodium, 1·1 to 4·7 per mille, places these waters among the *hypotonic* group, with reference to the fluids of the body. They present, in fact, a natural saline solution in a convenient and assimilable form, gently aperient and strongly diuretic. There is also a muriated chalybeate water. There is a good installation of sulphur, effervescing, douche, and other baths.

Climate.—Dry, bracing, and invigorating. Season, from May to October.

Indications.—Catarrhal digestive disorders, constipation and jaundice, nervous fatigue, gouty and rheumatic affections, and injuries.

War Service.—The Highland Moor Red Cross Hospital was opened for wounded and invalid soldiers on July 27, 1915, and from that date until October 19, 1916, 307 cases were received for spa treatment. At the Rock Park Spa Hospital 500 military cases were treated, and 133 at nursing homes.

Moffat (Dumfriesshire).

Waters.—Sulphur and muriated, 0·9 per mille.

Climate.—Pleasant and sheltered; suitable for invalids both in summer and winter.

Indications.—Rheumatic and gouty affections, the climate being appropriate for cases in which pain and nervous irritation are a prominent feature. The Bath Establishment and Hydropathic afford some facilities for hydrotherapeutic treatment.

Builth (Brecknockshire).

This place possesses a muriated sulphur water of definite medical value.

Strathpeffer Spa (Ross-shire).

Waters.—Very strongly impregnated with sulphuretted hydrogen gas, 40 to 60 volumes per mille. Two of the springs are also rich in lime salts, powerfully diuretic, but slightly constipating and tonic. There is also a chalybeate water. Sulphur, peat and effervescing baths, douches, and electrical treatment.

Climate.—The most northerly spa, in a sedative but stimulant, translucent air, combining marine and moorland influences. Season, May to October.

Indications.—(1) Rheumatism and gout; (2) nervous breakdown, concussion and shock; (3) digestive and cutaneous affections; (4) mixed cases of wounds and rheumatism. Neurasthenia and climacteric disturbances, and especially the disorders and debilities of age, are often helped by the sheltered, cool, and bracing climate.

War Service.—The Nicholson Mackenzie Mineral Waters Hospital was registered as a special hospital for the treatment of rheumatic cases, and opened for soldiers on January 9, 1915. From that date to October 21, 1916, 150 cases were received and treated. Of these, one-half were "practically cured," and returned to their units.

Llanwrtyd (South Wales).

Waters.—A valuable and strongly sulphuretted water, 36 volumes per mille, well adapted by its abundant yield for sulphur baths.

Climate.—Pleasant and equable. A quiet spa amid fine hilly scenery.

Indications.—The waters are useful both internally and externally for chronic skin affections—eczema, psoriasis, and seborrhœa; also for gout, rheumatism, and gastric dyspepsia, and as baths and lotions to promote the healing of wounds.

LISDOONVARNA AND LUCAN (IRELAND).

Lisdoonvarna (430 feet), in County Clare, the westernmost of British spas, has sulphuretted waters, 5 or 6 volumes per mille. The climate is mild, equable, and tonic-sedative. The indications are the same as for other sulphur waters, with a preference for gouty and digestive disorders.

Lucan is another sulphur spa, in the valley of the Liffey, eight miles from Dublin. The resources of both these spas have been as yet but little developed.

3. Salt Waters.

Strong salt (muriated) waters or brines abound in England, and in many places are employed for baths.

DROITWICH (WORCESTERSHIRE).

Waters.—A nearly saturated brine, 307 parts per mille, or ten times as strong as sea-water; radio-active, providing a powerful stimulant surface treatment, by means of immersion baths, douches, and local applications. The baths are open throughout the year.

Indications.—(1) Fatigue fever, rheumatism and fibrositis, traumatic and otherwise; (2) lumbago and sciatica; (3) nervous shock and neuritis; (4) frost-bite in the non-ulcerating stage; (5) convalescence.

Both post-arthritic and traumatic stiffness and contraction are assisted by the Droitwich baths, with which active and passive movements of the limbs may be combined. This is done the more easily in the Droitwich baths because of the high density of the water. Many persons who cannot bear whole baths may be relieved by local hyperthermal salt applications, which are at present too little employed in this country.

War Service.—Since the beginning of the war up to August 16, 1916, the trustees of the Corbett Estate have given 17,102 free treatments to disabled sailors and soldiers.

NORTHWICH and NANTWICH in the salt districts of Cheshire,

have also strong brine baths, and similar baths are given at Malvern and Stafford.

Saltburn-by-the- Sea, on the East cliffs, in an open and bracing situation, combines the advantages of sea-air with a good installation of brine baths.

Woodhall Spa (Lincolnshire).

Waters.—Hypertonic salt waters, 20 per mille, with calcium and magnesium. Salt and douche, effervescing, vapour, and radiation baths and intestinal lavage. When vaporized or pulverized, the water is employed locally for chronic rhinitis and pharyngitis.

Climate.—Dry and rather warm in summer; favourable to thermal treatment.

Indications.—(1) Rheumatism and arthritis, strains and injuries of joints; (2) nervous shock, neuritis, and sciatica; (3) cardiac failure; (4) slowly healing wounds.

War Service.—From the beginning of the war to October 25, 1916, treatment by waters and baths was given to 30 officers and 237 non-commissioned officers and men, who received in all 3,617 treatments.

Bridge of Allan (near Stirling).

Waters.—Nearly isotonic, containing a large quantity of chloride of calcium, 4·4 per mille, with some sulphates and carbonates. Turkish and medicated baths at the Allan Water Hotel.

Climate.—Mild, equable, and sheltered; suitable for respiratory and bronchial affections in winter and summer.

Indications.—The waters are beneficial in dyspepsia, venous engorgement and catarrh, rheumatism and gout.

Leamington (Warwickshire).

Waters.—These are nearly isotonic with blood-serum. In addition to chloride of sodium, nearly 10 per mille, they contain alkaline and calcium sulphate, the latter giving them their diuretic quality and rendering them tonic to the

gastric mucous membrane. Turkish, effervescing, brine, and douche baths. Open most of the year.

Climate.—Comparatively warm and dry; pleasant in winter and autumn.

Indications.—Dyspepsia and hepatic disorders, particularly in persons from hot climates; glycosuria and gout; also chronic rheumatism, stiff joints, sciatica, and lumbago.

