HYDROTHERAPY

AND

PHYSIOTHERAPY

FOR BATH ATTENDANTS, NURSES AND BIOPHYSICAL ASSISTANTS

BY

LIONEL C. E. CALTHROP

M.B.Durh., M.R.C.S.Eng., L.R.C.P.Lond.

Consulting Physician, Harrogate Royal Bath Hospital; Ex-President, Balneological Section, Royal Society of Medicine; late Medical Superintendent, Woodhall Spa Baths

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PREFACE

PHYSIOTHERAPY, of which Hydrotherapy forms a part, is now taking a more prominent place than it has ever had before among the means of treating disease ; this fact involves the need of special training for those who are to assist in carrying it out.

Until quite recently there has been very little opportunity for a bath attendant to obtain this training, which is just as necessary as that for a nurse ; nor have any books been specially written to enlighten him.

Although this handbook has been written with a view to assist those who wish to become bath attendants to understand the general principles and practice of hydrology and physiotherapy, it is hoped it may be of interest to nurses and biophysical assistants as well.

The contents are based upon lectures which the author gave in the School of Instruction for Bath Attendants at the Royal Baths of Harrogate during the years 1920 to 1930.

A bath attendant's viewpoint is obviously different from that of the prescribing physician, and, as his special function is to carry out the technique or methods of applying hydrotherapeutic treatment, many minor but practical details have been given which are necessarily omitted from the ordinary books on medical hydrology. It is assumed that the student has previously studied the anatomy and physiology of the human body and has acquired some knowledge of the principal diseases for which this kind of treatment is prescribed.

It is impossible within the limits of a handbook to cover all the ground completely, but an endeavour has been made to point out, like a traveller's guide, what is most essential in the principles of hydrology, so that the attendant may observe them for himself, and so carry out his duties both accurately and intelligently.

The principles hold good whether his duties lie in a spa bath establishment, a hydropathic, bath hospital or rheumatic clinic, though practical methods may vary.

The author's original intention was to confine himself to the subject of hydrology, but, as an attendant's duties may include the giving of other physiotherapeutic treatments (which are so often made use of in conjunction with hydrological), such as radiant heat, light and electrical treatments, these subjects have been included, although limits of space only permit them to be discussed sufficiently to give a general idea of the principles upon which the various apparatus are constructed, the chief therapeutic effects obtained, and, from the practical point of view, some of the precautions which must be taken in applying these treatments to patients.

Many works on hydrology and physiotherapy have been consulted, and the author acknowledges his indebtedness to them, and especially to those of R. Fortescue Fox, to whose advocacy and labours medical hydrology in this country owes so much.

Many thanks are due to the Corporations of Bath, Harrogate and Leamington for supplying the sources of the illustrations, and to my publishers for their great help in the production.

LIONEL C. E. CALTHROP.

RADLETT, HERTS.

LIST OF ILLUSTRATIONS

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PART I

INTRODUCTION

THIS handbook has been written with the object of explaining to those who wish to become bath attendants the principles and practice of Hydrotherapy and Balneotherapy, and also of Physiotherapy. The term Hydrotherapy is derived from two Greek words—" Hudor," meaning water, and " Therapeia," meaning healing—and is applied to the use of plain or fresh water in any form, including ice and steam, either internally or externally, for the healing of disease. Balneotherapy is derived from the Latin word " Balneum," meaning a bath, and the Greek word " Therapeia," meaning healing, and is applied by custom to the special branch of Hydrotherapy which is concerned with the use of any natural mineral (or spa) water for the healing of disease. The term Physiotherapy is from two Greek words—" Phusis," meaning nature, and " Therapeia," meaning healing.

Before entering upon the study of hydrology it is essential that the attendant should acquire a knowledge of the normal anatomical structure of the human body

and the position and size of its principal organs, such as the heart, lungs, liver, kidneys and bowels, etc., which he can obtain from the elementary text-books on anatomy, if oral instruction is not available. He must also possess a knowledge of the normal functions of the bodily organs as taught in the books on physiology.

Of the facts regarding the functions of the organs, some of the most important for him to remember are those relating to the heart and blood vessels and the manner in which the circulation of the blood takes place; the structure and functions of the lungs as the organs of respiration; he should know the difference between sensory and motor nerves and the position of the chief nerve trunks. Points in regard to the functions, as well as the structure of the skin and kidneys, which are the great excretory organs of the waste products of the body, must be borne in mind. A knowledge of the structure and mechanism of the joints will often be called for, and, as the subjects of the temperature of the body and the metabolism of its tissues are so important from the hydrotherapeutic point of view, they are here considered at some length, so as to give a clear idea of the part they play in the effects of treatment.

A bath attendant should be given some instruction in the nature of the diseases, such as gout, rheumatism, arthritis and neuritis, for which he will have to carry out the treatment, before he studies hydrotherapy. In its broadest sense any departure from the normal either in structure or in function is looked upon as disease. Some of the cases to which the attendant will have to apply treatment will only show slight departures from the normal, but others gross. It must be remembered that disease is essentially a progressive process associated with living cells and not a stationary condition; this process we try to check and reverse by treatment. A list of

diseases in which hydrotherapy is commonly used is given on p. 120.

Before practising an art it is necessary to know the principles upon which it is based, so when an attendant begins to practise hydrotherapy he must have principles and rules to guide him. An endeavour, therefore, has been made in this little book to explain as simply as possible :—

(1) The physical properties of water, air, and other media, on the one hand, and the main facts concerning the reactions of the human body to their application on the other, upon which the rules and principles governing the practice of hydrotherapy have been founded.

(2) The manner in which the attendant should carry out the various methods employed, and the precautions he must observe.

CHAPTER I

THE GENERAL PRINCIPLES OF HYDROLOGY

HYDROTHERAPY is one of the oldest forms of medical treatment; its principles and practice are the outcome of the long experience of the past, strengthened by much experimental research during the last century.

REACTION

All living things are affected by their surroundings, or, in other words, they react to them. The principles of the science of hydrology are based upon our knowledge of the effects which are produced upon the human body by the action of water, air, and other media, both in health and disease. These effects are called the reaction of the body.

Definition of Reaction

By the term reaction we mean the effect upon the nervous system of the application of water, air, or other media to the skin, and through the nervous system upon the circulation, respiration, temperature and metabolism of the body.

The whole object of hydrotherapy is to bring about the effects upon the organs of the body which are included in the term reaction, with the object of curing conditions of disease.

These effects may be either general, *i.e.*, affecting the whole body or simply local, as upon a limb or joint. Moreover, some effects can be produced by mineral

waters which cannot be obtained by plain or fresh water ; hence the necessity of using them.

Sometimes the chief effect the physician wishes to produce by hydrotherapy is the reduction of inflammatory swelling of the joints or the eliminating action of the skin. At other times it may be the strengthening of the heart muscle or a soothing effect upon the nerves, but nearly always the underlying factor upon which he relies to achieve his object is the reaction effect upon the chemical and vital changes going on in the tissues of the body which we call metabolism.

The reaction effects which will be most easily observed by the attendant are those displayed by the free perspiration and change of colour of the skin and those which concern the heart's beat and the circulation, as evidenced by the character of the pulse, and also those affecting the respiration, as shown by the change in the depth and rapidity of the breathing ; he must learn to count the rate of the pulse and respirations.

Water baths, for example, have an effect upon the nervous system, and with it also the closely linked muscular system, which may be stimulating and toning, or depressing and relaxing.

Then, again, the effect upon the temperature of the body will be noticed, and can be measured by the thermometer, which he must learn to read. The reaction effect upon metabolism is perhaps the most important of all, and can be estimated to some extent by the change in the body temperature, as noticed after a hot bath ; but beyond observing this point and any change in the patient's weight, the attendant will not be able to estimate the full effect on metabolism, as this can only be measured accurately by special instruments and tests.

There are two other points in regard to reaction effects which must always be borne in mind :—

Firstly, the cardinal fact that the amount and character of reaction varies according to the temperature, duration and mode of application of the medium employed ; this will be illustrated in actual experience again and again. For example, hot baths stimulate the circulation, but if too prolonged depress and exhaust it.

Secondly, that the degree of reaction depends also upon the condition of the patient. It will be found that his ability to respond or react will vary according to his constitution and disease. His power to respond to the application of heat and cold in various ways, and the consequent production of changes throughout the whole body, is the key to hydrotherapy.

It is the duty of the physician, before prescribing any hydrotherapeutic measures, to gauge as far as possible the power of his patient to react by making a very careful examination of him, but it will be the duty of the attendant (and one which will be of great assistance to the physician) to observe how the patient actually reacts when the treatment is carried out, and report any unusual or unlooked-for results.

The Mechanism of Reaction

In order to understand how the reaction of the body to hydrotherapeutic treatment is brought about, in other words, the mechanism of reaction, one or two important anatomical and physiological facts must be kept clearly in mind concerning the blood and lymphatic vessels and the sensibility and control of the nerves, which are true of all parts of the body, especially of the skin.

Vessels of the Circulatory Systems

As regards the blood vessels and lymphatics, the special points to remember are that the blood vessels, both arteries and veins, are not rigid tubes like gas pipes which

always remain the same size, but, owing to the fact that they contain both circular muscle fibres and elastic tissue down to the smallest arterioles and venules, they can contract or expand, and thereby vary the amount of blood which they contain considerably. The blood and lymph capillaries have no muscular tissue, but they can fill or collapse under pressure and changes of temperature. The lymphatic vessels have muscular and elastic tissue, and they can expand or contract under the influence of variations of temperature or pressure like the veins, and hence the amount of lymph they contain can also vary greatly.

It will be easy to understand that, owing to the hardening of arteries, which often happens in old age, their capacity for varying their size may be much diminished.

Another important fact to remember is that while the total amount of blood in the body remains the same if a portion of it is squeezed out of the superficial cutaneous vessels by their contraction, owing, for instance, to the application of cold, then the deeper ones must expand to receive it, and *vice versâ*.

The attendant will have frequent opportunities of observing these vascular changes.

While these variations are possible in blood and lymphatic vessels alike, it is true to say that the amount is always under the control of the sympathetic nerve supply, so that if we wish to dilate or contract the blood vessels we must do it by influencing the nervous system.

The Nervous Control

As regards the nervous sensibility and control of the skin's functions, this depends upon the fact that every portion of it is supplied with minute nerve fibres which convey afferent sensations of touch, heat and cold, and pain to special parts of the spinal cord and brain where

they are recorded ; they are then reflected in the form of efferent impulses along corresponding but different nerves to the arterioles and capillaries, the lymphatics, muscles, and the glands and hairs of the skin, resulting in either dilatation or contraction of the blood and lymphatic vessels, increase or decrease of the glandular secretions (perspiration, etc.), contraction or relaxation of the muscular structures according to the kind of impulse conveyed to them. In this way all the structures react through the nerve reflexes to the stimuli applied to the skin in the first instance.

It is to be noted that the nervous system is arranged in two portions linked together, the central and the sympathetic systems, the reaction in the vessels and glands of the skin being under the control of the latter, which functions automatically and unconsciously.

Since the chief effects of hydrotherapy, though by no means all, concern the thermal (heat) and mechanical action of water, air, etc., upon the skin surface of the body, it is necessary to study or recall to mind :—

(1) The structure and functions of the skin from the hydrotherapeutic standpoint.

(2) The physical properties of water and air which render them capable of producing these effects.

The **skin** has the following structure and functions :—

The epidermis or outer part is a thin protective layer ; the true skin underlying the epidermis is thicker and contains much elastic and muscular tissue, supporting glands, blood vessels, lymphatics and nerves.

The tension of the skin produced by the muscular and elastic structure varies according to the temperature to which it is exposed ; high temperatures relax and low temperatures cause contraction or tightening of the skin tension.

The blood vessels of the skin when full are capable of

containing one-half to two-thirds of the total blood of the body.

High temperatures cause expansion of the blood and lymphatic vessels, low temperatures cause contraction of them.

The skin is also a vast secretory and excretory organ by reason of its sweat and sebaceous glands. Of the 100 ounces of water lost by the body each day an average of 30 ounces pass away by the skin ; this is important in reference to its eliminating function.

The nerve fibres and their special endings in the skin furnish the clue to that remarkable sensitiveness to stimulation from outside which enables us through the skin to influence the deeper organs of the body by means of baths and other surface treatments.

The skin is further to be regarded as the chief organ through which is regulated the loss of heat from the body.

Body Temperature

The heat of the body is produced by one of the chemical processes of metabolism called oxidation, in which the oxygen of the air, which is inhaled and absorbed into the blood by the lungs, combines with substances in the blood and tissues.

The **temperature** or degree of **heat** of the body represents the balance between the production of heat within the body and the loss of heat from its surface chiefly through the skin. It is measured in British countries by a thermometer with a Fahrenheit scale of degrees. On the Continent the Centigrade scale is used.

In health the temperature of the body, including that of the blood, is a little over 98° F. ; it is hotter in the deeper parts and cooler near the surface of the skin, so

much so that the temperature of the skin surface may be 10 to 20 degrees (88° F.—78° F.) lower than that of the mouth or rectum, its average temperature being about 93° F.

Of the total daily loss of body heat four-fifths escape through the skin, partly by conduction and radiation from the blood and partly by the evaporation of the perspiration, viz., by convection.

There are three methods by which heat may be transmitted from one point to another :—

(1) By Conduction.
(2) By Convection.
(3) By Radiation.

Heat is said to be transmitted by conduction when it passes from hotter to colder portions of the same body or from a hot body to a colder body in contact with it ; and it is transmitted by convection when the material body containing the heat is carried from one point to another, as by perspiration ; lastly, heat is said to be transmitted by radiation when it passes from one object to another, not in contact with it, irrespective of the temperature of the medium through which it passes as through air or a vacuum. It does not pass in the form of sensible heat but in that of radiant energy or force, and is reconverted into heat when it strikes the other object.

The loss of heat from the body is proportional to the excess of the temperature of the skin and its blood vessels over that of the surrounding medium, be that water or air.

The heat loss from the skin is not only dependent upon radiation, but also upon the evaporation of the perspiration (convection). Any increase of perspiration causes an increased loss of heat, and *vice versâ*.

Three factors influence the amount of evaporation of

perspiration from the body when normally surrounded by air :—

(1) The temperature of the air.

(2) The relative humidity of the air, that is, the amount of water vapour it contains.

(3) The amount of movement of the air, as by wind, draught, etc.

Evaporation is the principal method of cooling the body in hot climates. In the dry, hot air of Egypt evaporation is usually at a maximum ; whereas in the hot, damp tropical climate of West Africa the evaporation of the skin is at a minimum, and the excess of bodily heat is with difficulty got rid of.

The loss of heat is markedly increased by movement of the air, as by wind or draught, and the body is cooled more rapidly still in cold, moist air, owing to the greater capacity of water vapour to absorb heat. This furnishes the explanation of the susceptibility of patients fresh from warm baths to be chilled by draughts, and if they are cooling off from any hot treatment they must be protected from them.

The rate at which the loss of heat can take place through the skin is very great, yet it is controlled and regulated by the influence of the nervous system upon the cutaneous blood vessels and glands in such a way as to maintain the temperature of the body at the normal 98·4° F., which is the particular heat at which the vital functions and metabolism of the bodily organs are carried on most favourably.

So perfect is the regulation of the temperature by this particular control, that neither a tropical climate of 130° F. nor an arctic cold of many degrees below zero has any marked effect upon the internal temperature of the human body.

On the other hand, the internal temperature of the body does become markedly affected if, instead of air, we

surround it by other media of increasing density so that perspiration and radiation cannot freely take place. If, for instance, we surround the body by air saturated with steam vapour, as in a Russian vapour bath, or by water, as in an immersion bath, or by the still denser medium of a peat or mud bath, or even a paraffin wax bath at a temperature above the neutral (92° to 95° F.), the body temperature will rise above normal to many degrees, varying with the temperature and duration, owing to the body being unable to lose its heat.

This fact has always to be borne in mind in connection with all whole-body treatments which involve these abnormal conditions.

It will be borne in mind, therefore, that the skin is the chief heat regulator, and through its action the body loses heat by conduction, radiation and evaporation.

It must also not be forgotten that the system of lymphatics in the skin performs an important function in regard to the nutrition of the skin and in the absorption of inflammatory exudations ; also that in regard to the functions of the cutaneous nerves, the sensations of heat and cold, also the important one of pain, are conducted by them to the brain.