War Service.—In the twelve months 1915-16 upwards of 3,000 treatments were given to 250 officers and men.

LLANGAMMARCH (MID-WALES).

Waters.—Contain chlorides of sodium, calcium, and barium, the latter 0·1 per mille.

Climate.—Bracing and moorland; comparatively cool in summer. A very quiet spa.

Indications.—The waters are adapted for indigestion and catarrh, and on account of their barium content have been used both internally and externally for cardiovascular disorders.

CHELTENHAM (GLOUCESTERSHIRE).

Waters.—Aperient, containing sulphates and chlorides. One of the springs is stated to be alkaline, containing bicarbonate of soda. Bath treatment may be obtained.

Climate.—Warm and sheltered; suitable for invalids in the autumn, winter, and spring.

Indications.—Dyspepsia, hepatic disorders, and chronic gout.

War Service.—It is stated that at the Cambray Spa more than 2,000 military cases were treated free of charge by electric light and massage, in 1915 and 1916.

4. Iron Waters.

In addition to those of HARROGATE, STRATHPEFFER, and LLANDRINDOD, the following may be mentioned:

TUNBRIDGE WELLS (Kent) has a dry and invigorating climate in open country, at an elevation of from 400 to 600 feet.

Flitwick (Bedfordshire) has a remarkable spring, containing about 2 parts per mille of the persulphate of iron. These waters are only to be had bottled.

Trefriw is situated on the Conway River, in North Wales, in beautiful scenery. The water is of much interest, containing a considerable quantity of protosulphate of iron—2·4 to 5·4 parts per mille—together with lime salts and silica. It is used internally and also for baths, and can be prescribed for cases in which an assimilable form of iron and calcium salts is indicated. The climate is mild, and the treatment may be followed throughout the year.

5. Pure and Solvent Waters.

Certain almost " pure " waters are truly " medicinal," on account of their high solvent power. In England, the St. Anne's Well at Malvern is the most remarkable example of this class. It is of much value as an eliminant, and would form a very efficacious " cure " if taken at the source. Malvern stands at an elevation of 300 to 900 feet, and possesses a rather dry and bracing climate, with an air of extraordinary purity. There are facilities for brine baths and hydro-therapeutics. The " indications " include nervous depression and exhaustion, convalescence after operation, rheumatism and gouty disorders, and debility, especially in elderly subjects.

Note.—The author desires to express his indebtedness, for various information in this chapter, to—Mr. John Hatton, Director of the Hot Mineral Springs, Bath; Mr. J. M. Scott, General Manager of the Thermal Mineral Baths, Buxton; Mr. F. J. C. Broome, General Manager of the Wells and Baths, Harrogate; Mr. J. H. Hollyer, of the Corbett Estate Office, Droitwich; Mr. C. Ravenhill, Manager of the Royal Leamington Spa; Mr. Ruck, Cambray Spa, Cheltenham; and to Dr. Lionel Calthrop, Woodhall Spa; Dr. John Murray, Llandrindod Wells; and Dr. Edward Duncan, Strathpeffer.

CHAPTER XVI

BRITISH MARINE RESORTS AND CLIMATES

A VERY important class of physical remedies is made up by those that belong to climate. The influence of climate and change of air in convalescence and chronic maladies is proverbial, and it may often be as powerful in checking incipient disease as in completing the recovery from protracted illness. Again, periodical changes of air and climate are indispensable for many elderly and debilitated persons, to enable them to continue in reasonable health and activity. Lastly, it should be borne in mind that to these familiar and direct effects of climate have to be added others less often recognized. These are the powerful but indirect effects of climate in modifying the action of other forms of physical treatment. That is the reason why similar baths, for example, may have a different action upon invalids at different health-resorts.

The coasts of the British Islands present a unique wealth and variety of marine health-resorts. As may be supposed from their varying positions, these differ widely in respect of all the elements of climate—in their aspect and exposure to winds, in temperature, humidity and sunshine, as well as in the quality of the air and of the soil. Some of them owing to local configuration of the land, are especially exposed to, or sheltered from, the open sea and the prevailing winds, and therefore have a local exposed or sheltered climate, which may be of medical importance.

As regards *temperature*, the first element of climate, the warmest places are to be found in winter along the western

coasts. These coasts are unaffected by the south-flowing polar currents, and protected from easterly winds by the intervening land; and, above all, they lie open to the air of the Atlantic and to the Gulf Stream. The south-westerly winds and currents are relatively warm in winter, and also relatively cool in summer. For this reason they greatly mitigate the changes of the seasons in the localities where they prevail. All the western fringes of Britain—Cornwall and Wales, the West of Scotland, and the whole of Ireland—are within their sphere of influence. The Atlantic is, indeed, so effectual a heat-carrier that the northernmost extremity of our western shore at Cape Wrath is as warm in winter as the Isle of Wight. A glance at the maps giving the isothermal lines for the British Islands in January shows that the distribution of heat is almost unaffected by latitude. Taking the average for day and night, the same winter temperature (42° F.) prevails at Sidmouth, at Tenby, up the west coast of Wales, across the south and west and north of Ireland, and northwards to the island of Mull and the Outer Hebrides.

The English south coast, from its aspect, is naturally more sunny than the west, but it is not quite so warm, since it is more affected by the easterly influence. Some towns, like Ventnor and Torquay, are warmer than others on account of exceptional shelter, or because they stand upon a southern slope.

A little farther up the Channel are the south-eastern resorts, which form a well-defined group, from Brighton to Westcliffe-on-Sea. They have a rather complex climatic character, in which the southern and eastern influence are variously mingled. The blend of sedative and tonic qualities makes them valuable for health for rather robust subjects, both in winter and summer. Some of these, like Hastings and Westcliffe, enjoy a shelter or aspect which gives them a southern rather than an easterly character, and makes them peculiarly appropriate for invalids in autumn and in winter.

A chain of summer health-resorts dots the whole eastern

coast of Britain, some of them very warm and sunny in summer, but most of them cold in winter. Invalids cannot, therefore, find winter resorts along this coast.

The marine health-resorts of the British Islands may be conveniently grouped as follows:

(1) *North-Western;* (2) *South-Western;* (3) those of the *South Coast* of England; (4) *South-Eastern;* (5) those of the *East Coast* of England and Scotland.