Metabolism

Closely associated with the subject of temperature, which we have just discussed, is that of metabolism, upon the changes in which the heat of the body largely depends. By the term " Metabolism " we understand all the chemical and vital processes by which the body obtains its nourishment from food, and builds it up into its living cells and tissues, supplies fuel to its organs for the performance of their functions, and also the processes by which it forms and gets rid of its waste products. These metabolic changes may be compared to those which take

place in a much simpler form in a steam engine, where the chemical changes which take place in the burning (oxidation) of the coal produce heat, which is conducted to the water in the boiler and makes it boil and form steam. The pressure of the steam vapour is converted into the force which drives the fly-wheels and makes them revolve and do work. The ash of the coal and escaping steam are the waste products.

Food has to be digested and absorbed from the bowel into the lymphatic and blood vessels, whereby it is carried by the blood to the tissues. It then undergoes further changes (chemical) by which it can be incorporated and converted into the living structure (protoplasm) of the cells of the body. This is the building-up process known as Anabolism, or Assimilation. During this building-up process heat is usually absorbed or becomes latent.

It must be borne in mind that, besides food, oxygen gas is taken into the blood of the body through the lungs, and this gas plays a very important part in metabolism by combining with other substances (oxidation), especially the carbon and hydrogen elements in the food absorbed.

Now, just as there is a building-up process always going on, so also there is a breaking-down process known as Katabolism, or Disassimilation. The body does not remain in a stable condition, for even while nutrition is occurring disintegrating changes are taking place simultaneously, and this applies equally to the individual cells of which the body is composed. As the food is used up by the cells to produce the energy and heat of the body, so waste products are formed which are carried out of the body dissolved in the water of the urine which is excreted by the kidneys, and in the sweat from the pores of the skin, and also in the form of carbonic acid gas and water expired by the lungs.

The contrast between the complexity of the food con-

sumed and the comparative simplicity of the waste products is worth noting. It is during the breaking-down or katabolic processes in the body of complex substances into simpler waste products that heat is chiefly evolved. Most of the metabolic changes of a katabolic character produce not only heat, but also from 7 to 20 per cent. of energy or work—for example, muscular action. These anabolic and katabolic changes are constantly going on in the body, but chiefly in the muscles, glands and liver. The human machine never rests completely: the heart must beat and the lungs respire.

When metabolism is going on at the normal rate, the body weight keeps at the same level and the amount of heat produced remains at the proper balance, or, in other words, the body temperature remains normal.

It has already been said that it is difficult for the bath attendant to observe metabolic changes, but there are means of measuring the rate at which they are going on in the body; one of these is to watch the variations in its temperature. If the metabolic processes are going on more slowly than normal, the temperature falls and becomes subnormal; if, on the other hand, the metabolic rate is quickened, as, for instance, by some form of hot treatment, the temperature rises, and, of course, these changes can be measured easily by means of the thermometer. Variations in the patient's weight can also be measured, a loss usually indicating an increase in the patient's previous metabolic rate. The rate of metabolism can be more accurately measured by a special apparatus for ascertaining and recording the amount of one of the waste products, viz., carbonic acid gas, given off by the lungs in a given time. A further estimation of the daily metabolic rate can also be made by measuring the amount of urea and other waste products found in the urine sweat, etc., in twenty-four hours.

One of the chief objects of hydrotherapy is to influence these metabolic processes so as to bring them back to normal, when they are found to be sluggish or irregular owing to disease, and to utilise them for the removal of swelling due to fluid or inflammation.

PHYSICAL PROPERTIES OF WATER AND AIR

We have now to consider some of the physical and other properties of **water** and **air**, and the way in which they may be used for hydrotherapeutic purposes.

Water is composed of two gases—hydrogen and oxygen—in chemical combination ; it is a clear liquid, colourless, tasteless and inodorous ; in thick layers it has a blue tint. It remains liquid between the temperatures of 32° F. to 212° F. and ordinary barometric pressure. It becomes solid ice if cooled below 32° F. and boils or becomes converted into steam vapour at 212° F. when heated. This steam vapour or gas is invisible until it becomes cooled by contact with the cooler air, when it condenses into a visible vapour or cloud. This conversion is easily seen by watching water boiling in a kettle, and noticing that as the vapour or gas escapes from the spout at first it is invisible, but soon becomes visible as it cools into steam vapour ascending from the spout.

While most bodies contract when they are cooled, water, on the contrary, expands when it becomes frozen, a most unusual but important property, which makes solid ice lighter than liquid water. It has been found that water expands by 9 per cent. of its volume in cooling from 4° C. to 0° C.

Another very important characteristic of water is that it has a higher specific heat (power of absorption of heat) than any other liquid or solid.

Now heat is absorbed by a melting body, and this heat has no effect upon the temperature of the body, which

remains constant until the whole is liquefied; the heat is converted into internal work or energy.

The latent heat of ice, *i.e.*, the amount of heat required to melt it into water, is greater than that required to melt any other solid substance. Similarly, the latent heat of steam, *i.e.*, the amount of heat required to convert water into steam at the ordinary boiling point, is greater than that required to vaporise any other liquid. Water is not a good conductor of heat, but it absorbs heat readily, though it gives it up slowly; it gives off heat, however, twenty-seven times more quickly than air.

The modifications to which water may be subjected render it a most flexible agent, as has often been remarked; its temperature can readily be changed and adapted to varying conditions; it can be projected upon the body with more or less force, as by a spray or douche; it can be used in either its solid, liquid or vaporous state, and it has the great advantage of being universally available.

Air

Air is a mixture (not a chemical combination) of two gases—oxygen and nitrogen—in the proportion of one part of oxygen to four parts of nitrogen, the effect of the presence of the neutral gas, nitrogen, being to dilute the oxygen and so prevent it from oxidising or combining with substances in the tissues too quickly, or, in other words, burn them up entirely.

At the ordinary atmospheric temperature and pressure the mixture of oxygen and nitrogen, which we call air, remains in a gaseous condition. The air contains small quantities (1 in 1,000) of carbonic acid gas (CO_2) and water vapour with traces of many other substances.

Like water, its temperature can be varied from the daily average up to very hot, viz., for hydrological purposes up to 300° or 400° F. Like most gases, it is a bad

conductor of heat, twenty-seven times less than water, but, on the other hand, it allows radiant heat to pass through it without raising its temperature appreciably; this property is made use of in the Turkish and other hot-air forms of treatment.

Air has a good capacity of absorbing moisture: the amount of moisture or water vapour which any volume of air can contain depends upon its temperature; the warmer it is, the more it can absorb.

Having now studied some of the physical properties of water and air, we can see how admirably they are suited in many respects for the purposes of hydrotherapy.

REACTION EFFECTS

We will now proceed to study more in detail the reaction effects already referred to, and, as we have shown what an important part the skin plays in the regulation of the body temperature, it will be convenient to consider the reaction effects on body temperature and then on the circulation, respiration, etc.

We will take the effect of the application of water first, and then that of air.

Water

In order to produce reaction effects water is used at various temperatures by means of baths, douches, etc.

Positive.		
Heat above skin temperature	104° to 110° F.	Very hot.
	98° to 104° F.	Hot.
Subthermal . . .	95° to 98° F.	Warm.
Indifferent or neutral .	92° to 95° F.	

Minus or Negative.

Heat below skin temperature	80° to	92° F.	Tepid.
	65° to	80° F.	Cool.
	55° to	65° F.	Cold.
	32° to	55° F.	Very cold.

Water is sometimes used for douches at 115° F., but rarely above that temperature, as its use may be dangerous.

Steam may be used up to 130° F., and rarely up to 135° F.

Reaction Effects of Water Baths on Temperature

A rapid loss of heat takes place if the surrounding medium be cold water, as on entering a bath of plain water at 55° to 65° F., especially if the circulation of the skin is active, the blood vessels full and the skin perspiring; then when, by the effect of the cold water upon the nerves, the blood vessels contract, squeezing the blood into deeper parts of the body, and the perspiration lessens in quantity, the loss of heat diminishes rapidly. This effect is made use of to check excessive perspiration.

When, on the other hand, the surrounding water is at a temperature of 93° F. (5° F. less than the temperature of the blood), the loss of heat from the body is just sufficient to keep the temperature of the body at normal, 98° F.; this is called the indifferent or neutral temperature, because there is no change in the body temperature; the actual point varies for different individuals in health and disease.

When the temperature of the water of a bath is above 93° F., the loss of heat through the skin is checked and the body temperature begins to rise above normal because the heat of the surrounding water stops the conduction and radiation of heat from the body and checks the flow

of perspiration, and the temperature of the skin tends to rise above that of the body.

It has been found, for instance, that an immersion bath of water at a temperature of 104° F. given for half an hour will cause the temperature of the body to rise 5° (from 98° to 103° F.), and a water bath at 120° F. will stop the perspiration altogether, and is therefore dangerous.

Reaction Effects of Water Baths on the Heart and Circulation

Hot Baths.—The first effect of hot (98° to 110° F.) water baths is to quicken the pulse rate, which indicates that the heart beats more quickly and the circulation is increased in rapidity; the blood pressure is lowered. If too prolonged, the heart's action becomes depressed and weakened.

Neutral Baths (92° to 95° F.).—Baths at an indifferent temperature do not affect the pulse rate or alter the force of the circulation.

Cold Baths (65° to 55° F.).—The primary effect is stimulating to the heart and circulation, with a tendency towards slowing of the pulse rate. If too prolonged in duration, depression of the circulation takes place, owing to nervous exhaustion.

Reaction Effects of Water Baths on Respiration

Hot Baths.—First increase the rate of breathing, but afterwards diminish it.

Neutral Baths.—Do not appreciably alter the rate of respiration.

Cold Baths.—First stimulate and deepen the respiration, but when prolonged depress and diminish the respiration

rate. It has been found experimentally that immersion baths of five minutes' duration at a temperature of 60° F. produce—

Increase of total quantity of air breathed up to	22 per cent.
Increase of expiration of carbon-dioxide gas (CO_2)	64 „
Increase of inspiration of oxygen gas up to .	46 „

Reaction Effects of Water Baths on the Nervous System

Hot Baths.—The first effect of hot water upon the nervous system is stimulating; if prolonged it is enervating and exhausting with loss of tone, but they often relieve pain greatly.

Neutral Baths.—Have essentially a sedative effect, and, as they do not affect the temperature, circulation, respiration or metabolism, allow of prolonged immersion.

Cold Baths.—Are toning and stimulating in the first place, but if prolonged they have a powerful depressing effect.

Reaction Effects of Water Baths on the Muscles

As the muscular system is very closely associated with the nervous system, we find very similar reaction effects.

Hot Baths.—These relax the muscular tone and relieve stiffness.

Neutral Baths.—Have no marked effect other than one of general relaxation.

Cold Baths.—The first effect is to cause contraction by stimulating muscular action. If prolonged there is shivering, which is brought about by a persistent contraction of the muscles.

Reaction Effects of Water Baths on Metabolism

Hot Baths.—Increase the metabolic rate in proportion to their temperature and duration. The consumption of oxygen and excretion of carbonic acid gas (CO_2) may be increased as much as 100 per cent.

Artificial Fever.—The body temperature balance may be so disturbed by the increased breaking down of proteids with excess of urea that an artificial fever is produced, especially if hot baths are repeated daily. The skin temperature rises above that of the body, contrary to the natural condition, and may take two hours to return to normal. This rise of temperature caused by the action of hot baths is due not so much to the heat of the water being conducted from the water to the body, but because the metabolism is stimulated and increased, and therefore more than normal heat is produced within it.

Neutral Baths.—The effect of neutral baths, viz., with water at a temperature of 92° to 95° F., is to produce no change in the metabolic rate.

Cold Baths.—These with water at a temperature of from 80° F. (cool) to 55 °F. (very cold) greatly increase the metabolic rate, especially in the matter of the oxidation of body fats and sugars ; they also temporarily increase the number of red and white corpuscles in the blood, and so additionally increase the oxidation in the tissues.

Intensive Reaction.—By intensive reaction is meant the process by which heat, either general or local, disperses unhealthy deposits, such as occur in rheumatism and gout. Heat has more effect upon diseased tissue than upon healthy ; it disperses unhealthy deposits by increasing local metabolic changes.

Reaction Effects of Air

When the medium surrounding the body is **Air** certain

Table of Reaction Effects of Water by Baths, Douches, etc., according to Temperature and Duration

Effects up to Fifteen to Twenty Minutes' Duration

Temperature.	Hot 98° to 110° F.	Neutral, 92° to 95°.	Cold, 80° to 65° F.
Skin	Heats, softens, dilates vessels, increases perspiration.	Warms.	Checks perspiration, cools, reduces sensibility.
Nervous system	Excites, relieves pain.	Soothes, sedative.	Stimulates at first, soon depresses.
Muscular system	Diminishes irritability, relieves fatigue effects, weakens contractions.	Relaxes.	Increases tone, strengthens contractions.
Heart and pulse	Quickens.	Slows, strengthens.	Quickens, then slows.
Blood vessels	Dilates superficial.	No change.	Contracts.
Blood pressure	Lowers.	Lowers.	Raises.
Respiration	Quickens but not deepens.	No change.	Quickens and deepens, then slows.
Temperature	First lowers, but soon raises.	Raises slightly.	Lowers.
Metabolism.	Increases in proportion to heat, chiefly in proteids, also fats and sugars.	No change.	Increases rate of fats and sugars, not proteids.

Effects after Fifteen to Twenty Minutes' Duration

Skin . . .	Heats, increases perspiration.	Warms.	Checks perspiration.
Nervous system .	Depresses, exhausts, causes thermal debility.	Sedative.	Depresses.
Muscular system .	Relaxes, decreases energy.	Relaxes.	Decreases irritability, cramps.
Heart and pulse .	Quickens, stimulates.	No change.	Slows.
Blood vessels .	Dilates superficial, may inflame.	No change.	Dilates, and congests (skin blue).
Blood pressure .	Lowers.	Lowers.	Raises.
Respiration . .	Quickens, then lessens.	Raises slightly.	Slows greatly.
Temperature .	Raises greatly.	Raises slightly.	Lowers.
Metabolism .	Increases rate of.	Slight increase.	Gradually lessens rate of.

reaction effects on the skin circulation, temperature, etc., take place.

If, as in winter time, the temperature of the air is below 50° F. the loss of heat will be rapid until the cutaneous circulation contracts and the sweat glands close.

It has been ascertained that when the body is exposed to air at about 89° F. the normal balance between the production and loss of heat of the body remains steady and unaffected. This level of temperature, which is called the neutral or indifferent point for air, is fixed at 89° to 85° F. (note, 4 degrees below that of water, air being, as we have seen, a bad conductor of heat as compared with water).

Clothing checks the loss of heat by keeping the body surrounded by a zone of warm air at a temperature of about 89° F., owing to the way it acts as an obstacle to radiation.

When, however, the temperature of the surrounding air is raised above the neutral point, as in a hot air cabinet (120° F.) or in a Turkish bath (from 120° to 240° F.), the production of heat in the body is increased, but as both radiation of body heat and evaporation of the sweat can go on uninterruptedly if the air is dry, the loss of heat is proportionally increased, with the result that the temperature of the body is only slightly raised if at all above the normal. It should be noted that this effect is quite different in its results to that which is produced by a water bath, where both the radiation and evaporation from the skin is checked, and therefore the body temperature rises to a degree which might prove dangerous if not realised.

OTHER MEDIA

Besides plain water and air, there are various other media which are employed in hydrological treatment.

Table of Reaction Effects of Air, according to Temperature and Duration

Temperature.	Hot, up to 300° F.	Neutral, 85° to 89° F.	Cold, below 85° F.
Skin	Increases perspiration, excretion.	Keeps warm.	Diminishes perspiration.
Nervous system	Stimulates, relieves pain.	Sedative.	Stimulates.
Muscular system	Relaxes, weakens.	—	Tones, strengthens.
Heart and pulse	Quickens, then slows.	No change.	Slows.
Blood vessels	Dilates superficial, decongests deep.	,,	Contracts superficial, congests deep.
Blood pressure	First raised, then lowered.	,,	Raised.
Respiration	Quickened, evaporation from lungs increased.	,,	Quickened.
Temperature	Raised slightly.	,,	Lowered.
Metabolism.	Increased in proportion to heat.	,,	Increased greatly.