Nearly all places belonging to the first four groups may be described as winter as well as summer stations. The entire coast of Britain is a summer health-resort.

For a more complete account of the climates of the British Islands, as well as for a detailed description of the various localities, the reader is referred to the works mentioned at the close of this chapter.* It must here suffice to summarize the chief features that have a medical importance in the climate of each section of the coast, based upon the observations made at some typical stations. Some notes are added upon the individual characters and indications that attach to the chief members of each group.

It should be borne in mind that all these places offer to the health-seeker some definite and particular climatic influences, together with more or less provision for baths and other accessory physical remedies. Some persons are disposed to consider all winter health-resorts as essentially very much of the same character. A similar opinion is sometimes expressed with regard to medicinal waters and baths. But in addition to larger differences of kind, they exhibit many differences of an individual character. There is, in truth, an individuality both in places and waters, as there is with persons. As with persons, so with health-resorts, the *differentiæ* can never be completely and satisfactorily stated. When the ordinary elements of climate have been taken into account, together with the influences belonging to situation, soil, aspect, shelter, and water-

* See, especially, "The Health Resorts of the British Islands," edited by Dr. Neville Wood.

supply, there still remain characters that it is difficult to define, but to which sensitive individuals, and especially invalids, react, and which undoubtedly affect them favourably or otherwise. It may be some at present indefinable quality in the air or in the water-supply, or some other influence belonging to the locality. Whatever the cause, some impression, probably complex and not as yet wholly explicable, is made upon the sensitive organization of the invalid, and brings from him the verdict, " This place does (or does not) agree with me." The proof of this observation is often repeated year by year. Facts of this kind sometimes almost suggest an affinity between persons and places like that between individuals. But whatever the explanation, there is no doubt that some *physical quality*, or combination of physical qualities, in air, earth, or water, has produced a favourable and healthful, or unfavourable and hurtful, reaction upon body and mind.

1. North-Western Group.

	Mean Temperatures.					For the Five Months.					
	Nov.	*Dec.*	*Jan.*	*Feb.*	*Mar.*	*Mean Temperature.*	*Mean Daily Range.*	*Relative Humidity.*	*Sunshine (Hrs.)*	*Rainfall (Ins.)*	*Rainy Days.*
Blackpool ..	43·5	39·4	38·3	39·1	40·7	40·2	9·8	87·4	339	14·0	87
Southport ..	43·2	39·4	38·6	39·4	41·4	40·4	9·5	—	331	13·0	83
Rothesay ..	43·5	40·1	39·4	39·8	41·1	40·8	9·9	—	—	18·6	101
Portrush .. (Donaghadee)	44·5	41·2	40·4	40·8	41·9	41·8	9·3	87·2*	—	13·7	97

* For Londonderry.

This section includes the west coast of Scotland, the north and east of Ireland, the Isle of Man, and the coast of Cumberland, Westmorland, and Lancashire. The climate of this region, like that of the west and south-west generally, is very equable, warm in winter, cool in summer, and showing in most places a comparatively small daily range of

temperature. For example, the winter mean daily range in Rothesay is just under 10 degrees. As regards winter warmth, the mean temperature of the invalid's winter (November to March) upon the north-west coast is 40·7° F. This is many degrees warmer than London, but 1 degree cooler than the south-east coast (for example, Hastings), 2 degrees cooler than the south coast of England (Bournemouth), and 4 degrees cooler than the south-west (Falmouth). The humidity and rainfall are about the same as in the south-west, rather more than on the south coast of England, and considerably more than on the south-eastern coast. It must be remembered that in dry climates there are daily great varieties of temperature, and that humidity is not only within limits beneficial in itself, but inseparable from an equable winter warmth.

Oban, on the Firth of Lorne, is exposed to the south and south-west, and sheltered by hills from easterly and northerly winds. The climate is of a typical west-coast character. The south-westerly winds and ocean currents to a great extent equalize the daily and seasonal variations of temperature. The annual mean temperature (48·3° F.) is very nearly the same as that of Bournemouth, and only 2 degrees lower than that of Torquay. The rainfall is comparatively heavy (52 inches), but owing to the warmth of the prevailing winds and the well-drained and sandy subsoil the relative humidity of the air (84·8 per cent. for the whole year) is not high. The warm and sheltered climate of Oban permits many delicate flowering shrubs—myrtles, fuchsias, rhododendrons, azaleas, and others—to grow luxuriantly throughout the year. The same is true of other south-western stations in the south and west of Ireland, and in Cornwall and Scilly.

Rothesay (Island of Bute).

A very mild and sedative climatic health-resort, in beautiful scenery near the west coast of Argyllshire, very pleasant from March to June and in September and October. As

at Oban, the air is considered beneficial for nervous convalescents, and for chronic renal and cardiac affections. Baths may be obtained at the hydropathic establishment and at the swimming baths. The mild and humid atmosphere, as in the Channel Islands and in Cornwall, seems to be rather favourable to children and to old persons, although not so desirable in the middle period of life. The longevity of many of the residents in winter resorts of this character is quite remarkable.

At Shandon in Argyllshire, the Hydropathic is beautifully situated on the Gairloch, and sheltered from north and east. The climate resembles that of Rothesay.

Grange-over-Sands (Morecambe Bay).

This is a sheltered resort on the northern shore of the bay, and open to the south-west. The climate is mild, and well-adapted for invalids in the winter months. Like Blackpool and Southport, it has facilities for hydro-therapy. Physical treatment of this kind may often be combined with an appropriate change of air in autumn or winter, with much advantage. The indications are those belonging to most sheltered members of this group: Chronic bronchial catarrh, pulmonary tuberculosis and asthma, and convalescence and insomnia in nervous subjects. The place is not recommended for rheumatism.

Blackpool, St. Anne's, and Lytham (Lancashire).

Blackpool is a very bracing health and pleasure resort, rather windy, facing west. The climate is considered favourable at all seasons of the year for chronic catarrhal affections of the nose and throat, and chronic bronchial catarrh in young subjects; also for slight functional disorders of the nervous and circulatory systems.

St. Anne's-on-the-Sea is a much quieter and more restful resort, a few miles to the south, having rather similar climatic

characters, but more sheltered, and therefore in effect not so stimulating as Blackpool.

Lytham, a little farther south, is another comparatively restful place, with a southern aspect and well sheltered, suitable for spring and winter resort.

Southport (Lancashire).

Southport is a bracing and windy marine health-resort, facing south-west. The indications are the same as at Blackpool. The place is also esteemed for surgical convalescence and for sensitive nervous and rheumatic subjects. Hydro-therapeutic institutional treatment is available, and the Corporation Bath Establishment provides Turkish, vapour, and sea-water baths.

West Kirby, Cheshire, faces west upon the estuary of the Dee, having a mild and not moist climate, well suited for invalids in winter and spring. It is recommended for chronic cardiovascular, renal, and pulmonary disorders, but not for rheumatism.

In the north and east of Ireland there are several important marine health-resorts that may be placed in this group. The air on these coasts is fresh and mild, without extremes of temperature, and the rainfall is moderate in amount. Portrush, in County Antrim, is a very tonic and bracing place, facing north, beautifully situated on a rocky coast near the Giants' Causeway. Newcastle, in Dundrum Bay, on the east coast, is remarkable for its land shelter from winds. Bray and Greystones, south of Dublin, are also beautiful east coast resorts, comparatively dry and well sheltered. The winter climate of the Irish coast facing St. George's Channel is mild, and very different from the comparatively harsh and exposed eastern climates of England and Scotland.

2. South-Western Group.

	Mean Temperatures.					For the Five Months.					
	Nov.	*Dec.*	*Jan.*	*Feb.*	*Mar.*	*Mean Temperature.*	*Mean Daily Range.*	*Relative Humidity.*	*Sunshine (Hrs.)*	*Rainfall (Ins.)*	*Rainy Days.*
Torquay ..	47·9	44·6	42·5	42·7	44·5	44·4	9·6	84·6	428	15·6	80
Roche's Point (for Queenstown)	46·8	44·4	43·4	43·7	44·4	44·6	8·9	—	—	21·3	97
Jersey ..	48·4	44·4	42·5	43·0	45·0	44·7	8·6	88·4*	450	15·9	95
Woolacombe (for Ilfracombe and Westward Ho)	48·5	44·4	42·8	43·7	44·6	44·8	7·8	—	392	13·4	82
Falmouth ..	47·7	44·7	43·5	43·7	44·4	44·8	7·4	85·6	406	22·7	98
Newquay ..	48·1	45·2	43·5	43·7	44·2	45·0	7·7	86·0	397	15·5	95
Scilly (St. Mary's)	49·7	47·1	45·9	45·6	46·1	46·9	6·8	—	423	15·9	98

* For Guernsey.

This section may be taken to include the coasts of Wales, Somerset, Devon, and Cornwall, of the west and south of Ireland, as well as the Scilly and Channel Islands. Among this group are found the warmest winter climates of the United Kingdom, which approximate nearest to those of the French and Italian Riviera. In actual mean temperature the south-western resorts of Britain come within 4 degrees of Nice. But they differ widely from their southern rivals in the daily distribution of heat. On the British coasts cloudy skies make the nights warm, and the clouds that add warmth to the night cut off a proportion of sunshine from the day. Hence the *low daily range* and characteristic *equability* of the west, to which reference has been already made. On the Riviera the winter skies are more often cloudless, with warmer days and colder nights.

Aberystwith (Mid-Wales).

Aberystwith is in winter one of the warmest of the Welsh health-resorts, although the rainfall and humidity are comparatively low. It is protected by a chain of hills from the

north-east and south, and stands upon a gravelly soil. An abundant service of soft water has been taken from Plinlimmon. The indications are those proper for an equable and somewhat bracing climate.

Tenby (South Wales).

Tenby is built upon a rocky promontory of Carmarthen Bay, and is fairly sheltered from the north and north-west. The winter climate is remarkably mild and agreeable, with a good proportion of sunshine. It is to be recommended in medical and surgical tuberculosis, and for many cases of anæmia, albuminuria, and asthma, and for elderly subjects generally.

Weston-super-Mare (Somerset).

A sea-bathing resort with northern aspect, and situated on the Bristol Channel. The climate is dry and mild, and the place may be recommended for neurasthenia, anæmia, and albuminuria.

Ilfracombe and Woolacombe (Devon).

Ilfracombe is the chief health resort of Northern Devon, mild in winter, cool in summer. It is a sunny place, sheltered from the west, and suitable for catarrhal affections, scrofula, and retarded convalescence. The Cliffe Hydro is furnished with hydro-therapeutic appliances.

Woolacombe, with its fine sands, a little farther west, enjoys a similar climate.

Newquay and St. Ives (Cornwall).

Newquay is a rather bracing resort on the north coast of Cornwall, pleasant in the summer and autumn seasons.

St. Ives, almost at the extremity of this coast, is a quaint old fishing town facing nearly east, upon a picturesque bay. It may well be visited throughout the year by those who require a mild but rather stimulating air. This coast has been recommended for asthma.

Scilly (St. Mary's).

The Scilly Isles have the warmest climate in the United Kingdom, moist and equable, and typically marine in character. The semi-tropic vegetation in the garden at Tresco rivals that of the Riviera and Algiers. Such a climate is often helpful in the summer months to over-taxed and nervous persons, and for those affected with cardiovascular degeneration, if they are willing to spend their days quietly in boating and fishing.

Falmouth and St. Mawes.

Falmouth, formerly one of the chief ports of the kingdom, is beautifully situated on its famous harbour, facing south-west. The rocky headlands and undulations of this part of the Cornish coast provide much local shelter. The winter climate is one of the warmest and most equable in Great Britain, rivalling that of the south-west of Ireland. Like the Irish coast, Falmouth is fully exposed to the Atlantic winds, and the rainfall and humidity are consequently high, but the soil is porous and dries rapidly. For the same reason it is comparatively cool in summer. St. Mawes, on the other side of the harbour, has the same climatic character.

This district may be recommended for winter residence to those who ought to be much in the open air, and for whom a warm and sedative atmosphere is desirable, such as those suffering from bronchial and other catarrhs, with dryness and irritability of the mucous membranes, and chronic heart and kidney affections, with high arterial tension or failing compensation. Like other south-western resorts, it is an excellent retreat for persons who are injuriously affected by sudden changes of temperature, and by the bleak winds of the average English winter and spring. Climates of this kind are, however, contrary to the old opinion, to be avoided in cases of febrile tuberculosis.