If the duration of the treatment is prolonged beyond fifteen to twenty minutes the following effects are produced :—

Skin	Perspiration continues.	No change.	Becomes chilled.
Nervous system	Enervated, thermal debility	Soothed.	Exhausted.
Muscular system	Relaxation.	Slight relaxation.	Tonic contraction, cramp, rigidity.
Heart and Pulse	Rate slowly diminished.	No change.	Slowed, weakened.
Blood vessels	Dilated.	,,	Contracted.
Blood pressure	Lowered.	,,	Gradually lowered.
Temperature	Thermal fever.	,,	Lowered greatly.
Metabolism	Increased.	,,	Gradually diminished.

First of all come all the different mineral waters at spas holding in solution a variety of soluble saline and alkaline crystalline compounds, sulphur, iron, arsenic, iodine and bromine, with various gases and radio-active substances. All these have their own individual reaction effects, differing according to their mineral and gaseous contents. Their properties and modes of application are too numerous to be recorded here, and must be studied by the attendant who has to use them.

Next we have the media which are used for packs, viz., the many varieties of mud or fango, either native, as at Woodhall Spa or Harrogate, or imported from Battaglia or Pistany. There is also peat, differing in its constituents according to the locality from which it is obtained. Among other media must be mentioned mustard, bran, fuller's earth, volatile oils and paraffin wax.

Their physical properties and reaction effects, as well as therapeutic uses, are described under the treatment given by each medium.

Reaction Effects in General

In watching reaction effects, it will be noticed that they vary in amount in different patients and in different diseases ; they may also vary in the same patient at different times, but, generally speaking, it may be said that extremes of heat or cold, whether applied by water or air, produce greater reaction effects than moderate temperatures, while neutral temperatures produce very little, if any, change. As a rule, applications of short duration are stimulating and exciting, whereas applications of long duration are depressing and exhausting.

Thermal Debility

Thermal debility is a condition of weakness of the heart

and nervous system with general debility, which is caused by the too prolonged or habitual use of hot baths.

In order to prevent a condition of thermal debility arising a proportional application of cold after the application of heat should always be carried out, and the number and duration of successive baths must be curtailed.

Fainting

Patients instead of reacting normally during a treatment may turn faint or collapse, and an attendant must know what to do in such an emergency. The faintness will be due to failure of the circulation and respiration by the effect of heat.

If the patient is in a bath :—

(1) Open the waste pipe and let the water flow out.

(2) Keep the patient's head low so as to help the circulation of the blood to the brain.

(3) Get the patient out of the bath and lay him on a sofa or even on the floor on his right side.

(4) Apply smelling salts.

(5) Give him a tablespoonful of brandy in water or sal volatile (one teaspoonful in a wine-glass of water to be drunk in sips).

(6) Apply heat to heart region by towel wrung out of hot water.

(7) Splash cold water on to the face, or cold wet cloth to head.

(8) Rub hands and feet briskly.

(9) Open windows and doors for fresh air.

(10) Report to the physician.

WATER DRINKING

In the definition which has been given of the term "Hydrotherapy," the attendant will notice that it includes

the use of water internally as well as externally for the healing of disease, so that it is not out of place to point out that the internal administration of water, either plain or that of the mineral waters found at spas, is a very important part of hydrological treatment, and one which he may be called upon to carry out.

It is necessary, therefore, that he should know something of the physiological and therapeutic effects of water when taken internally.

FRESH WATER

Water is essential to life chiefly because of its remarkable power of dissolving substances, especially those which constitute the food of the body, so that they can be absorbed into the system ; its solvent action is also necessary to carry out of the body the waste products of its metabolism by way of the lungs, skin and urine. It is calculated that 100 ounces (5 pints) of water pass out of the body by these three routes each day, though we hardly realise the fact.

The effect of drinking water depends largely upon its temperature : cold water stimulates the action of the stomach and bowels in proportion to its coldness ; it tends to lower temperature, slow the pulse rate, and increase blood pressure. If the water be hot it has rather the opposite effect, viz., it diminishes gastric and bowel action, increases body temperature, quickens the heart beat and lowers blood pressure. Water is rapidly absorbed from the bowel (not from the stomach, through which it quickly passes) ; in small quantities it stimulates the secretion of the digestive juices, and by dissolving the constituents of food makes them more digestible. Cold water should not be drunk during great perspiration or exhaustion, as it may unduly depress rather than stimulate.

MINERAL WATERS

Spa waters are usually drunk before breakfast, when the stomach is empty and therefore absorption is easiest; but their administration must be carefully regulated as to dose and time of drinking in accordance with the patient's powers of absorption and also elimination.

Mineral waters differ enormously in mineral content and physiological effects, and centuries of experience have established their value; but haphazard drinking of them, without medical advice as to suitability, quantity, and time in relation to other treatments, is not only injudicious but often disastrous.

A description of the chemical and other properties of the mineral waters of Great Britain alone is too large a subject to be dealt with adequately here. Usually information respecting any individual spa water is easily obtained locally.

The most important point for any bath attendant to learn, whose duties happen to be at a spa, is how far the mineral water has any special properties which affect its use for balneological treatments, whether they be baths or douches, etc.

Knowledge on this point, as well as others, he must make it his business to acquire locally. He will always find that there are some features which distinguish the particular mineral water from almost every other kind.

CHAPTER II

HYDROTHERAPY

HAVING studied the reaction effects of the body caused by the application of water, air and other media at varying temperatures which form the basis of the principles of hydrology, we will now proceed to consider the various appliances and the methods which are practised in hydrotherapy to bring about the particular reactions which the physician wishes to obtain by these media.

Immersion Baths

We will take the consideration of this form of bath treatment first for the following reasons :—

(1) It will probably be the first form of treatment which you will have to give on your own responsibility.

(2) In some respects it is one of the simplest forms of bath treatment to carry out.

(3) It is one of the best in which to learn the effect of water treatment and in which to watch the reaction of the patient.

(4) If you thoroughly understand the *rationale* of the method of giving immersion baths, and have carefully watched the reaction of patients in the case of this form of treatment, the knowledge you will have gained by giving a series of immersion baths will be the best preparation for learning how to give other forms of hydrotherapeutic treatment.

You must, however, be warned that, though the full immersion bath is in some respects a simple form of

treatment, it is a very powerful one; so powerful and intense can it be in its reaction effects that for some patients it would be dangerous and therefore quite unsuitable.

Definition of a Full Reclining Immersion Bath

It is a form of bath in which the whole body of the patient up to the level of the neck is immersed in a reclining position in water at a definite temperature and for a definite duration of time.

Immersion baths may be warm (95° to 98° F.), or hot (above 98° to 104° F.), and higher still, viz., very hot (104° to 110° F.), or they may be indifferent or neutral, viz., 92° to 95° F., or they may be cold, viz., at any temperature below 80° F. down to 65° F. The chief alteration in the condition of the water which we can vary is the heat of it; the correct adjustment of the temperature so as to correspond with what is prescribed is one of the most important duties of the bath attendant and entails his being able to read a thermometer. More depends on this point than any other detail of giving the bath.

The Bath (see Fig. 1, p. 32).

The bath is made of metal, porcelain or hard wood. It is usually from 6½ to 7 feet long, 2 feet broad and 20 inches deep, and at the head end is sloped at an angle of about 70 to 80 degrees. When full it can hold from 70 to 90 gallons of water. It may stand on the floor of the bath-room or be half sunk, in which case it is generally placed on sand or some foundation which will allow of expansion. Large deep immersion baths, a special variety, are usually sunk entirely below the level of the floor, as in the old Roman baths, with steps leading down into them and a handrail so that the patient can steady himself. In a modern establishment baths are commonly

placed on the floor at right angles to the wall, which arrangement facilitates the handling of helpless patients.

At the foot end of the bath are fixed the supply pipes of fresh hot and cold water and of mineral waters, sometimes with simple control taps or mixers for hot and cold supply. Where steam is used for heating the water the steam supply is let in at the foot end also. The metal bath has the advantage of being more rapidly warmed than porcelain, but it easily becomes corroded by certain mineral waters.

Porcelain baths take longer to warm, but their glazed surface withstands the corroding action of most mineral waters and remains smooth and easy to clean.

Immersion baths are made of hard teak wood in preference to metal and porcelain where brine baths are given, as at Droitwich, or where the water or peat contains some strong chemical or acid ingredients. The bath should be placed in the bathroom not only at right angles to one of the walls so that the attendant can get at the patient from either side, but also in such relation to the door and window as to prevent a draught of cold air from reaching the patient when in the bath. The bathroom should be separate from the dressing-room.

Before preparing the bath the attendant must carefully read through the doctor's prescription, specially noting :—

(i.) The kind of bath and water to be used.
(ii.) The temperature of the water.
(iii.) The duration of time of immersion.
(iv.) The kind of packing to be used after the bath.
(v.) The time the packing is to remain.
(vi.) The time the patient is to rest after the bath.

Prepare the bath exactly as prescribed and report to the doctor if any difficulty arises in carrying out the prescription on account of the effects on the patient.

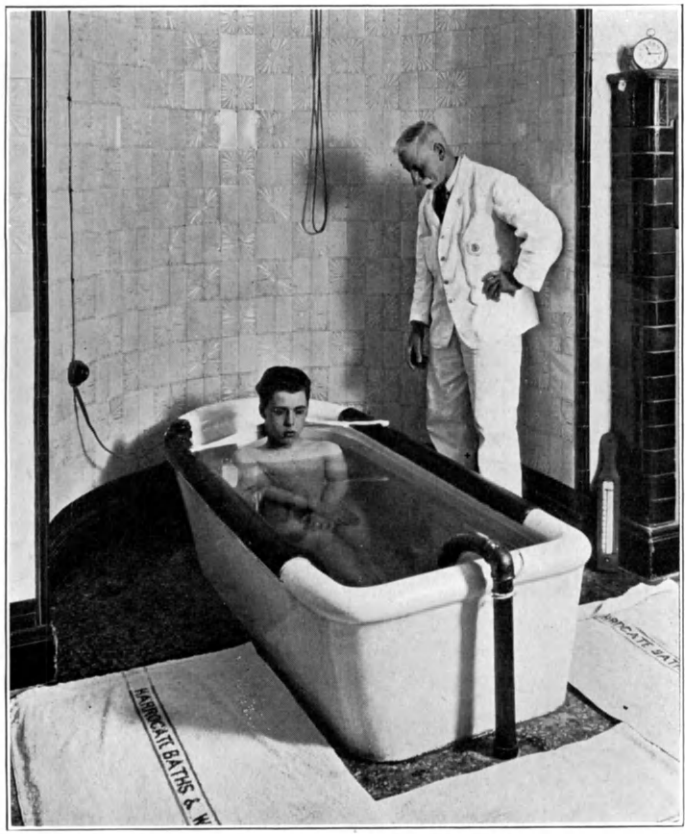

FIG. 1.—THE IMMERSION BATH.

(By courtesy of Harrogate Corporation.)

[*To face p.* 32.

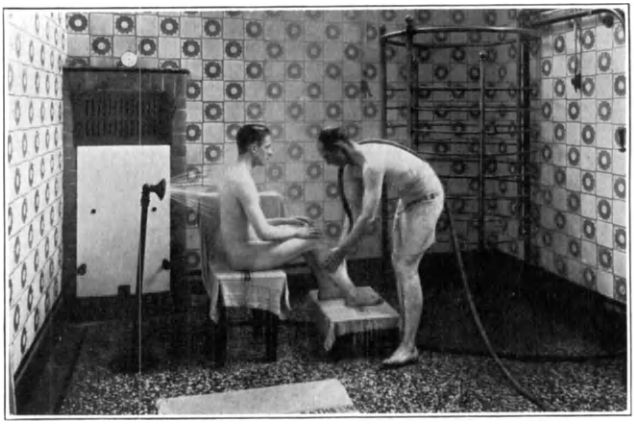

FIG. 2.—THE AIX DOUCHE MASSAGE BATH.

(By courtesy of Harrogate Corporation.)

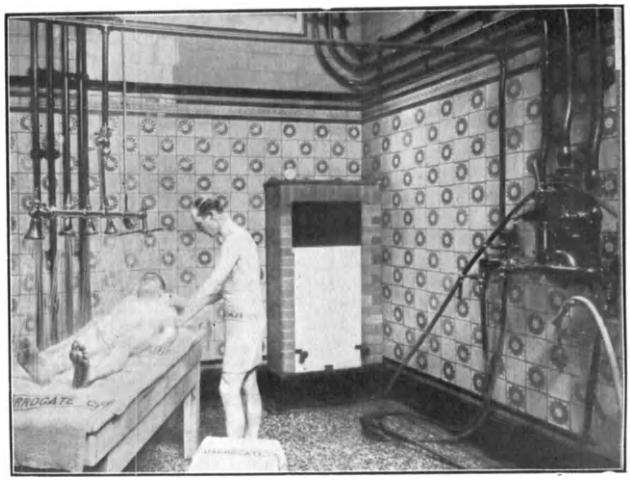

FIG. 3.—THE VICHY DOUCHE MASSAGE BATH.

(By courtesy of Harrogate Corporation.)

[*To face p.* 32.

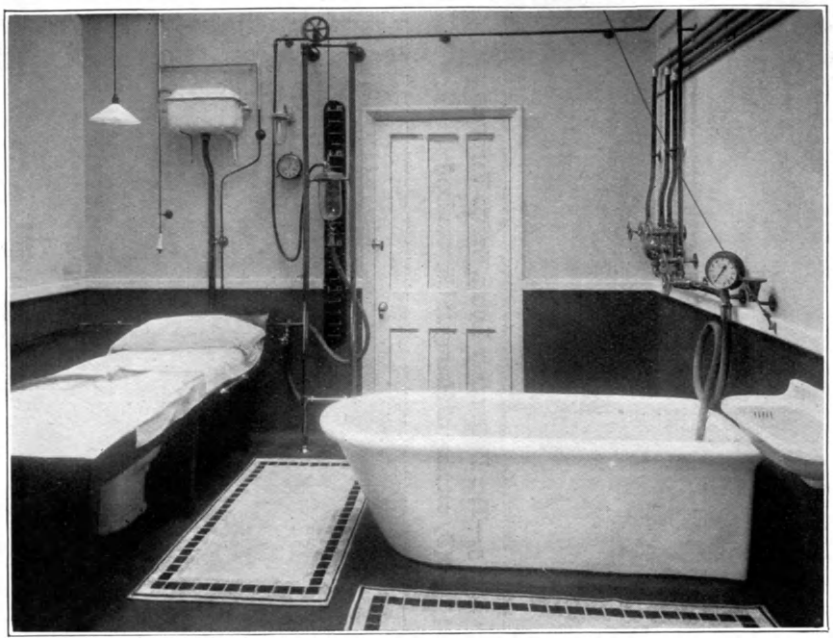

FIG. 4.—THE PLOMBIÈRES DOUCHE.

(By courtesy of Leamington Corporation.)

[*To face p.* 32.

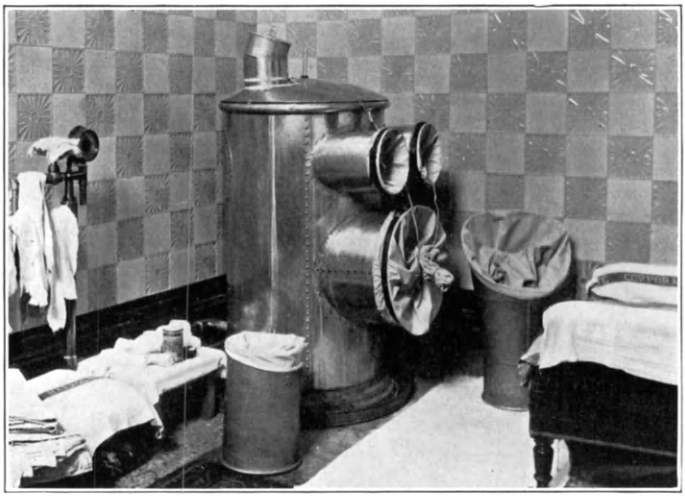

FIG. 5.—THE BERTHOLLET LOCAL STEAM VAPOUR.
(By courtesy of Harrogate Corporation.)

FIG. 6.—THE MUD (FANGO) PACK.
(By courtesy of Bath Corporation.)

[*To face p.* 33.

It is well that the doctor should prepare a patient for the kind of bath he is about to have by describing it and encourage him to have confidence in the bath attendant. On the other hand, the attendant should try to get in touch with a new patient from the beginning ; remember, all is probably quite strange to him, and he will be nervous and apprehensive and sometimes cantankerous because he is ill. Some patients have preconceived and usually erroneous ideas as to how the bath should be given. Handle these with tact and firmness.