Torquay and Babbacombe (South Devon).

Torquay is an attractive seaside winter resort, built upon ground rising from rocky cliffs and headlands, resembling a town of the Italian Riviera. It faces south and west, is sheltered from the north, and has a dry soil. It is said that Torquay enjoys the most sheltered climate upon the English coast, but on the hill-sides, where many of the houses are built, the air is stimulating, and not sedative as at sea-level.

The same remark applies to Babbacombe, which is situated on the edge of the cliff a little farther north, and with an easterly aspect. The winter at Torquay is considerably warmer than in London (4½ degrees), and the summer cooler. Sheltered walks and drives enable visitors to be much in the open air. Whilst the warmth and shelter may prove relaxing to young and vigorous subjects, Torquay makes an eminently suitable winter residence for elderly and weakly persons. The indications are those that rule for the entire group of health-resorts: Irritable neurasthenia, brain-fag, insomnia, premature senility, the early stages of cardiac, arterial, and renal degeneration, bronchial and other catarrhs, and sometimes asthma. It is worthy of note that rheumatic and gouty affections, for which the coast resorts are not always to be recommended, often do well at Torquay. The Corporation has added to the climatic advantages of the locality a well-equipped installation of medical baths.

Paignton and Brixham on Tor Bay, and Teignmouth a little farther north, present the same general climatic characters.

In Ireland the South-Western Group is well represented. Queenstown, on Cork Harbour, is well sheltered and very mild in winter, with a comparatively low rainfall (32·8 inches). Glengariff, farther west in Bantry Bay, has been likened in climate and situation to Falmouth, whilst Queens-

town is compared with Torquay. Both are true health-resorts both in summer and winter.

The CHANNEL ISLANDS have a very similar winter climate to that just described, with much bright sunshine.

3. Southern Group.

	Mean Temperatures.					For the Five Months.					
	Nov.	*Dec.*	*Jan.*	*Feb.*	*Mar.*	*Mean Temperature.*	*Mean Daily Range.*	*Relative Humidity.*	*Sunshine (Hrs.)*	*Rainfall (Ins.)*	*Rainy Days.*
Bognor ..	45·6	41·3	39·5	40·5	42·3	41·8	8·9	—	—	11·0	78
Bournemouth	46·9	43·1	40·5	40·9	43·3	42·9	10·5	86·0	453*	13·2	82
Sidmouth ..	46·9	43·7	40·3	41·6	43·1	43·1	10·5	86·2	—	13·8	89
Ventnor ..	47·4	43·2	41·7	42·2	44·1	43·7	8·6	85·0	413	13·0	76

* Ten years' average.

In point of temperature the English south coast is in winter about 2 degrees cooler than the south-westerly resorts; but, by way of compensation, it is rather more sunny. The amount of rainfall may be said, roughly, to diminish progressively from west to east. Therefore, in regard to humidity, the south coast group should occupy an intermediate position, being more dry than the south-western but not so dry as the south-eastern group.

SIDMOUTH (SOUTH-WEST DEVON).

Sidmouth is a restful and very sheltered station in a valley facing south-east. The soil is dry, and the rainfall considerably less than that of Torquay and Falmouth. The sunshine records are high. It is therefore suitable for conditions requiring a warm and comparatively dry sheltered winter climate—for example, catarrhal, cardiovascular, and some nervous ailments—and in many cases it is favourable for chronic joint troubles, rheumatism, and sciatica. There is a bath establishment, with douches and brine and effervescing baths.

Budleigh-Salterton and Lyme-Regis, like Sidmouth, are quiet resorts, standing upon dry soil and well sheltered by hills.

Bournemouth and Swanage (Hampshire).

Bournemouth is a winter and summer health-resort, facing south, on a dry and sandy soil. Central Bournemouth, nearly at sea-level, is a little sedative or relaxing, but on the East and West Cliffs the houses are at a higher elevation and much more exposed to the wind. The climate is dry and sunny, and there are pleasant sheltered walks. The abundance of pine-trees adds a healthful element to the air. It may be very cold in the latter part of the winter, but the air is generally clear, dry, and stimulating, on the higher ground. Persons who require a somewhat tonic winter resort often do well at Bournemouth, particularly those suffering from nervous exhaustion and depression and chronic pulmonary affections, without bronchial irritation, as well as convalescents from illness and operation. For gouty and bilious subjects the place is sometimes too stimulating for a prolonged stay. Turkish and sea-baths can be obtained.

Swanage, although only a few miles from Bournemouth, has a very different aspect. The town faces east, and has therefore a more open and bracing climate. The climate is well adapted for delicate children and the robuster type of invalids.

Ventnor (Isle of Wight).

Ventnor has one of the warmest and most equable climates on the coast of Britain, and in many respects is an ideal winter health-resort. The town is situated upon a very sunny and well-sheltered undercliff which extends for several miles along the coast. The soil is dry and porous. The climate of Ventnor and of the whole southern shore of the Isle of Wight is favourable for cases of subacute and chronic disease requiring rest and several hours daily in the open air. The aspect of the town, sloping to the sea, gives it a full measure of winter sunshine. When it is inadvisable

for visitors to leave the house, this open-air treatment can be given upon sunny balconies. The disorders that benefit at Ventnor include irritable neurasthenia, some chronic tuberculous and renal affections, anæmia, bronchial catarrh, and asthma. The air is favourable to relaxation and rest. Marine and radiant heat baths may be obtained.

SOUTHSEA, facing the Solent, is a pleasant seaside place for visitors in summer.

BOGNOR, in Sussex, is a quiet and sunny place, facing south, and sheltered by the Downs from the north and north-east. The humidity and rainfall are low. The air is considered beneficial in catarrh and for elderly persons and convalescents. With its fine sands and good air, Bognor makes an excellent resort for children.