The Preparation of the Patient

The preparation of the patient for the bath is an important item. If necessary a patient should have a cleansing bath the day before coming so that the skin may properly react.

A patient who has hurried down to his bath, and is in an overheated, excited or exhausted state, is not fit to get into a bath until he has cooled down and rested and his pulse rate restored to normal. On the other hand, a patient who is already fatigued or cold is not in a suitable condition for a bath, for he may turn faint in the bath or he may take a long time to react, and if a good perspiration be required he may not perspire within the fifteen or twenty minutes prescribed. So that it is necessary for the attendant to look at the patient and observe if he is in a fit state when entering the dressing-room.

The Preparation of the Bath

In the first place the bathroom must be a comfortable temperature and not below 60° F. or above 70° F. When preparing the bath see that the water prescribed is run into the bath in the following order : First the hot water and then the cold, especially when the bath is first filled in the early morning ; and remember that the bath itself is

cold and will feel cold to the patient unless it is warmed up first to the temperature of the water it is to contain ; so that the best plan is to run in the hot water first and then cool it down to the temperature prescribed.

Bear in mind that hot water is relatively lighter than cold water, and floats to the top of the bath, so that it requires well mixing. If the cold water is run into the bath first it will stay at the bottom and the hot at the top, and you will have two layers of water at different temperatures unless they are well mixed. If you run the hot water in first and the cold afterwards, the hot tends to rise and the cold to fall to the bottom and they will tend to mix automatically. Mix the water with your hand or a wooden ladle, not with the thermometer, or you may break it.

Look at the size of the patient, and if he is big and stout don't fill the bath too full, or you are likely to flood your bathroom. When you have filled your bath and mixed the water to a uniform temperature, test the degree of heat by your **thermometer**. Never judge the temperature by your hand; that method is quite unreliable. The ordinary bath thermometer is fixed in a metal frame or in a wooden one, which enables it to float on the water. It registers degrees of temperature according to the Fahrenheit scale from freezing point, 32° to 130° F., and sometimes to boiling point, 212° F. The space between each degree is usually divided into five unnumbered spaces. You must learn to read it correctly. If you don't see to read without spectacles use them, but for heaven's sake don't guess the temperature.

Hold the bulb of the thermometer well down into the water after shaking down the mercury column and wait until it ceases to rise ; then take it out and read the number of the degree opposite the top of the mercury column. The number is the degree of heat of the water.

See that the patient does not have to walk over an icy cold cement or tiled floor to the bath, so put a hot towel on the floor. A patient should not lie down rapidly in the bath, but get into the water gradually ; nor should he jump out of the bath, or he may turn giddy. Often, as you know, in such cases as rheumatism or gout, in which the joints are stiff or painful, attendants must assist their patients into or out of the bath, and there is an art in doing this satisfactorily. One of the best ways is to make them sit on the edge of the bath with their feet towards the foot of the bath ; lift the nearest leg over the rim of the bath with one hand while steadying the body with the other ; then lift over the other leg so that he has both legs in the bath. Next, grasp the patient under his armpits and gently lower him down into the water while he holds the rim. In the case of a very helpless patient it is necessary that two attendants take hold of the patient, one on each side, and lower him into the bath. It is in such a case that the advantage of having the bath placed at a right angle with the wall, and not parallel with it, becomes obvious, permitting access to both sides of the bath and of the patient.

It is customary in the case of a large deep immersion bath to place the patient in a special chair, suspended by a pulley from a travelling wheel, so that he can be conveyed over the rim of the bath and lowered into the water without moving from the chair. When the patient is in the bath, note the time at which he gets into the water and time him by the clock (or hour-glass). It is well to see that he is lying comfortably and, in the case of a **full bath**, well immersed, with the water above his shoulders and his head supported in an easy position on the broad band or head strap, with a clean towel on it, or on the rim of the bath, with a folded towel to rest on, otherwise the muscles of the neck may be painfully strained. In

the case of a brine bath the mineral water is of such high specific gravity, and therefore very buoyant, a patient will have difficulty in keeping sufficiently immersed, and it is necessary to fix against his feet a leaded support or a foot-board which can be varied in position according to the length of his body ; by doing so the feet are kept in their proper position at the foot of the bath and the patient is able to lie in the bath with his head in a restful position on the head-strap ; this arrangement prevents him from slipping down and running the risk of being submerged. At Droitwich the brine is so strong that it is necessary to have two or three wooden pegs across the chest, abdomen and thighs to keep the body immersed.

While the patient is in the bath watch him by looking in at short intervals and see how he is getting on and reacting. See that the bell for calling the attendant is placed where he can reach it.

It may be necessary to raise the temperature of the water while the patient is in the bath, say, at half-time, by 2 or 3 degrees ; if so, see that his feet are out of the way before adding more hot water, and specially so if the heat is increased by steam. In getting out of the bath at the prescribed time, the patient should move and rise gradually and be helped out if necessary. Sometimes it may be ordered that he should have a quick cold sponge down before he leaves the bath, specially if very free perspiration has taken place.

Before the patient is due to get out of the bath, see that the hot towels are ready for wrapping round him. Bring them rolled up and set them on a chair close handy.

TOWELS

An important part of the attendant's duties is the care and heating of the towels, sheets and blankets he uses.

Towels are usually made of huckaback material or

Turkish towelling; cotton sheets are also used for certain purposes. In the laundry care is taken to dry them well. After they are received from the laundry the attendant stores them ready for use in cupboards close at hand to the bath-rooms. These cupboards are provided with shelves made of wooden laths at close intervals, and under the shelves are pipes heated by steam so that the towels can be thoroughly dry and well heated before being used.

Points to which the attendant must pay particular attention are: That all towels must be scrupulously clean, and that all which have been used in cases of skin disease or discharging sores and similar cases must be kept quite apart so that they may be thoroughly disinfected and sterilised before being used again.

Method of Packing after Bath

After the patient has got out of the bath the warm towels should be applied in the following manner, while the patient, if able, is standing up :—

A huckaback or small Turkish towel should be placed over the chest and abdomen, and should be long enough to reach from the neck to the knees, and a similar one should be put on the back; over both of these should be folded a large Turkish towel covering the head, but not the face, and stretching the whole length of the body and folded over the front.

The patient should then lie down on a sofa to rest, and one more huckaback towel should be wrapped round the feet and legs by passing it below the feet and folding it over above them.

This amount of covering will favour perspiration, and after an interval of fifteen to twenty minutes the towels should be opened out to allow of cooling. If the patient's temperature has dropped to normal and the pulse rate

slowed down, he may rise on to the edge of the couch and dry himself.

He then slowly dresses and goes to the cooling-room or waiting-room, and rests until the reaction has passed sufficiently to permit him to go home or to his hotel, where he should continue to rest in order that the bath may produce its full effect. The length of time it is necessary for a patient to rest after a bath depends upon the amount of reaction produced, and this should be carefully observed, as it is an important part of the treatment.

After the patient has left, air your bathroom and flush and clean out the bath with boiling water and soap brush.

Hydrostatic Pressure

It must not be forgotten that the water in a bath exerts a hydraulic pressure, in proportion to its depth and specific gravity, not only vertically upon the bottom of the bath, but laterally on its sides as well, and this lateral pressure is exerted just as much upon the patient during immersion as on the bath. It has been calculated that the hydrostatic pressure on the body may amount to 500 kilograms (= 220 lb.), and even more.

The Three-quarter Bath and Half Bath

Hence, besides the full immersion bath, a three-quarter bath, or even a half bath, may be prescribed, in which case it will only be necessary to run in about 30 to 35 gallons of water into the bath for a three-quarter bath and about 20 to 25 gallons of water for a half bath, depending upon the size of the bath. The three-quarter bath is used in the case of a patient who is having an immersion bath for the first time or whose circulation and respiration are weak, in which case only sufficient

water is run into the bath to cover him halfway up the chest, so that there is no excess of hydrostatic pressure upon it to interfere with his heart's action or breathing.

When a half-bath is ordered the water only reaches as high as the patient's waist, and it will be necessary to use a covering towel or blanket while they are in the bath.

The rules as to temperature and duration apply to these variations of the immersion bath as much as in the case of a full bath.

It may be noted here that there is no hydrostatic pressure in a douche massage bath, foam bath or vapour bath.

VARIETIES OF IMMERSION BATH

In bath establishments at spas the various mineral waters are applied by means of the immersion bath, and, according to the character of the water, certain modifications of the ordinary method of preparing the bath and applying this form of treatment to the patient may be necessary.

Where mineral water as it issues is naturally hot, as at Bath, where the temperature of the water is about 120° F., there is no need to artificially heat it, but where, on the other hand, the spa water is naturally only about 60° F., or earth temperature, it is usually heated for thermal baths and other uses by fixing in the storage tanks a set of steam coils, or calorifier, so that it is ready for use in the bath, and only needs the addition of the cold to reduce it to the temperature prescribed.

In other cases, as for instance in the Droitwich Brine Baths, the temperature is raised to the required degree by passing a jet of steam into the brine bath from a steam pipe, which is fitted into the foot-end of the bath. Care must be taken in raising the temperature of the bath while the patient is in it that the steam does not play

upon the patient's feet, also that the steam valve does not leak.

It is impossible in this little book to give details concerning the varieties of mineral waters. If an attendant is attached to a spa establishment he must, of course, learn all he can about the properties of the special spa waters he has to use.

If, for example, the water is a very buoyant one, the patient must not be allowed to float helplessly in the water, but steadied in a comfortable position by fixing wooden pegs or bars across portions of his body, so that he is fully immersed and his feet supported so that he does not slip down or under the water, as may easily happen when it is remembered that the upper portion of the body is heavier than the feet and legs. In most baths it is better to see that the patient has a support for his feet as well as for his head ; this is the case at Woodhall Spa, where the mineral water is buoyant, though not nearly so much as the Droitwich brine.

" Deep " or " Pool " Immersion Baths

We have already mentioned, when speaking of immersion baths, that from ancient times deep or pool baths have been used. They may vary in size according to the daily flow of water available and the particular uses to which they are put. The smallest would require many times the number of gallons which would fill a reclining immersion bath, and can accommodate several patients at the same time; they may contain anything over 300 gallons of water.

Over the pool bath are placed cranes which, by hydraulic power, move specially suspended chairs, in which very crippled patients can be placed and lowered into the bath. The temperature of the water is usually about 98° to 100° F., and douche and spray pipes are

arranged at the side of the bath with their mixers, etc., and undercurrent douches are applied to any part of the body according to what is prescribed, the temperature of the douche being given at several degrees higher than that of the bath.

Therapeutic Effects

One of the great advantages of pool immersion baths is the freedom with which the patient can move about and the ease with which both passive and active movements can be carried out, owing chiefly to the relief to muscular spasm and diminution in nervous strain and fatigue which they afford.

The attendant will note that in giving this kind of treatment he will have to give the patient fairly constant attention, and often a good deal of assistance as well.

At Bath, owing to the thermal character of the mineral water and large supply, this form of bath is easily and effectively carried out.

Saline and Brine Baths

In Great Britain the standard brine baths are those of Droitwich. Droitwich brine contains as much as 3 lb. of sodium chloride (common salt) to the gallon of water, so that it is exceptionally strong.

To make, therefore, a 40-gallon brine bath of equivalent strength, as much as 120 lb. of salt would have to be added to fresh water.

This is rarely, if ever, done in practice, as suitable reactions can be obtained by weaker solutions, that is, by the addition of from 5 to 30 lb. of salt to 40 gallons of water. If only 5 or 6 lb. of salt be added to 40 gallons of water, the strength will be equivalent to that of sea water (but not brine). If 30 lb. of salt be added to fresh water,

the strength will be one-fourth of the natural Droitwich brine.

Therapeutic Effects

In either case, however, a saline or brine bath at subthermal temperature (98° to 90° F.) for from ten to twenty minutes will act as a good stimulant and tonic, and, if given as a thermal bath of from 100° to 104° F., will produce free stimulation of the skin and increased metabolic reaction, which are particularly beneficial in chronic rheumatism, fibrositis and sciatica. The buoyancy of the water, especially for sciatica and very stiff joints, is a most useful and comforting adjunct to the effect of this form of immersion bath.

Artificial and Medicated Baths

Artificial baths, that is those which are made by the addition of mineral salts to fresh water, serve a distinctly useful purpose, but it is true to say that no natural mineral water can be exactly imitated artificially.

The Alkaline or Soda Bath

This bath is made by the addition of 1 lb. of carbonate of soda to 40 gallons of water; some prefer to add as well salt or carbonate of potash.

Method of Giving the Bath.—This bath is given in the same way as has already been described for immersion baths, but the temperature and duration will be determined by the condition of the patient and the object in view.

Therapeutic Effect

Given specially for its softening and soothing effect upon the skin and its efficacy in relieving muscular and rheumatic pains.

Medicated Immersion Baths

These are immersion baths in which to the water used is added various chemical medicaments, such as ammonia, salts, mustard, alcoholic extracts of pine and other oils. Directions as to quantities are given usually with each substance used. They have therapeutic value in their stimulating or sedative effect upon the skin or nervous system as well as by their temperature. In other respects the method of giving them follows the same principles as for immersion baths in general, and must follow the physician's directions.

Effervescing Baths

Carbonic Acid Effervescing Baths.—These effervescing baths are given in most establishments, and the attendant must know how to prepare them.

Plain effervescing baths are made by dissolving in a bath of 40 gallons of fresh water 2 lbs. of a salt called bicarbonate of soda, and, when ready for effervescence to begin, adding to the water $2\frac{3}{4}$ lbs. of a powder (or tablets) of sodium bisulphate; the chemical action which takes place in the water between these two powders produces small bubbles of carbonic acid gas (CO_2).

Instead of the tablets of sodium bisulphate strong liquid hydrochloric acid may be used by means of a special apparatus to control the flow into the water.

There are also large apparatus for producing the gas and leading it into the water, but they are expensive and unnecessary for ordinary use.

Method of Giving the Bath

After having filled the bath and dissolved the bicarbonate of soda and got it at the right temperature, as prescribed by the physician, just before the patient enters

the bath or just after he lies down the attendant places the effervescing tablets on the floor of the bath on each side of his body, when brisk effervescence will take place.

Effervescing baths are generally given at what we have described as tepid or cool temperatures (92° to 80° F.), and in a series the temperature is reduced rather than increased, and the duration is usually not longer than fifteen minutes.

Therapeutic Effect

The effect of these baths is due almost entirely to the action of the carbonic acid gas in stimulating the circulation in the skin and counteracting the cooling effect of the water. The momentary feeling of chilliness is soon replaced by that of warmth ; by dilating the peripheral vessels they relieve tension in the deep ones, an action which is called decongestive. Short effervescing baths are stimulating, especially at the lower temperatures ; at the higher ones they have a tonic and even soothing effect.

Precautions

It is specially necessary to watch the reaction effects of the patient when giving these baths, also the temperature and duration of them.

Nauheim Baths

Nauheim baths, as given in this country, are made artificially in imitation of those given by means of the natural mineral waters of Nauheim, in Germany, which contain sodium chloride (common salt), chloride of calcium, with small quantities of other salts and an unusual quantity of carbonic acid gas (CO_2), the amount varying in different springs.

In a course of Nauheim baths the first six or ten baths

are given without effervescence, *i.e.*, a still bath, so that in imitating the Nauheim waters two elements are necessary :—

(1) There must be the addition of sodium chloride and calcium chloride (or a mixture of Nauheim salts which are available by importation) to the fresh water bath.

(2) There must be the means of producing effervescence (Sprudal baths) when this quality of the Nauheim waters is required.

As regards the first element, since there are different strengths of the Nauheim waters, so, when artificially prepared, four strengths are usually made to imitate them, viz. :—

No. 1.—4 lb. of sodium chloride and 12 ounces of calcium chloride for one bath.

No. 2.—6 lb. of sodium chloride and 18 ounces of calcium chloride for one bath.

No. 3.—8 lb. of sodium chloride and 24 ounces of calcium chloride for one bath.

No. 4.—10 lb. of sodium chloride and 30 ounces of calcium chloride for one bath.

The solution made with these salts does not effervesce, so that when effervescence is required the production of carbonic acid gas is carried out by the same means as are used in the previously described plain effervescing bath.

To cause a proper distribution of the effervescence when tablets are used they must be placed according to the number prescribed on the bottom of the bath on each side of the patient. The use of the liquid hydrochloric acid by means of Mr. Woodmansey's apparatus is effective and gives very even distribution.