4. **South-Eastern Group.**

	MEAN TEMPERATURES.					FOR THE FIVE MONTHS.					
	Nov.	*Dec.*	*Jan.*	*Feb.*	*Mar.*	*Mean Temperature.*	*Mean Daily Range.*	*Relative Humidity.*	*Sunshine (Hrs.)*	*Rainfall (Ins.)*	*Rainy Days.*
Margate ..	44·7	40·4	38·9	39·9	42·1	41·2	8·1	87·8	359	9·4	78
Hastings and St. Leonards	45·3	40·8	39·5	40·1	42·4	41·6	8·7	88·0	417	12·5	87
Worthing ..	46·2	41·6	39·0	40·2	42·1	41·8	10·5	86·8	424	11·8	74
Brighton and Hove	45·7	41·2	39·6	40·6	42·4	41·9	9·2	86·0	396	11·9	76
Eastbourne..	45·0	40·9	40·3	41·0	42·9	42·0	9·3	85·6	402	13·8	81

Attention has been already called to the combination of climates in the south-eastern coast resorts, which gives them, in varying degree, a tonic and sedative character. They resemble in this respect their *vis-à-vis* on the French side of the Channel, and the health-resorts of the Baltic and Norwegian coasts. All of these places have a clear, salt fresh air, rather dry and of a peculiarly stimulating quality to certain classes of invalids.

WORTHING, Sussex, is rather intermediate in character between the southern and south-eastern groups. It is a sunny and sheltered place, with rather low humidity and stimulating air.

BRIGHTON AND HOVE (SUSSEX).

The town is built on chalky soil, and sheltered from the north by the Downs, the long sea-front facing south and west. The rainfall is moderate and the record of sunshine high. The principal element in the local climate of Brighton is the keen and invigorating air, particularly in the winter months. The place is suitable for many invalids in the autumn and winter, but is useful all the year round. The indications are—Convalescence, neurasthenia, general debility and want of tone, anæmia, and the early stages of tuberculous disease. Douches, sea-water baths, and Turkish baths, can be obtained both at Brighton and Hove.

EASTBOURNE (SUSSEX).

A dry and sunny south coast resort, with a south-easterly aspect. The climate is favourable to convalescents and persons affected with glandular and tuberculous affections, or with injuries to the joints and bones, for whom a tonic and sunny marine climate may be advisable. There is a good bathing beach, and Turkish and sea-water baths can be obtained.

HASTINGS AND ST. LEONARDS (SUSSEX).

Hastings is a typical winter climatic resort, very mild, equable, and sunny. Hastings proper and the old town are milder and more sheltered than St. Leonards, being protected from the north by the Castle Cliff. In the winter time many invalids and convalescents can be recommended here, for whom a cold or very bracing air would be too stimulating. Such are cases of hypersensitive neurasthenia, rapid heart, atonic renal disease, and many catarrhal conditions. Hastings approximates to Falmouth and Torquay rather

than to Brighton or Eastbourne. But it is considered cooler and drier than the south-western resorts. A more bracing climate can be found on the hills above the town. The bath establishment provides Turkish and sea-water baths and a fine swimming bath.

Folkestone (Kent).

A sunny sea-bathing resort, sheltered by the Downs and with promenades enjoying protection from wind. Folkestone is frequented by invalids throughout the year, but the easterly soupçon in the air makes it too bleak for infirm people in the late winter and spring months. The climate is well adapted to those who require a tonic and bracing regimen—*e.g.*, depressed convalescents, suffering from anxiety, wounds, or shock—and is also helpful in the early stages of tuberculous disease, in many cases of insomnia, anæmia, etc. There is a bathing establishment, with Turkish and other medical baths.

Ramsgate and Broadstairs (Kent).

Ramsgate, on the south side of the Isle of Thanet, has a south-east aspect. It is more sheltered than Margate, and enjoys a larger proportion of winter sunshine. Turkish and sea-water baths may be obtained.

Broadstairs, intermediate in position between Ramsgate and Margate, is very quiet, but pleasant and sunny, and well suited for delicate subjects in the autumn and first half of the winter.

Margate (Kent).

Margate is the most bracing health-resort in Thanet, situated on its north-east coast, and lying open to the north-east. It is therefore not suitable for feeble patients in the colder months of the year. The soil is dry, and, in addition to good sea-bathing, there is a bath establishment at Cliftonville. Margate is suitable for convalescents who possess good powers of reaction, and especially for chronic tuberculous and other affections of the bones, joints,

and glands. It is a good tonic resort for persons "run down" and dyspeptic, and may be helpful in improving the general health before serious operations.

Southend, Westcliff-on-Sea, Leigh-on-Sea.

These places occupy a long line of sea-front on the estuary of the Thames. In consequence of their southerly aspect and the configuration of the land, they have a local climate of their own. It is much warmer, more sunny, and more sheltered in winter, than that of the east coast generally. The great feature in the climate of this portion of the coast is the quality of the air. There is no finer or more tonic air than that of Westcliff within an equal distance of London.

5. **Eastern Group.**

EASTERN GROUP OF MARINE RESORTS COMPARED WITH THE SOUTHERN AND WESTERN GROUPS.

	Mean Temperature.					*Rainfall in Inches.*	*Rainy Days.*	*Sunshine in Hours.*
	Jan. to March.	*April to June.*	*July to Sept.*	*Oct. to Dec.*	*Year.*			
Nairn	38·3	49·1	55·5	41·6	46·1	25·0	207	1,188*
N.W. Group ..	40·0	50·6	57·2	44·2	48·0	36·9	206	1,556
Scarborough ..	39·8	50·0	57·8	44·1	48·9	26·9	188	1,411
Clacton-on-Sea ..	39·0	51·1	59·9	44·5	48·6	19·3	149	—
Felixstowe ..	39·4	51·6	60·3	45·1	49·1	23·1	165	—
S.E. Group ..	40·7	52·6	60·7	46·0	50·0	27·6	167	1,767
S. Group ..	41·6	52·5	60·0	46·9	50·2	29·6	177	1,734†
S.W. Group ..	44·1	53·0	60·1	48·7	51·5	36·1	196	1,779

* Strathpeffer. † Ventnor.

Clacton-on-Sea (Essex).

Clacton-on-Sea has a nearly southern aspect, and is sheltered by cliffs from the north. This gives the place a milder winter than that of most east coast towns. The rainfall is very low and the soil porous; the air is remarkably free from fog and very bracing. The place may be recom-

mended in summer and autumn for convalescents from illness and operations, and in summer for pulmonary cases that require a bracing climate.

Walton-on-the-Naze and Frinton (Essex).

These are summer resorts having a more easterly aspect than Clacton, and therefore more exposed.

Felixstowe (Suffolk).