In making use of Nauheim baths for the treatment of

disorders of the heart, it is the usual practice to give a series of from twelve to twenty-one or more baths, the first eight or ten being given without effervescence, but increasing the strength of the solution by adding more salts, according to the table given. At the eighth or tenth bath effervescence is added in certain cases. As the course of baths proceeds, the strength of the bath is increased, and likewise the amount of effervescence, the physician watching the results and prescribing the increase accordingly.

In making the bath particular attention must be paid to getting the right temperature of the water, which in a series is lowered rather than raised.

The patient should recline against the back of the bath with the head comfortably supported and the body immersed up to the neck. The bathroom must be well ventilated, but not draughty. A towel spread from the neck to the thighs over the rim of the bath will prevent concentration of the gas near the face. The duration of the bath may be as short as four minutes, and gradually prolonged to eighteen minutes during the course.

Therapeutic Effect

The action of the fine gas bubbles upon the skin surface results in dilatation of the cutaneous blood vessels and withdrawal of the blood towards the surface, relieving the pressure in the deep vessels and in the heart itself. The pulse usually diminishes in frequency by four to six beats per minute by the end of the bath, and the heart's contraction becomes stronger. The pulse rate should be taken by the attendant before, during and after the bath. Besides their effect upon the circulation, these baths have a toning effect upon the nervous and muscular systems.

Precautions

A feeling of oppression may be experienced at first, but this soon passes off with a few deep inspirations.

The patient must slowly rise from the bath at the exact time and take the full measure of rest prescribed for his case.

Any feeling of chill on entering the bath will soon be converted into a sense of warmth by the stimulation of the skin by the salts or gas bubbles. In cases of long-standing high blood pressure, the effect of the bath must be closely watched.

RESISTANCE EXERCISES (SCHOTT'S)

These are exercises which are given sometimes in connection with a course of Nauheim baths with a view to increasing a patient's muscular tone, including that of the heart; they have also the effect upon the pulse of increasing its volume, lowering its tension and slowing its frequency when given in suitable cases. They are occasionally given before a course of baths has commenced, but much more often during the course on the days between the bath. They are called resistance exercises because the movements of the patient are resisted by the administrator.

There are six exercises for the arms, five for the legs and three for the body, all the movements being resisted by the administrator's hand in accordance with the relative position of the patient to him. The patient is standing throughout.

Arm Exercises

(1) Opening extended arms horizontally.

(2) Raising extended arms above the head directly outwards.

(3) Raising extended arms above the head forwards.
(4) Bending forearms.
(5) Raising flexed arms above head.
(6) Raising arms backwards.

Leg Exercises

(1) Raising extended leg forward.
(2) Raising extended leg backward.
(3) Abducting extended leg.
(4) Raising leg flexed at knee and hip forward.
(5) Passing extended leg in front of and across the other.

Body Exercises

(1) Bending body at the hips forward.
(2) Bending body at the hips sideways.
(3) Rotating body at the hips first to the right and then to the left.

In order that the administrator may keep up a steady and graduated resistance to each of the patient's movements it will readily be seen that he has to alter the position of his hands during the exercises. For fuller details of these exercises the special books must be consulted.

The patient sits between each individual exercise for a minute and rests for half an hour afterwards. Only a few of them are given at first, more being added as the course proceeds under the guidance of the physician.

Oxygen Effervescing Baths

These baths can be prepared by spreading four to six tablets containing 8 ounces of perborate of soda over the bottom of the bath, and then, when the patient is ready

to enter, smaller tablets containing ½ ounce of borate of manganese. An effervescence is then obtained by the production of oxygen gas through chemical action between the tablets, and distributes itself quite well throughout the bath. On the other hand, seeing that oxygen gas can be conveyed so easily in cylinders, it is more common to distribute the gas from a cylinder through the water by making it pass through a series of parallel pipes laid down along the floor of the bath, such as is described under Aerated Immersion Baths.

Method of Giving

When these baths are ordered the physician will give directions as to temperature and duration, etc., otherwise the general rules for immersion baths will apply.

Therapeutic Effects

Oxygen effervescing baths are strongly stimulating, and the gas (unlike that of carbonic acid) may be freely inhaled.

Foam Baths

This kind of bath has been recently introduced into hydrological institutions, and so I give some account of them.

They are one form of effervescing bath in which, however, the effervescence is not produced in the water used but in a separate apparatus and led into the bath; the gas itself may be carbonic acid, oxygen or compressed air. It is led into the bath from a cylinder under pressure, and escapes through a special distributor submerged in a receptacle containing enough water to cover it completely at the bottom of the bath. To this water, 3 or 4 inches deep, a sufficient quantity (about 1½ ounces) of a special

foam-forming extract is added to form a dilution of not less than 1 in 10,000. The temperature of the layer of water varies from 103° to 108° F. or more, according to the temperature required for the foam.

The effect of the addition of the foam-forming extract is to reduce the size of the bubbles very considerably and to cover the patient with piled-up foam instead of water.

Therapeutic Effect

Their effect is quite different in reaction to ordinary effervescing baths. In the first place the patient is covered with foam, not water, so there is no hydrostatic pressure, and in certain cases this is a distinct advantage ; in the second place they are usually given at high temperatures and not at subthermal, and as the foam stops the radiation of heat from the body the temperature of the patient quickly rises and the skin perspires freely. There is, however, not the exhaustion which follows a water bath given at the same temperature.

Peat Baths

Peat is a semi-solid substance formed by the decay of vegetable matter, chiefly that of mossy plants, enriched by the mineral substances contained in the earth and water in which they lie. In addition to the vegetable matter of the fibre and root, it contains resin and oils, silica, phosphates, iron, sulphur, free acids, together with salines and other earthy substances. The peat is exposed to further decomposition, ground to a fine mass and then mixed with water and stirred to make a semi-solid mush, which can be used for a bath or a pack. Sometimes, in order to add to its mineral content, it is mixed with saline, brine or sulphur water instead of plain water.

Physical Properties

Peat is a bad conductor of heat, but it retains heat much longer than water ; its specific heat is lower than that of water ; it neither abstracts nor gives out heat as quickly as water, so that in a peat bath, and more so in a peat pack, the layer of peat which is next the skin remains at much the same temperature as the skin, and therefore moderates the heating effect of the layers beyond.

For peat baths the point of thermal indifference is found to be 10 degrees higher (102° F.) than that of water, so that it can be applied comfortably as a bath at a much higher temperature, viz., up to 112° F., and locally up to 115° F. or more.

The peat is stored in a separate preparation room and heated in a large revolving vat by passing steam into it in such a way as to heat it uniformally up to 100° F.; then when a bath is ordered it is further heated up to the prescribed temperature for the bath.

Method of Giving a Peat Bath

The bath must be carefully prepared in the matter of temperature, as it cannot be adjusted afterwards like a water bath ; yet in this particular case the question of the right temperature is important. The bath is usually on a low carriage, so that it can be wheeled from the preparation room into the bath-room. The bath itself is made of hard wood, and the bottom of the bath is sunk more towards the back than at the foot end to prevent the patient from sliding down ; a crossbar is fitted on the brim, so that by holding it he can steady himself. The bath is fitted with a cover so as to keep it warm in transit.

Owing to the mechanical compression exerted by the peat it is not unusual for a three-quarter or half bath to

be ordered for the first one or where the compression of the chest would be injurious. The temperature will vary from 102° up to 108° F. or more, and the duration about twenty minutes.

Before entering the bath the patient should fill the nails with soap to avoid staining. The attendant will have to be ready to assist the patient to get into the bath, and when he is ready to get out, to scrape off the peat, which sometimes clings to the skin, while he sits on the edge of the bath. Having cleared the skin as far as possible, the patient passes for a few minutes into the adjoining needle bath (102° to 90° F.), or has a warm-to-cool sponge down ; he is then wrapped in a large bath towel and lies on a sofa covered by a blanket where it is desired that perspiration should continue ; then the towels are gradually opened out to cool down and rest until ready for dressing.

Therapeutic Effects

Peat has a mechanical effect by its compression, and it also has some chemical adsorptive and bactericidal action upon the skin. Patients taking these baths must be carefully watched, as they are a very powerful means of treatment owing to their effect in raising the temperature of the body by preventing radiation of heat more than water, and also by the excessive sweating of the skin without free evaporation tending to exhaust the patient's strength. On the other hand, given with due care as to temperature and duration, they form a valuable means of stimulating the skin's action, increasing metabolism which helps to resolve chronic inflammatory thickening about joints, muscles and nerves, and relieving pain and muscular spasm. They are also given to obtain the absorption of deep-seated inflammatory deposits.

Mud (Italian Fango) Bath

Mud in semi-liquid state, usually of volcanic origin, is used where it occurs native for a full immersion bath in the same way as peat. Hyperthermal temperatures are borne comfortably, and their therapeutic effect is very similar to what has been described under peat baths. In Great Britain, mud, either native or imported, is used exclusively locally in the form of packs (see p. 104).

PARTIAL BATHS

So far we have only described methods of applying water and other media to the whole body by means of full baths of different varieties. There are, however, many conditions in which a full bath of any kind is undesirable and might even be dangerous ; but there still remains a large field in which the usefulness of partial immersion in water may be applied by means of half baths, sitz baths, arm, leg and foot baths, which we will proceed to describe.

When giving these treatments it is important to realise that the body is so constituted, and its parts so inter-related through the nervous system, that the application of heat or cold to one part will certainly affect the rest of the body in some way or other. For instance, heat applied to one arm causes the other arm to swell, and heat applied to the feet or hands so as to dilate their blood vessels will relieve congestion of the brain or of the abdominal organs.

Half Bath

The half bath is used not only as a means of avoiding hydrostatic pressure in the case of a delicate patient, but of applying heat or cold limited to the lower half of the body and legs (note that in the case of the sitz bath the legs are excluded).

Method of Giving the Half Bath

This all depends upon the condition for which it is prescribed; in any case, the amount of water required will be about 20 to 25 gallons, that is, enough to reach up to the umbilicus; if the object of the bath is to relieve pain in the legs or in the lower part of the body the temperature prescribed may be anything from 98° F. up to 105° F. or more, according to what the patient can stand. With ordinary care the temperature can be increased while the patient is lying in the bath by letting out some and slowly adding more hot water, watching the rise in temperature with the thermometer. While the patient is in the bath he should be covered by a warm blanket and, if necessary, a cool, wet cloth upon his head. The duration will vary, according to the case, from ten to twenty minutes. Before the patient leaves the bath it is advisable that he have a quick, cool sponge-down. He should be wrapped in warm towels and blanket and put to bed or made to take a long rest.

A half bath is sometimes used in conjunction with warm or cool affusion with friction to the upper part of the body.

In suitable cases it is used with tepid to cool water for lowering the temperature in febrile conditions.

Lastly, it can be used as a cool or cold stimulating bath with friction of the exposed skin, or as a quick cooling bath after hot sweating treatments.

Sitz Bath

This form of partial bath is found in most hydrological institutions, though authorities differ as to the advantages to be gained by its use over other methods. In its most improved form it affords a simple method of applying either hot or cold water in several different ways to the

lower part of the body, excluding the legs; therefore the application is more limited and, in some ways, safer and more under control than that of the half bath.

The Bath

The sitz bath is either circular or almost square in shape, and usually made of metal or porcelain, with sides sloping outwards at an angle of about 70 degrees and providing a depth of bath of about a foot. It measures 20 inches by 15 inches. It has also a back which extends the sides up to the height of another 10 inches. The back is perforated with holes for a back-spray; the sides are perforated for side-sprays, and in the bottom of the bath is provided an ascending spray. There is also an automatic self-emptying apparatus to provide for a continuous flow of water if necessary. The shape of the bath differs slightly according to whether it is for male or female patients: if for the latter, it is narrower across the brim, so that the clothes can be kept out of the water when the patient does not undress. When the ascending spray is being used the patient sits upon a horseshoe-shaped stool which fits into the bath. The bath will hold, when the patient is sitting in it, about five or six gallons of water, reaching just above the groins.

Method of Giving a Sitz Bath

As in the half bath, so here the method used will depend upon the effect desired, and, moreover, the legs as well as other parts of the body have to be dealt with, as they are outside the bath. It may be said at once that, in practice, neutral temperatures (92° to 95° F.) are rarely if ever used alone in sitz baths or half baths; they are mainly used either for the application of heat above 98° F. or cold below 80° F. down to 65° F. or even lower.

Hot Sitz Bath

When used for the application of heat, generally for relieving pain in the lower part of the back or hips or in the pelvis and for derivative purposes, the temperature will be something over 98° F., and very often as hot as can be borne, in which case the hotter the bath the shorter the duration.

In the case of the application of heat the patient must fully undress, as the whole skin will perspire, and while sitting in the bath the patient must be covered with a blanket which is specially made with an opening for the head, so placed that while it hangs over his back it is long enough to cover over his feet, which are often placed in a tub of equally hot water. A wet, cold cloth is also applied to the head. The patient remains in the bath for the time specified, and as he rises he is given a cool sponge-down, and then wrapped in a warm towel and blanket, and rests until the reaction has passed off and he is cool enough to dress and leave, or he may be put to bed. If a stronger derivative action is desirable mustard may be added to the water in the proportion of one tablespoonful to the gallon. When using mustard it must be noticed that there are no open wounds of the skin.

Cold Sitz Bath

If the object of the bath is to apply cold, then the temperature of the water will be below 80° F. and usually 65° to 70° F., and should cover the groins and no more.

As, in any case, the cold is only going to be applied to the lower part of the body, if the patient is undressed, after he sits down in the bath the attendant must cover his body with a blanket and wrap up his legs in warm towels. The patient remains in the bath for three to ten minutes, the colder the water the shorter the duration, while the attendant rubs his body from time to time if at

all chilly. He should dry, dress quickly and take a walk to get warm. The sitz bath is so shaped that the patient need only partially undress if he wishes.

LOCAL BATHS

Arm, Leg and Foot Baths

The attendant who has already given the full immersion bath will have no difficulty in giving these partial or local baths. The reactions are similar in character to those of full baths, keeping in mind that though only applied locally they also have a general effect. Hot foot baths can make the whole body perspire. In the matter of temperature, usually higher and lower temperatures can be borne than those of full baths, and, if necessary, the duration can be longer without fatigue.

Method of Giving Local Baths

It may suffice to say as to methods that for **Arm** baths the vessel (usually a long narrow trough) must allow the hand and arm to be immersed up to above the elbow ; for **Leg** and **Foot** baths the vessel must hold enough water to reach to the knees ; shallow tubs are often used for the feet as the water only covers the ankles.

It need hardly be said that just as much care must be taken in the giving of these treatments as for more formidable ones ; in fact, more care is often necessary, as local baths are often prescribed for patients who, for one reason or another, are too ill or delicate to bear full body baths.

Therapeutic Effect

The therapeutic value of these partial baths is not to be despised, especially at the beginning of hydrological treatment. Often the general reaction set up by them is a useful preliminary to further methods and can be used

to initiate and train a patient's reaction ability. Foot baths, for instance, are extremely useful for their derivative action in relieving cerebral and visceral congestions, also for sprains and painful conditions of the feet.

SPECIAL APPLICATIONS OF WATER

At this point we must refer to some other methods of applying water which bring about well-recognised reactions and have valuable therapeutic effects when they are properly carried out.

They are all different methods of applying water at a temperature below that of the skin usually within the range known as cool, viz., 80° to 65° F.

(1) Ablution

This is carried out by the application of water to the surface of the body while reclining, including chest, abdomen and back, with arms as far as elbows and legs as far as knees, with friction by the naked or gloved hand. This procedure is cleansing, cooling and suitable for reducing temperature in febrile conditions.

(2) Affusion

By affusion is implied the brief application of water at 80° to 70° F. or 65° F., effected by pouring it over the patient's body (head omitted), either while lying on a bed covered with mackintosh, blanket, etc., or in an empty bath at quick intervals. It is not only eminently cooling in febrile conditions, but stimulating at the same time, and therefore not depressing. Friction is not necessarily used, but the stimulation may be graduated by the height from which the water is poured.

It is one of the best treatments for sunstroke.

(3) The Sheet Bath

By this method the patient, while lying on a bed covered with mackintosh, etc., is encircled in a wet sheet, temperature 90° to 80° F., in a particular manner from the neck to feet. Friction is used as well to counteract too rapid cooling, while fresh supplies of cool water are applied as the parts get warmer.