Felixstowe occupies a rather elevated position on a peninsula with a south or south-east aspect, and with a certain amount of shelter from northerly and easterly winds. The rainfall is low and fogs uncommon. A special feature of this part of the coast is the fine still season of autumn and early winter. During this period there are often many days continuously in which it is possible to spend the greater part on the beach in warm bright sunshine and still air, even in November and December. Later on, in the early months of the year, come easterly winds and cloudy skies, which are unsuitable for invalids.

Cromer, Overstrand, and Sheringham (Norfolk).

These are very bracing sea-resorts, cool in summer and facing north. They are contiguous, on a dry soil, and with a low rainfall. As in the case of some other east coast health-resorts (such as Felixstowe), the period of late autumn during the prevalence of westerly winds is sometimes very pleasant at Cromer. Sea-water and other baths may be obtained. These places may be recommended in summer and autumn for invalids requiring a tonic air, and for anæmic and tuberculous subjects.

Scarborough (Yorkshire).

Scarborough is an extremely bracing east coast resort, facing due east and in the vicinity of moors. It possesses an aperient sulphated water, and there are good facilities

for sea-bathing. A visit to Scarborough may be especially recommended to convalescents and to nervous and hypochondriacal patients in the summer season.

Saltburn-by-the-Sea.—(See Chapter XV.)

North Berwick, near Edinburgh, is a cool and bracing resort, with sea-bathing.

Nairn (North-East of Scotland).

Nairn is a pleasant and sunny, bracing Northern marine resort, open to the north-east and overlooking the Moray Firth, on a dry soil, with a very low rainfall and a cool summer season. The air of Nairn, as of the north-eastern district of Scotland generally, has a partly sedative and partly tonic quality, which is beneficial in nervous and mental fatigue, insomnia, and irritability. Catarrh and scrofulous affections and Graves' disease also do well at Nairn. The Sea-bathing Establishment provides salt, seaweed, and douche baths.

Peterhead (North of Scotland).

A good sea-bathing station, in strong Northern air, pure, dry, and very bracing, very pleasurable in the long days of the Northern summer. The air is both invigorating and soothing in conditions of nervous exhaustion, and sometimes beneficial in atonic dyspepsia and in anæmia. The bathing establishment has Russian, Turkish, and swimming baths.

British and Foreign Winter Resorts.

The table on p. 268 shows the climatic elements of some of the chief winter resorts—(1) Alpine, (2) marine, (3) desert—in comparison with the marine resorts of Britain. They are arranged in order of temperature, beginning with the coldest and Alpine stations. Then follow the British marine stations in their groups, the warmest being those of the south-west; afterwards come those of the French and Italian Riviera, Algiers (on the other side of the Mediterranean),

and Madeira; and last of all Assouan, as representing the health-resorts of the desert.

BRITISH WINTER MARINE HEALTH RESORTS COMPARED WITH THOSE OF THE RIVIERA, THE ALPS, AND THE DESERT.

	Mean Temperature.					For the Five Months.					
	Nov.	*Dec.*	*Jan.*	*Feb.*	*Mar.*	*Mean Temperature.*	*Mean Daily Range.*	*Relative Humidity.*	*Sunshine (Hrs.)*	*Rainfall (Ins.)*	*Rainy Days.*
Davos Platz	29·1	21·2	18·7	22·5	27·0	23·7	18·8	81·0	549	10·9	75
Denver (Col.)	39·0	33·0	29·0	32·0	39·0	34·4	25·6	58·8	1057	3·1	25
British Isl.—											
1. North-Western	43·8	40·0	39·2	39·8	41·3	40·7	9·6	87·3	335	14·8	92
2. South-Eastern	45·4	41·2	39·5	40·4	42·4	41·7	9·2	88·8	400	11·9	79
3. Southern	46·7	42·8	40·5	41·3	43·2	42·9	9·6	85·7	433	12·8	81
4. South-Western	48·2	45·0	43·4	43·7	44·7	45·0	8·1	86·1	416	17·2	92
Nice ..	53·2	47·5	45·6	47·2	50·8	48·9	18·5	75·6	—	15·0	—
Cannes ..	52·6	46·3	48·0	48·8	51·0	49·3	12·7	72·7	—	—	—
San Remo ..	54·4	49·7	46·6	48·9	51·1	50·2	—	—	—	—	—
Mentone ..	54·6	49·6	47·9	49·6	52·3	50·8	11·6	—	—	—	—
Algiers ..	63·1	57·0	54·8	56·3	58·7	58·0	12·8	66·2	—	18·7	—
Helouan (Egypt)	65·9	57·3	55·0	57·2	61·6	59·4	21·1	53·8	1096	0·1	—
Madeira ..	63·3	60·2	58·6	58·1	58·7	59·8	12·8	65·4	861	18·9	48
Assouan (Egypt)	73·0	64·5	61·3	65·5	71·5	67·1	28·5	40·9	—	—	—

It is noteworthy that the *mean temperature* alone gives but an imperfect idea of the climate of a place, and even of the distribution of heat and cold. In discussing the South-Western Group it was pointed out that the winter (November to March) temperatures of Falmouth and Nice differed only by 4 degrees, but at Falmouth the thermometer shows a *daily range* considerably less than half that at Nice. It follows that at Nice the days are relatively warm and the nights colder than at Falmouth. The extended daily range on the Riviera is due to the rapid cooling of the earth under a clear sky. The same phenomenon, but more remarkable, is seen in the Alps, where the thermometer falls very low at night when the skies are clear. On the borders of the

desert, at Assouan, the contrast between day and night becomes even more striking. After sunset comes a sudden fall of nearly 30 degrees of temperature, an enormous daily range, owing to the rapid cooling of the ground under a cloudless sky. It will be observed that the mean daily range for the five colder months at all the British coast stations is very small, varying from 8° to 10° F. The even warmth of the minimum or night temperature in some localities is quite extraordinary. For example, at Donaghadee, near Portrush, the readings for the four months from December to March fall within half a degree, and on the east as well as on the west coast of England within about a degree and a half.