The sheet bath is used for lowering temperature and for testing reaction ability, being a milder form of bath than the immersion bath.

(4) The Drip Sheet

This is a stimulating form of treatment carried out by wrapping the patient in a sheet from neck to feet while he stands in a foot bath, and pouring water over him at cool temperature while the attendant rubs or slaps the surface covered by the sheet. The duration of this application will not be more than about five minutes.

Its effect is tonic and stimulating and has, to some extent, the effect of a douche massage bath. It is used in hydropathic establishments.

(5) The Whole Body Wet Pack

This procedure was initiated by an English physician, Dr. Lucas, nearly 200 years ago. It consists in wrapping up the patient in a sheet which, unlike the wet sheet and drip sheet, has been wrung out of water so that it is only damp. The sheet is applied first, and then covered by two blankets. The temperature of the sheet will vary according to the nature of the case and also the duration of its application. It is used in cases of fever and insomnia and many other asthenic conditions.

(6) The Cold Friction Bath (Brand)

This is essentially a cool bath in which the patient is immersed in water at a temperature of about 70° F., never lower than 65° F., while friction is given to his skin as he lies in the bath. It was most successfully introduced by Dr. Brand for the treatment of enteric fever, not so much for reducing fever as for counteracting nervous and cardiac exhaustion. It may be used for reducing the temperature without exhausting the patient.

These are all valuable hydrological measures, but full details of these methods cannot be given here, not that their importance and value has been overlooked, but because they are more often applicable to acute and febrile or mental conditions than to chronic and ambulatory cases, and therefore the opportunity and necessity for using them occurs mostly in the patient's own home or in fever hospitals and other institutions than in the ordinary bathing establishments, and falls to the lot of nurses to carry out under the close observation and direction of the physician.

Moreover, the whole success of their technique depends upon the precision and meticulous care with which the details are carried out, and this requires special training and experience of such cases. Full details of these methods will be found in Dr. Baruch's " Epitome of Hydrotherapy."

CHAPTER III

WATER IN MOTION

Sprays and Douches

WE shall now consider the application of water in motion in the form of sprays and douches, etc. We have already seen that the chief physical characters of water which we make use of in immersion baths are :—

(1) The quiet contact of water with the skin.

(2) Its temperature which we can vary with safety within certain limits.

Now in the case of sprays and douches we bring into action another property of water, viz., its mobility and the forcible impact which it is capable of exerting under hydraulic pressure upon the part to which it is projected. We have got nowadays into rather a loose way of using the terms " Spray " and " Douche," and the same confusion obtains in books. There is, however, a difference between them which, if kept clear, assists in the understanding of the subject in hand. The original meaning of the word spray is, fine particles or drops of water (like rain), such as is seen when a strong wind blows across a wave of the sea, and breaks up the top of the wave into fine spray.

The meaning of the word douche (Italian, doccia) is a single continuous stream or jet of water, as it escapes under pressure from the nozzle of a pipe.

The essential difference therefore between a spray and a douche is that in the case of a spray the column of water in the supply pipe is divided up by passing through

several holes in the nozzle disc, and escapes in the form of small streams under comparatively low pressure, which quickly break up into drops as they fall upon the skin, hence the names shower bath, rain spray, etc.; whereas in the case of the douche, the water escapes in one jet or column under high pressure and remains in that form until it strikes the surface of the body.

It is obvious, therefore, that the effect of the douche is much stronger and more concentrated than that of the spray and, as it must be used with much greater pressure to be effective, it can never be as gentle and soothing as a spray, but always stimulating and forcible.

SPRAYS

Sprays differ in shape, but the common form consists of a short metal pipe which is extended into a broad disc at its nozzle end, and the disc is perforated by a series of holes usually arranged in circles. The diameter of the holes may vary from $\frac{1}{32}$ to $\frac{1}{8}$ of an inch, the size of the apertures regulating the fineness of the spray. Sprays may be given separately or in combination with a bath, and are commonly employed where a gentle force of hot water is to be applied to a stiff or painful joint, muscles of neck or spine, etc. They are sometimes employed to keep one part of the body warm while another part is being treated, as in the Aix douche bath with one attendant. The pressure required is low, viz., about 5 to 10 lb. per square inch. The nozzle is held in such a position as will allow the water to impinge at an oblique angle so as to reduce the force of the impact. The doctor will give in his directions the temperature to be used and the duration and state the part to which the spray is to be applied.

In preparing a patient for a spray, it might be thought that it was unnecessary for him to undress if the treat-

ment is only to be given to the foot or hand, but even this local application may cause a good deal of reaction and free perspiration, so that he will be much more comfortable if undressed and wrapped in a bath sheet.

Local Spray

Having prepared your patient by placing him in a suitable position, take your spray—adjust the temperature by turning on the hot supply of the mixer through the pipe—and then the cold to bring the temperature to that degree which has been prescribed; test it by the thermometer. Then bring your spray to the part to be treated, having previously protected the clothes by blanket and mackintosh.

After the application the part should be dried and wrapped in a warm towel and rested for the twenty minutes or so until the reaction has passed off.

Descending Spray

The local spray is often applied to the head, or in combination with the needle bath from another position, viz., vertically from above, commonly from a fixed rose disc about 2 feet above the patient; this is called the descending spray or shower bath, when the water falls in a gentle continuous stream, or a rain spray when the apparatus is so regulated that it falls in big drops or rapidly interrupted streams. In applying the spray in this form see that the temperature is correct before placing the patient under it. It is not always safe to trust to the temperature being correct, as it flows from the mixer, even though a thermometer is fixed in the flow pipe. It is always well to test it by an ordinary bath thermometer, you cannot tell by your hand alone.

Ascending Spray

Another form of vertical spray is the ascending one ; this is usually given by seating the patient upon a circular support in a sitz bath with the lower part of the body exposed ; it is applied to the anus or vulva for piles, fissures, local skin diseases, enlargement of the prostate, etc.

If it be desirable to apply water in the form of a spray to the whole of the body, it can be done by means of the needle bath, which will be described later.

Throat Sprays

Another common use of the spray, especially of certain mineral waters, is in the form of throat sprays for various conditions of the throat, nose and eye diseases.

For this purpose various apparatus are used, with the object of making the spray as fine as possible ; so fine, indeed, that the spray of water looks like a cloud. In this form they are easily applied or even inhaled either through the nostrils into the nasal cavity or through the mouth over the tonsils to the back of the pharynx and nose into the larynx and trachea.

A coarse spray would only irritate or choke the patient ; they can easily be applied to the eyes in this fine form. It would take too long to describe in detail the various apparatus. If steam be used to form the spray, it must be carefully used, as it may splutter and perhaps scald.

Sometimes the spray is made by causing a jet of water to strike a metal shield and ricochet off at an angle, whereby a fine spray is formed. This apparatus is safe and easily managed, but the temperature of the water must be watched.

More commonly now compressed warm air is used to pass over the nozzle of a fine jet of water, and this makes a nice fine spray.

Therapeutic Effects of Local Sprays

The effects of sprays depend upon the temperature and pressure at which they are applied, but in general they cause the same reactions we have already described when water is applied at different temperatures, but more intense. The application of a hot spray by the impinging of the streams of water stimulates the secretory action of the skin area, dilates the blood vessels, increases the circulatory activity in the blood and lymphatic vessels, softens hard thickenings in underlying tissues, relieves tension and pressure in the tissues and thereby soothes pain in the local nerves. Where the pressure is strongest it may become counter-irritating.

The application of a cold spray has the opposite effect; it reduces the activity of the skin, checks perspiration, contracts the blood and lymphatic vessels and reduces the circulation in them and tones underlying tissues. The application of alternating hot and cold spray has a marked effect in this latter respect.

The Needle Bath

This is an apparatus by which a series of sprays can be applied to the whole of the body simultaneously. It is given either as a treatment complete in itself or preparatory to another treatment or at the close of a treatment.

The apparatus consists usually of a large vertical or upright supply pipe, from which branch off horizontally four or more circular pipes of smaller calibre with numerous perforations on their inner surface. The circular pipes are held in position by two or more upright supports, a space being left between the two front ones for the patient to enter the bath. An ascending douche is sometimes fitted to the base of the large vertical supply pipe, and the latter is usually prolonged upwards to

supply a descending spray about 2 feet above the centre of the needle bath.

There is a modification of the needle bath known as Baruch's rosette needle bath, in which there are no circular pipes, but about five vertical pipes with a series of spray discs or rosettes attached, through which the water issues in the form of sprays.

To the large vertical pipe the water is brought after it has passed through a mixer, and on this supply pipe are fixed a thermometer and pressure gauge.

The pressure can be so regulated that the spray is of moderate strength, or in needle-like jets (hence the name **Needle** bath) as it escapes from the circular pipes. The temperature is regulated by the controlling taps at the mixer, and the spray should be turned on and tested as to heat and pressure before the patient enters the bath, and the patient must wait until it is so adjusted.

The descending spray has a separate control, and so also has the ascending spray, so that they can be used or not as prescribed. Owing to the varying height of patients, it is a great convenience to have a platform on which he can stand, which can be raised or lowered to prevent the upper circular spray from striking his face.

The temperature used varies from 110° to 60° F., according to prescription, usually beginning with the high and often quickly reducing to the low, so that the attendant must quickly adjust at the mixing box.

He must have the hot towels handy and wrap up in the usual way when the bath is finished and the patient rests, as in other treatments.

Therapeutic Effect

The needle bath has a strongly stimulating effect upon the system, and it is only those who are fairly robust who can stand it at full pressure ; its pressure can be regu-

lated, however, so as to have a toning or sedative effect. It can be used as a hot stimulant, though probably its most frequent use is for cooling patients after various hot treatments by lowering the temperature of the water rather quickly, and thereby closing the pores of the skin and checking excessive perspiration; but it is a very valuable, stimulating and toning form of bath, and often suitable when immersion baths are contra-indicated.

DOUCHES

The essential difference, as we have already pointed out, between a spray and a douche is that in the case of the spray the water escapes under moderate pressure from a disc in a number of small jets which soon break up, whereas in the douche properly so-called the water escapes in a single jet or column under high pressure with strong concentrated force, and does not break up until it strikes the body. The pressure is varied according to the object in view, and the impact should not be so strong as to cause bruising or other injury to the tissues. As a rule, a pressure not exceeding 30 lb. per square inch is used.

The Various Forms of Douches

The ordinary apparatus for giving the douche consists of a hose pipe, to which is attached a metal nozzle 4 to 8 inches long, with a tapering end which helps to increase the force. The nozzle is perfectly circular, and its bore, or internal diameter, is usually about $\frac{3}{8}$ to $\frac{1}{2}$ inch. It is important that the channel of the nozzle should be perfectly smooth and even, as any projection will break the column of water. The supply pipe should be at least 8 feet long beyond the mixer to which it is fixed; near the mixer should be fitted both a thermometer and

pressure gauge on the supply, which it is very important to watch. There must be a hot and cold supply to the mixer coming from tanks at the same level at sufficient elevation to give a pressure of 40 to 50 lb. to the square inch.

The **Fan Douche** is that form in which the water is spread out in the shape of a fan as it escapes from the nozzle ; it is usually produced by having attached to the nozzle a metal plate which by pressing a spring handle can be brought to impinge upon the column of water, as it issues from the nozzle so as to flatten out the jet into a fan-shape stream.

The fan douche is used upon those parts of the body, such as the abdomen and chest, which could not stand the force of the douche jet. There is sometimes an advantage in using the finger rather than a separate contrivance, as the change from jet to fan douche is much more quickly made.

The Wave Douche

This is a modification of the fan douche in which the water, instead of issuing from a round nozzle, comes from a slit-like aperture in a steady flat stream, 2 or 3 inches broad, and by means of the shape of the apparatus varies its direction and intensity, like a wave. It is doubtful if it possesses any special advantage.

The Percussion Douche

This is a special form of douche pipe nozzle, by means of which a water column of any desired form may be obtained from a widely scattered shower of large drops to a fusillade of " bullets." The pressure is higher than an ordinary douche, and a stinging sensation is produced as the water strikes.

The water in this form of douche can be used at a

lower temperature than usual on account of its stimulating effect.

The Multiple Douche or Spray Douche

We have seen that the ordinary spray gives a gentle flow of water under low pressure, but with douches we are making use of the force which water under high pressure can exert.

In the case of the ordinary douche the water is in one column or jet, but it is sometimes useful to use a disc with several apertures, so that there are several parallel jets as fine as a needle and exerting much more force than the ordinary spray.

The Filiform Douche

This is made by a special form of nozzle, by which the water issues from a very small opening horizontally, the water being under high pressure ; it is used as a strong counter-irritant, and may produce bleeding, so must be used with caution.

It has been used in cases of sciatica, lumbago or chronic rheumatism as a counter-irritant.

The Mixer

An important part of the various apparatus for giving sprays and douches is the **Mixer** or **Mixing Box.**

This is a small chamber made of metal supplied by two pipes conveying hot and cold water, with a view of mixing them in such proportions as to produce the correct temperature and pressure. The supply tanks should be placed at approximately the same level, so that the pressure in the two pipes may be equal ; these supply pipes have controlling cocks, as also has the douche pipe. On the supply pipe from the mixer is fixed a thermometer

which registers the temperature of the water after it has passed through the mixer.

One form of mixer (Shanks) works automatically, and gives a constant supply of water at a given temperature, a useful contrivance for a deep or pool bath.

Pressure Gauges

On all supplies for douches of water and supplies of steam are gauges, which, by means of a clock hand, indicate on a figured face the number of pounds of pressure supplied, which can be controlled and varied by a regulating handle.

When giving douches, particular care should be taken to watch the pressure gauge as well as the thermometer.

The Tribune de Douche

This is a table upon which are assembled the douche pipes with pressure gauge thermometer clock and controlling handle, so that they are conveniently handy for use.

Modes of Giving the Douche

The attendant, having adjusted the control handles of the douche mixer to obtain the water at the right temperature and pressure and tested it, makes the patient stand at a distance of from 4 to 6 feet, according to the strength of the douche, holding the nozzle in a horizontal position, he applies the douche to the back, the legs and arms, then to the chest and abdomen in the broken " fan " form. If there is any special part the doctor has drawn attention to in his directions, these instructions must be carried out, as, for example, in the case of sciatica.

The Scotch Douche

By this term is meant the alternate application to the

same part of the body of a hot douche, followed immediately by a cold douche, and the rule is that the hot douche should be applied for four times the length of the time of the cold douche, say one minute hot and one-quarter minute cold.

For this purpose it is necessary to have two separate pipes, one supplying the hot and the other the cold. The attendant holds the hot douche in the right hand and the cold in his left. He usually begins by warming the patient's back and then applying the douche to the legs and working upwards.

The temperature of the hot douche may be varied from 100° to 115° F., and the cold from 80° down to 60° F.

The operator must be able to control and adjust the form, the temperature, the pressure and duration to a nicety.

The hotter and colder the douche, the briefer the application must be. It is a good plan to commence with moderate degrees of heat and cold and increase the heat and lower the cold by 2 degrees each successive treatment.

A good form of treatment is to place the patient in the needle bath so as to warm the skin and stimulate the circulation and then apply the douche.

Another method is to give the patient a steam vapour cabinet "bath" for eight to ten minutes and then follow with the douche treatment.

Before the douche is applied the patient should steady himself by hand rail or other support.

The Submarine or Undercurrent "Douche" or Spray

A very useful method of applying a spray or douche is that known usually as the Undercurrent Douche, which is applied to some part of the patient's body while they are in an immersion bath. This is done by passing the

nozzle of the supply pipe under the water in such a position that the douche plays upon the part to be so treated. The advantages of this method are that the force of the douche is modified and softened down by passing through the water in the bath before it reaches the patient, and that the heat of the douche water is more easily borne. When the attendant has to give the undercurrent douche for some minutes at a temperature several degrees above that of the water in the bath, he must have some means of keeping the water in the bath at a level temperature, otherwise it would become unbearably hot. This is effected by having fixed all round the rim a perforated supply pipe whereby cool water can be run continuously into the bath while there is a special waste pipe to take the overflow.

Usually the undercurrent douche is applied at the end of a bath, but in the so-called Tivoli bath, for instance, the douche may be applied the whole time of immersion.

The Electric Douche

It is possible by a special arrangement of the terminals of an electric supply or battery to apply a continuous current of electricity in a douche by charging the water as it leaves the nozzle, but care has to be taken in regard to strength of electricity used, and in the matter of insulation.