The returns of *humidity* furnish another valuable indication of the actual climate. It will be readily understood that high relative humidity (saturation equals 100 per cent.) must coincide with a low daily range and equability of temperature, all of which phenomena result from the tempering influence of the sea which is so striking a feature in island and coast climates. Low humidity, again, goes with abrupt variation of temperature, giving a high daily range, and these are experienced in countries remote from the sea, with mid-continental and desert climates. In high altitudes, also, the humidity is low, and is, in fact, much less than the figures suggest, for cold air absorbs but little moisture. For example, at Denver, with a temperature of 34°, the figure for humidity (58 per cent. of saturation) represents a very much smaller quantity of moisture (*actual* humidity) than 53 per cent. at Helouan, with a temperature of 59°.

A dry atmosphere may be *cold and dry* on the mountains, or *hot and dry* on the desert. In either case it must exercise a powerful effect upon the cooling of the body, and so indirectly upon nutrition, circulation, and the nerve centres. Probably this may be one of the chief factors in the medical action of Alpine and desert resorts in the winter months.

The climate of the British Islands as a whole, and of the seaside health-resorts more particularly, is of quite another type. In the British Islands the warmth of the western

seas in winter and their coolness in summer and their fresh winds at all seasons, with the frequent slight oscillations of temperature to which they give rise in the moisture-laden air, have produced a climate less favourable to mankind in a few respects, but generally and in the long run far more favourable both in health and disease than any other kind of climate. However much of progress and civilization may be justly attributed to the operation of hereditary and racial human characters, it seems certain from the evidence of history that in many parts of the world this particular kind of climate has had a marked influence in moulding the physical and mental characters of their inhabitants. In the British Islands it has, in course of time, inured the people to energy and endurance, by the incessant play and stimulus of physical forces.

NOTE

For further information upon the actions and uses of remedial waters and baths, and on the treatment of disease by climate, the reader may be referred to the following recent works. A complete account of the climates of the British Islands and their influence upon health and disease has yet to be written.

The Geographical Distribution of Disease in Great Britain, by A. Havilland. London, 1892.

The Climates and Baths of Great Britain and Ireland, by a Committee of the Royal Medical and Chirurgical Society. 2 Vols. Macmillan, 1895.

General Climatology, by Julius Hann, trans. by R. de Courcy Ward. New York and London, 1903.

The Therapeutics of Mineral Springs and Climates, by J. Burney Yeo. London, 1904.

A Handbook of Climatic Treatment, by W. R. Huggard. Macmillan, 1906.

Climatotherapy and Balneotherapy, by Sir Hermann and Dr. Parkes Weber. Smith, Elder and Co., 1907.

Clinique Hydrologique (Bibliothèque de Thérapeutique Clinique). Masson, Paris, 1909.

Crênothérapie, Climatothérapie, Thalassothérapie (Bibliothèque de Thérapeutique, Gilbert and Carnot). Baillière, Paris, 1910.

Hydrotherapy, by Guy Hinsdale. W. B. Saunders and Co., 1910.

Health Resorts of the British Islands, edited by Neville Wood. University of London Press, 1912.

Principles and Practice of Medical Hydrology, by R. Fortescue Fox. University of London Press, 1913.

Civilisation and Climate, by E. Huntington. Yale University Press, 1915.

Also the *Journal of Balneology and Climatology* (London, 1895, to 1909). and the *Proceedings of the Section of Balneology and Climatology* of the Royal Society of Medicine.

ADDENDUM

This diagram, for which the author is indebted to Dr. Frank Radcliffe, shows the average pulse-rate of ten cases of "disordered action of the heart" treated at Heaton Park Command Depot by the Sedative Pool Bath. The bath was given daily, at 92°, with a duration of thirty minutes.

Experience of these baths at the Red Cross Clinic in London shows an almost invariable reduction of pulse-rate

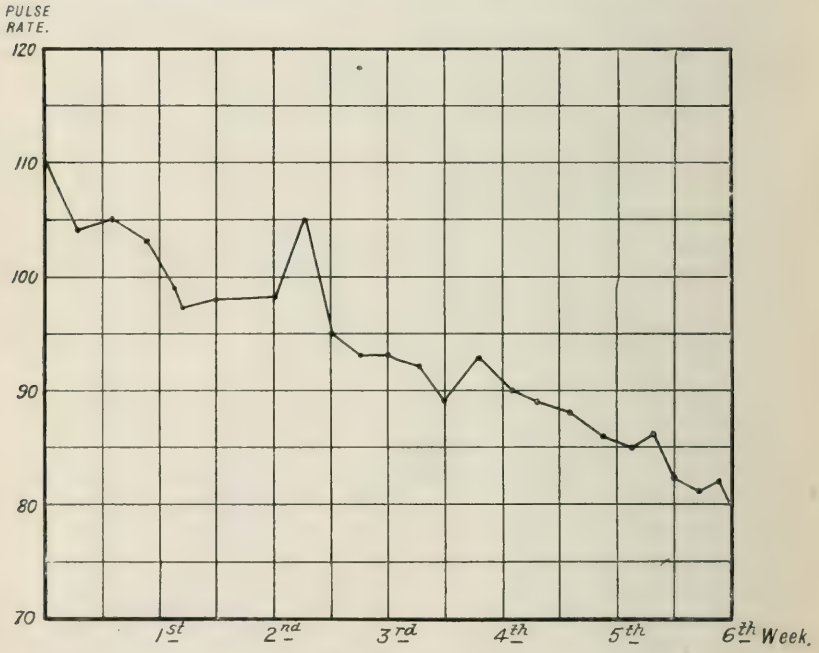


FIG. 87.

in cases of shell-shock, with improvement of sleep and relief of headache. It is interesting to note that the temperature of the body, which is usually subnormal in cases of tachycardia and shock, is raised a degree or a degree and a half by baths of this kind. Nearly all the charts therefore show a reduction of pulse and an increase of temperature (see pp. 10 and 57).

No. •

HEALTH RESORTS. CASE-RECORD CARD.

Section of Balneology and Climatology of the Royal Society of Medicine.

Regiment Reg. No.

Name Age Rank

History of Onset Diagnosis

Region affected

Admitted to 191

Condition on admission

Treatment (for details, see other side)

Result Date of Discharge 191

Signature of Med. Reporter

Place and Date

Please return as soon as completed to the Secretaries of the Committee in one of the envelopes supplied herewith.

FIG. 88.

* These Case-Record Cards are also used at the Red Cross Clinic for Disabled Officers (see p. 184).

INDEX

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