Therapeutic Effects of Douches

The effects of the hot douche by its percussion are much more stimulating both to the skin, and especially to the corresponding nerves, than those of the spray ; the heat is more concentrated, and therefore the effect on the circulation more marked, and also the pressure exerted is much greater, so that bruising of the tissues may take place

if it is used too strong. Otherwise the effects are of the same character as those of a spray, but more intensified.

As an application of cold instead of heat it is stimulating and rousing, and accelerates tissue metabolism. Applications of douches are only of comparatively short duration, if too prolonged depression and exhaustion of the nervous and circulatory systems are produced. When general hot douches are given it is necessary to prevent the flow of too much blood to the head by applying cold, wet cloths to the head and applying the heat to the feet last.

Aerated Immersion Baths

These are full immersion baths in which the water is set in motion by passing through it bubbles of air from pipes laid in the bottom of the bath.

The arrangement is as follows: A row of metal pipes, four or five in number, are fixed along the whole length of the floor of the bath connected at the foot end with a supply pipe from a motor air pump. These parallel pipes are perforated at intervals with holes through which the air can escape into the water of the bath. To protect the patient from the pipes a movable wooden frame is fixed over them with wooden bars separated by intervals through which the air bubbles can freely pass. The bars can be lined with indiarubber cushions so that the patient can lie down with comfort upon them.

In this bath the water is not whirling round the patient, but continually striking the surface of the body by the pressure of the fairly large bubbles of air which are rapidly flowing through it and causing a general commotion of the water.

Method of Giving

Rules for the giving of the bath will be the same as for other immersion baths. A three-quarter bath is generally

enough as regards quantity of water. Directions for temperature and duration will of course be given. As soon as the patient is lying down in the bath the air is turned on and increased in force as required.

Therapeutic Effects

The principle upon which this form of bath was designed is that, by the continual motion of the water caused by the passage through it of the air bubbles, the surface of the body is stimulated by the water and air in a somewhat similar manner to that of the friction and manipulative movements of massage, only more gently, and the reaction of the skin and circulation is augmented.

The Whirlpool Bath

This form of bath was largely used during the Great War. Its object is to combine a bath of fairly high temperature with a continuous current or movement of the water under hydrostatic pressure directed against a limb or whirling movement round it by means of a turbine. The temperature of the incoming water is regulated by a mixer, to which a recording thermometer is attached, and the pressure is also regulated by controlling cocks either fixed in the sides of the bath vessel or in the mixer.

As additional water is always flowing into the bath it is provided with an adequate overflow pipe.

In one form of this bath, instead of multiple jets, a single jet or ejector (Bardwell), by which air is mixed with the inflowing water, is used, and this single jet can be arranged to direct the stream of water on to any particular part to be specially treated. The temperature of the water in the bath is kept at about 100° F., but that of the water in the jets is used from 110° up to 120° F. when the limb can bear it.

The duration of this bath is from ten to thirty or forty minutes, according to the nature of the case.

Fill the bath with water at 98° F. and gradually increase the temperature by shifting the lever to right or left and watching the supply pipe both as to temperature and pressure.

Therapeutic Effects

This treatment is usually applied to limbs only, the heat relieving pain and the whirling water by its motion producing a friction of the skin and underlying parts akin to gentle massage manipulation, which stimulates the general circulation in the limb and joints.

WATER IN MOTION PLUS MASSAGE

Douche Massage Baths

These forms of bath treatment consist in the application of the water in the form of a douche or spray with the addition of massage, while the patient is either sitting or lying down.

There are four variations of the principle :—

I. **The Aix Douche Massage Bath.**
II. **The Vichy Douche Massage Bath.**
III. **The Harrogate Douche Massage Bath.**
IV. **The Buxton Douche Massage Bath.**

You must bear in mind that when the douche is used alone, as in the Scotch Douche, you rely upon the pressure and vibration of the douche itself to produce the mechanical stimulation which is desired, and the pressure of the douche may range up to 30 lb. per square inch and even higher.

But in the Douche Massage Baths there is added to the

effect of the douche the stimulating effect upon the system of massage and passive movements; hence the pressure needed in the douche is much less and does not usually exceed 10 to 12 lbs. per square inch.

The Aix Douche Massage Bath (see Fig. 2, p. 32)

The patient is often placed in a steam vapour room or hot air cabinet at a temperature of 110° to 115° F. to induce perspiration for about ten minutes. He is then conducted into the Aix Douche Room. This room has its floor so arranged that it is covered by hot water to a depth of 2 or 3 inches, which keeps both the room and its occupants warm. Beside the supply pipes, mixer, and douche pipe, there is a stool about 2 feet high, with a low back (6 inches). The patient is seated upon the wooden stool. The attendant having previously adjusted the temperature and pressure of the douche, in the case where the bath is to be given by one attendant (not two as at Aix-les-Bains), now places a warm spray to play over the patient's back to keep him warm. The nozzle of the douche used in the Aix method is curved so as to make the water impinge at the right angle when the douche pipe is hung on the shoulder of the attendant. He then hangs the douche pipe on his shoulder in such a way that he can direct the douche water upon the part he is about to manipulate, and at the same time leave both his hands free to perform the various massage movements. This takes some practice to accomplish. The pressure of the douche must not exceed the 12 lb. as already mentioned, or the water will splash up in the face of the manipulator and prevent him from seeing what he is doing. Often 5 to 10 lb. pressure is quite sufficient.

The object of the douche is to stimulate the circulation, both central and lymphatic, of the tissues, and prepare

them by its temperature and mechanical stimulation for the simultaneous massage. The attendant commences massaging the lower extremities first—the toes, feet, ankles, legs and thighs—moving upwards in the direction of the venous and lymphatic circulation, increasing the circulation in these vessels by a movement commonly called " double clicking," which may be described as a double pushing movement, with both hands grasping the part of the body. The muscles are kneaded by petrissage across their longitudinal axis and picked up in the direction of the longitudinal axis, so as to make sure that they are quite free from adhesions or deposit. He also moves each joint passively to see that their mobility is as free as it should be.

Having treated the lower limbs, he does the same to the upper limbs, which, on the Aix stool, are easy to reach, beginning with the fingers and proceeding up the limb and treating the neck and shoulders at the same time. He then deals with the abdomen and chest and completes the " bath " by douche massaging the back. It is obvious that the buttocks cannot be reached in the sitting position, which is the ordinary pose for this form of douche massage. For this reason, many years ago the inclined plane was introduced at Aix, on which the patient was placed in the prone position so that the buttocks and back of the thighs could be handled.

The description I have given is that of an Aix Douche Massage given by one attendant, but the method which has always been adopted at Aix is for the treatment to be given by two attendants, one of whom uses a douche with more pressure than the other, the high-pressure douche being used when the limbs are being treated and the lower pressure douche when the chest or abdomen is being dealt with.

A great advantage also in having two attendants instead

of one is that the whole bath can be given much more quickly, and therefore not so likely to be exhausting to the patient.

The temperature of the water used for the douche ranges from 98° to 102° F., according to the object in view in giving the treatment. Where an almost neutral temperature is prescribed, the object aimed at will probably be to give a soothing treatment only.

Where the higher temperature of 100° to 102° F. is prescribed the purpose in view will be to give a treatment which will be strongly stimulating to the skin, nervous system, circulation and metabolic changes in the tissues.

The usual duration of this treatment is about twenty minutes to half an hour ; longer than this is likely to be tiring and depressing. Note must be made of any special directions given about treating a particular part—say, for instance, a joint.

It takes one attendant at least twenty minutes to go over the whole body at one sitting, and this must be borne in mind if one part has to be specially treated so as not to prolong the bath unduly.

It is a common practice for the patient to be douched all over at the end of the bath with water at a temperature of 102° F., cooling quickly to 80° F. or below.

He is then wrapped up in towels and blanket, so as to encourage perspiration for five to fifteen minutes, and then rests for half an hour or more until he has thoroughly cooled down and the reaction has finished, when he can dress.

The Vichy Douche Massage Bath (see Fig. 3, p. 32)

The method of giving the Vichy douche massage differs from that of the Aix douche massage in two or three important ways :—

(1) The patient is treated in the recumbent position.

(2) Instead of a single douche, a high pressure spray from four or five rosettes attached to a horizontal supply-pipe plays upon the patient continuously as he lies, avoiding the face.

(3) All his muscles are relaxed.

As a preparation for the Vichy bath a needle bath is often given for two or three minutes at a temperature of 103° F. or less, and then the patient lies down upon the special couch after the spray has been adjusted to the correct temperature (usually about 98° to 100° F.). The attendant then proceeds to massage the patient, beginning at the feet or hands and proceeding up the limb towards the body; he then massages the chest and abdomen while the patient is lying upon his back; when this is completed, the patient turns over on to his stomach while the attendant massages the back, paying, of course, particular attention to each part mentioned by the doctor for special manipulation.

It will be noticed that it is much easier to apply the douche to the abdomen, on the one hand, and to the back, on the other, by the Vichy method of giving this douche massage than by the Aix method.

The couch should be at the right height to enable the attendant to give the massage to the best advantage, and this will be found when the upper surface of the couch or water-bed is from 2 feet to 2 feet 3 inches from the ground, according to the attendant's height.

The Harrogate Douche Massage Bath

This form of douche massage is a modification of the Aix method to this extent, that the first part of the bath is carried out on the wooden stool, viz., the legs, arms and neck are massaged with the Aix douche, and then, instead of the patient continuing on the stool, he is made to lie down on the Vichy couch and massage is again

carried out with the Aix douche or hose, the Vichy spray not being used. It is claimed for this method that the abdomen and back are more easily reached and handled than on the inclined plane, as at Aix, and it is more comfortable and less fatiguing for the patient.

The Buxton Douche Massage Bath

This modification of the douche massage bath was introduced at Buxton, and is carried out by douching and massaging the patient while he is lying in a shallow nickel-plated trough of warm water, the head and other parts of the body being supported, if necessary, by suitably placed " loufa " pads. The water in the trough just covers the body, and the masseur has a douche spray over his shoulder, as is done in the Aix method, and massages the part of the body on which the water from the douche is falling. The treatment is completed by the use of the direct douche while the patient stands, followed by a needle bath ; the temperature of the bath, douche and needle bath being determined by the physician's prescription. The advantage claimed for this method is that, through the body being immersed in water while the massage is being given, the muscles and tissues are more relaxed.

Therapeutic Effects of Douche Massage Baths

We noted that in the case of immersion baths the effects varied with the temperature and duration. In douche massage baths the reaction effects are similar in character, but owing to the addition of the stimulation of the douche, and still more of the massage manipulations, the effects are greatly intensified.

The therapeutic effects of the douche massage bath depend upon : (1) the temperature of the douche and spray, *i.e.*, whether hot or neutral ; (2) upon the pressure

of the douche ; (3) the character of manipulations used by the masseur ; (4) upon the duration of the bath.

Hot douche massage baths with as high a pressure as is practicable, and with vigorous petrissage and friction manipulations, stimulate the nerves to which they are applied, and increase the circulation in the blood and lymphatic vessels in the skin and underlying parts to a considerable degree ; they are only applicable to those patients who are strong enough to bear them, but extremely beneficial in cases of chronic (not acute) inflammatory thickening about muscles and nerve sheaths, and also joints, as well as cases of obesity for reducing excess of fat.

Neutral douche massage baths with low pressure throughout, and with gentle effleurage manipulations, have a remarkable sedative effect upon the nervous system as well as upon the circulation, which is the opposite effect of the hot douche bath ; they are applicable, therefore, in a variety of low asthenic nervous states and weakly patients.

The therapeutic advantages of the four variations of douche massage baths and their suitability for different conditions have already been pointed out. It will be observed that these forms of baths can be used both for their local and general effects.

MASSAGE AND MOVEMENTS

Massage, or the manipulation of the body by the hands, is a very ancient form of treatment, and has long been associated with certain forms of bath treatment. It was first systematised by Ling, who established a school of massage and exercises at Stockholm. Ling's system laid down four primary methods of manipulation—effleurage, petrissage, tapôtement and friction. Vibration was introduced later by Kellgren.

Effleurage is essentially a stroking slowly to and fro of the skin with either the fingers or the entire palm of the hand in continuous contact with it, varied according to the strength required. The movement is made centripetally—that is, in the case of the limbs, from the extremities towards the body, the upward movement being the stronger and the reverse movement being more gentle.

Petrissage is a kneading manipulation by which the skin and underlying muscles are picked up between the fingers and thumbs, or in the palm of the hands, those of a limb being manipulated in succession from the more distant portion up towards the body seriatim, the muscles are grasped and pulled upwards in the direction of their length and rolled in both hands against the underlying bones.

Tapôtement is the manipulation by which a series of rapid blows are struck by either the fingers, the movement taking place from the wrist, or by the ulnar edge and little finger of the hands, a movement taking place from the elbow, or by either surface of the whole hand, the movement taking place from the wrist and elbow. This manipulation also includes hacking, slapping and cupping or beating. These methods are carried out generally by both hands rhythmically, the movement of one hand alternating often with that of the other.

Friction is the rubbing in circles by either the fingers or thumb, or the thenar eminence, or the whole hand, either lightly or deeply, and can be applied where petrissage is impossible.

Vibration, as the name implies, is the manipulation by which a shaking or vibratory movement is conveyed to part of the body by laying the tips, or more of the fingers, or the whole hand, upon the surface and making it quiver or vibrate by a corresponding action of the

operator's arm. It is now often given by a motor-vibrator.

Each of these methods produces different therapeutic effects. The whole system of massage is based upon the use of these primary manipulations, and the adaptation of them to various parts of the body according to their function and anatomical structure. Their selection will depend upon the different conditions to be treated and the part to be treated.

Massage is employed, as we have seen in the douche massage baths, coupled with passive movements of all the joints of the body.

PASSIVE MOVEMENTS

Passive movements and exercises are based upon the normal movements of the joints. These movements are chiefly of two kinds—extension and flexion—viz., a movement in one direction and the reverse. Certain joints, as the shoulder and hip, which are " ball and socket " joints, permit of circular and rotatory movements as well.

The object of using passive movements is to insure that the full and normal movements of the joints take place or, in diseased conditions, are restored.

After passive exercises, a patient is often taught to take active exercises of the same character ; active exercises train not only the muscles and joints, but the nervous system, to become capable of performing them voluntarily, and so retain their proper mobility and action. The Zander system has been designed to carry out all these movements by mechanical means.

From what has been said on the subject of massage and movements, it is quite obvious that the bath attendant who undertakes to give the douche massage baths intelligently and correctly must not be merely what

used to be called a " rubber," but a fully trained masseur, who has a proper knowledge of the anatomy and physiology of the body, including the position of the muscles and nerves and the structure and mechanism of the joints, and has acquired the ability to perform all the essential manipulations and exercises.

IRRIGATIONS

Before leaving the subject of sprays and douches, we must point out that in the case of **Nasal, Intestinal,** and **Vaginal** so-called **Douches,** the term douche is not strictly appropriate, for, though the water escapes from the nozzle of the supply pipe in one jet or stream, only sufficient pressure is used, and that usually of gravity, to enable the water to find its way along the mucous membrane of the passages which we wish to irrigate, and it is advisable that no excessive force be used at all.

INTESTINAL OR COLONIC LAVAGE

This treatment consists in washing out the large intestine (colon) with either plain or mineral water, or some weak antiseptic solution in cases of constipation, or intestinal toxæmia, or in colitis, or even arthritis associated with intestinal fermentation. Various methods are now in vogue, but the earliest was the Plombières.

Plombières Method (see Fig. 4, p. 32)

The equipment necessary is as follows : A well-ventilated but not chilly room ; a sofa with leather mattress conveniently placed so that the attendant can get to either side, with an aperture in the centre through which any fluid coming from the patient can be received. At the foot of the sofa a vessel, capable of holding at least

half a gallon of fluid and protected, so that its contents can be kept warm, suspended by a cord working over a pulley so that its height can be varied within 3 feet, as shown by a scale along which it slides on its supports; from the bottom of the vessel is attached an indiarubber tube, 4 to 5 feet long, with a controlling tap, and at the end of the tube a nozzle to which can be fixed a separate indiarubber rectal tube, varying in length from 4 to 12 inches and $\frac{1}{4}$ to $\frac{3}{8}$ inch in diameter, which is passed into the patient's bowel. Longer rectal tubes are not, as a rule, used as they often curl up, unless they have a small lumen, and do not pass beyond the rectum. Connected with the douche room is a lavatory, so constructed that the contents of the bowel when passed may be inspected. Adjoining, or part of the douche room, is also a bathroom, where the patient may be given a "Tivoli" bath; this is an immersion bath fitted with an overflow pipe and a means of keeping the water at a uniform temperature of about 98° to 100° F., while a hot spray is played upon the abdomen through the water, viz., as an undercurrent "douche," at a temperature of 105° to 110° F.

There are separate cubicles where the patient can undress and rest after the treatment is completed.

It may be mentioned that, besides the Plombières method, there have been introduced at least three other apparatus by which the irrigation or lavage of the bowel can be carried out, and each claim certain advantages over the Plombières method. We have not space to give full descriptions of them, but they are as follows:—

(1) The "Gymnacolon" (Von Borosini), with short rectal tube.

(2) The Studa Chair Apparatus, with short rectal tube.

(3) The Schellberg Apparatus, with long rectal tube (4 to 5 feet) passed in stages as far as the cæcum.

Method of Lavage (Plombières)

The attendant having prepared the water or solution at the right temperature (usually 100° to 104° F.) and fixed the containing vessel at the prescribed height (usually 18 to 24 inches above the patient's level), and having protected the couch with towels, the undressed patient lies upon the couch on his right side. The attendant stands on the patient's left side, and, having looked to see that there is no inflamed pile or painful crack or fissure, he lubricates the tube and inserts it gently into the rectum and passes it up through the sphincter until 4 to 5 inches of the rectal tube is lying in the bowel.

It has been a debatable point as to how far the rectal tube, if 12 or more inches long, reaches when passed into the bowel. The sphincter ani lies about $1\frac{1}{2}$ to 2 inches from the anus, so that the tube, if already passed 4 inches, must be through the sphincter, the rectum is from 5 to $5\frac{1}{2}$ inches long, but there is a sharp turn before communicating with the sigmoid flexure, and it has been found that, if the tube is passed more than 6 inches up the rectum, it often curls round back into the rectum, so that no advantage is gained by passing it into the bowel more than 4 to 5 inches; this bending back of the rectal tube has been proved by X-ray photograph. Normally the colon increases in diameter as one passes from the sigmoid flexure to the cæcum, except at the sharp bends at the splenic and hepatic flexures, so that if once a tube gets into the sigmoid flexure there should be no difficulty in passing it along the whole length of the colon up to the cæcum. Now it is found that if a long tube is sufficiently small in diameter (not more than a $\frac{1}{4}$ inch) and flexible, it can be passed in the course of four or five successive days, so as to let the bowel get accustomed to its presence, right along to the cæcum, as can

be proved also by X-ray, and it is because this is possible that an apparatus like the Schellberg can be utilised if necessary.

There are conditions of the bowel with spasm where the passing of any rectal tube more than just into the rectum is difficult, even in experienced hands. On the other hand, if fluid is allowed to flow with gentle pressure, the bowel itself will by peristaltic action pass it along well up into the colon, as can easily be demonstrated, so that when using the Plombières method nowadays it is customary to insert the rectal tube just into the rectum past the sphincter. The fluid is allowed to flow steadily into the bowel by gravity, the quantity prescribed being to begin with 1 pint, gradually increased up to 2 pints, at a temperature averaging 100° F. After two minutes on his right side the patient turns on his back, and again in two minutes he turns on his left side, and then evacuates when he feels the desire. After a short interval the same process is usually repeated, the first application having emptied the lower part of the bowel of any fæcal accumulation, so that the second application is likely to be more effectual as a washout (lavage).

Often the lavage stops at this stage, in which case it can be given when the patient is only partially undressed.

But in other cases it is carried to the next stage, viz., a Tivoli bath, when, of course, the patient must be fully undressed.

The attendant will have prepared the bath while the patient is evacuating the motion by seeing that the water is at the prescribed temperature and the spray working properly. The patient gets into the bath and lies down in a comfortable position and the high pressure spray is played through the water on to his abdomen, moving it round chiefly over the colonic area from right to left for the prescribed time (usually five to ten minutes).

The patient then leaves the bath, is dried and wrapped in warm towels, and rests for twenty minutes or more until he has cooled sufficiently to dress ; this rest after the full treatment is essential as the effect may be, owing to the very nature of the complaint, exhausting for the time being.

Therapeutic Effect

This treatment is given both to re-energise the bowel and to remove fæcal accumulations, as well as to cleanse and disinfect it in cases of constipation, colitis, intestinal toxæmia and fermentation, and other similar conditions, and the spray has a toning and soothing effect in cases where there is relaxation, spasm, colicky pain and irregular action of the bowel ; it is also given in cases where there is not only bowel trouble or skin disease, but also arthritis, in which event the patient will require extra help and care from the attendant.

The Vaginal Douche

The vaginal douche (sometimes called " special douche ") is used in the treatment of some diseases of women.

The mineral water or solution is held in a porcelain or glass container working on a sliding support, so that its height above the level of the reclining patient can be varied if necessary ; attached to the container is a supply pipe with control tap, and the vaginal tube is fixed to the nozzle of the supply pipe. The treatment is given either while the patient is reclining in a bath or sitting over a bidet. It is most important that no force should be used but that of gravity, which allows the water to flow gently along the passage and irrigate it.

Therapeutic Uses

The vaginal douche is used for irrigating the vagina when there is abnormal discharge, the temperature of the douche in this case being about 100° F. and the duration about five to ten minutes. It is also used for applying heat locally to the pelvic organs, when the temperature of the douche may be prescribed as high as from 110° to 120° F., when given combined with a bath.

The Nasal Douche

Nasal douches are given on the same principle as the above but with a smaller apparatus, and the patient has to learn to breathe through the mouth while the nose is being irrigated.

CHAPTER IV

STEAM VAPOUR

We have already considered the various ways of applying water in its still form, viz., in quiet contact with the surface of the body, as in the case of immersion baths, and also the various methods of using the force or pressure of water in motion by means of sprays and douches.

We have now to consider the use of water after it has been converted into **Steam Vapour,** *i.e.*, in a state of very fine subdivision or drops.

In this form it is used, not for its force or pressure, but chiefly as a means of conveying to the skin a moist heat of higher degree than can be borne if conveyed in its ordinary liquid form. In order that you may understand the action of steam vapour you must know some facts about steam itself.

Water boils under ordinary atmospheric pressure at a temperature of 212° F. (100° C.), by which we mean that the fluid water is converted into an invisible gas (steam gas).

When this gas is allowed to escape into the cold air, it quickly cools and condenses into very fine particles of water, which then become visible as a dense white cloud. This is what we call **Steam Vapour.** In this process of condensation it rapidly loses its heat, and thereby cools to a temperature which can be borne by the skin.

If you watch a kettle boiling and watch the steam coming out of the spout, you notice that close up to it there is nothing to be seen, but about an inch away from

the spout a white cloud is formed which floats upwards into the air. If you placed your finger close up to the spout the invisible steam would scald it, but you can pass your hand through the vapour at a little distance from the spout and it will feel only hot, and the further away you move it the cooler the vapour becomes until you feel no extra heat at all. If you test the vapour as it escapes from a boiling kettle you will find that the thermometer drops to 130° F. at 5 inches from the spout, showing that you have converted the water into a gas and then condensed the gas into fine particles of water at a temperature of 80° to 100° below boiling point, viz., 130° to 110° F. Steam vapour, as applied to the body, is, of course, composed of a mixture of fine drops of water and hot air.

The highest temperature at which steam vapour can be borne by the whole body is 120° F., but if applied locally it can be borne without injury up to 130° F. This temperature is 20° above that which can be borne by immersion in water in ordianry liquid mass or bulk except for a very short duration.

Steam Vapour may be applied either locally or generally.

Berthollet Local Steam Vapour (see Fig. 5, p. 32)

For local application of steam vapour to the limbs the apparatus commonly used is that known as the "**Berthollet,**" named after its designer, a celebrated French chemist in Savoy, the original apparatus having been invented by him for utilising the vapour which arises from the hot sulphur water of Aix-les-Bains.

It consists of a large metal cylinder, about 3 feet in diameter and 5 feet high, from the side of which branch out two smaller cylinders above and one large cylinder below, into which fit metal tubes shaped to contain the

arms and legs respectively. The large main cylinder is closed at its upper end, except for two openings, into which fit lids which can be opened partially as required so as to act as valves for the escape of excess of steam. Into the closed upper end is also fixed a thermometer for registering the required temperature. The large cylinder stands over a supply pipe for the steam, which has a steam-pressure gauge and controlling taps. Inside the main cylinder are fixed wooden supports for the arms and hands and foot-rests and supports for the feet and legs. To the outside of the small cylinders which receive the arms and legs are attached mackintosh sleeves.

Method of Applying the Berthollet Local Steam Vapour

Towels are laid upon the supports inside the large cylinder for the arms and legs, and the steam is turned on and supplied until the thermometer registers about 125° F.

The patient may be partially undressed or fully in the case of all four limbs being treated. He sits down opposite the cylinders, passes his arms or legs through the mackintosh sleeves and into the small cylinders until they rest upon the supports. A layer of towel is folded over the limb so as to prevent drops of hot condensed steam falling upon the limb and scalding it. Over the limbs, when in proper position, the mackintosh sleeves are drawn and tied so as to prevent steam and moisture escaping.

The application of the steam is usually given for from fifteen to twenty minutes. After the application the limbs are withdrawn, dried and rested, as after any other form of hot treatment.

Massage is often given after the steam treatment, as it has a good preparatory effect in moistening and warming a dry skin surface.

GENERAL APPLICATION OF STEAM VAPOUR

The Cabinet Vapour Bath

The best apparatus for the general application of steam vapour to the body, excluding the head, is the Cabinet Vapour Bath. This consists of a wooden box large enough to contain a chair, upon which the patient sits while he is having the treatment. It is provided with a door at the side or in front through which the patient enters. It has a large lid which slopes slightly down in front, and in the middle of the lid is an aperture through which the head protrudes so that he can breathe fresh air. The level of the lid is arranged to correspond with the neck of the patient as he sits in the chair. A supply pipe for the steam is continued under the chair in the form of a ring on the floor of the cabinet with a metal shield, and in the lid is fixed a thermometer for registering the temperature inside the cabinet. The steam supply is under proper control and the pressure, as measured by a gauge, can be adjusted to the temperature prescribed.

Method of Giving the Cabinet Vapour Bath

As the steam is to be applied to the whole body the patient must fully undress, and takes his seat on the chair after the steam has been turned on for a while so as to warm the cabinet. After he is seated, a towel is wrapped round his neck so as to prevent the escape of steam through the aperture for his neck in the lid. A cold, wet cloth is sometimes applied to the top of the head.

The steam is then again turned on and regulated in quantity so as to keep the temperature inside the cabinet up to about 110° to 120° F. as prescribed.

The duration of the application will usually vary from ten to twenty minutes or more, partly according to the

patient's ability to perspire, partly according to whether the application is only preparatory to another to follow, such as the Douche Massage bath, or prescribed as a complete treatment in itself.

At the finish of the time the steam is turned off and the patient rises, and may have a sponge down or a short needle bath with temperature 102° F., cooling to 90° or, at most, 85° F., after which he is wrapped in towels and lies down upon a sofa and rests until he has sufficiently cooled down to dress.

The Berthe Vapour Cabinet

This is really a modification of the preceding apparatus for applying steam vapour in a cabinet bath which was devised by M. Berthe in order to apply medicated steam vapour to the skin surface.

The cabinet is of the ordinary shape, with chair or stool and lid with aperture for the head, thermometer, etc., and it is supplied with steam, but the supply is first passed through a mixing box to the top of which is fixed a receptacle for holding volatile oils, such as eucalyptus, pinol, etc., which slowly falls into the mixing chamber and so becomes incorporated with the steam before it enters the cabinet. Its efficacy depends upon the increase in the stimulating action of the steam owing to the addition of the volatile oil.

In some establishments there is a **Steam Vapour Chamber** where, as in the Russian vapour room, the patient sits undressed and inhales the vapour which, by a special apparatus, is already charged with eucalyptus, pinol, cresoline, etc., and perspires freely at the same time. This treatment is very beneficial in cases of nasal catarrh, etc. After remaining in the chamber for ten to fifteen minutes he passes into a short needle bath to wash

and cool down, and then lies down wrapped up in towels until he is fit to dress.

The Russian Steam Vapour Bath

The ordinary means of applying steam vapour to the whole body, head as well as trunk, is that of the Russian Vapour Bath, which is found in all Turkish Baths as a separate chamber leading off from the first hot room, or in other establishments it may be installed by itself.

It is usually a chamber of at least 12 by 10 feet and about 12 feet high, with walls composed of white glazed bricks or " Manu " marble. It is provided with chairs or wooden rests upon which the patients can recline.

The steam is conveyed to the chamber in good-sized pipes, which are perforated at intervals so that the steam can escape into the room in a downward direction on to the floor, where it rebounds and diffuses itself through every part without the danger of its playing directly upon the patients. Proper ventilation is arranged for and a vent is provided for the spent vapour to escape, so that a steady fresh supply is always coming in. The whole room is filled with steam vapour reduced to a temperature of 115° to 120° F.

The patient with a dry and torpid skin usually begins to perspire easily after remaining from ten to fifteen minutes in the vapour room, and, when forming part of a Turkish bath, can then pass into the dry, hot air rooms or into the shampoo room directly.

The Auto-Condensing Thermal Couch

Another convenient method of utilising steam vapour found in some establishments is that introduced originally by Dr. Wilde in the form of the Thermal Couch.

The steam from a boiler is passed into flat condensing

chambers, from which it is allowed to escape through small holes on either side of the patient, who lies upon a special filter mattress supported by a wire mattress. Over the patient is a metallic cover, hinged to open as required, reaching from his feet to his neck. There are special means of regulating the supply of steam, and the temperature at which it is applied is not more than 105° F. The patient's temperature rises quickly and free perspiration takes place.

The after-treatment is carried out on the same lines as after other hot methods.

(Full particulars can be obtained from the Cox-Cavendish Electric Co., 105 Great Portland Street, W.1.)

Therapeutic Effects of Steam Vapour

Two or three methods of applying steam vapour have now been described, and it is found in practice that it is seldom necessary to use a temperature as high as the maximum which can be borne, for usually quite a satisfactory general reaction can be obtained with lower temperatures. If the temperature of the steam is above 130° F. the effect upon the skin is too stimulating and causes pain, swelling, and eventually inflames, scalds and blisters it. The chief reason why the steam vapour has this effect is because the skin cannot perspire fast enough to carry off the extra heat as it would in dry air, owing to the air being saturated with moisture, the result being that the body temperature rises quickly. Therefore for general application, especially as in a cabinet vapour bath, a temperature of 105° to 110° F. is often enough ; but it is necessary to graduate the amount of steam so that there shall not be an excess, which will prevent rather than assist the proper action of the skin. For local applications, however, as to a joint or limb, the higher temperatures (120° up to 130° F.) are commonly used. Steam vapour

Table showing the Comparison between the Reaction Effects of Steam Vapour and Dry Hot Air

Of Body.	Steam Vapour.	Dry Hot Air.
Skin . . .	Moistens, softens, incites easy perspiration, prepares dry skin for massage.	Sometimes dries skin, causes burning sensation, increases perspiration but sometimes fails.
Nervous system .	Soothing.	Stimulating.
Heart and pulse .	Accelerates rate of beat.	Increases rate, then lessens.
Blood vessels . .	Dilates superficial, decongests deep.	Dilates superficial, decongests deep.
Blood pressure. .	Raises, lowers slowly.	Raises, then lowers quickly.
Respiration . .	Increases rate not greatly.	Increases rate and evaporation from the lungs.
Temperature . .	Tends to raise greatly.	Raises only slightly.
Metabolism . .	Increases rate	Increases rate slightly.
	For strong patients only, never to very old or to feeble, or in heart disease, cautiously in renal diseases.	Safer for old and feeble people, can be given safely to cases of heart and renal disease.

baths have a special value on account of their effect upon the skin itself. At a moderate temperature they cleanse it, and open its pores, when the skin is dry and scaly they moisten and soften it. They promote and facilitate the natural secretion of its sweat and sebaceous glands. With higher temperatures the cutaneous blood vessels and capillaries dilate, and the glands are powerfully stimulated, so that perspiration is greatly increased. The nerve-endings in the skin are soothed and pain in their nerves is often relieved. The presence of the moisture mitigates any irritating effect of the heat. The therapeutic effect of a vapour bath is not, however, limited to the skin surface, but its stimulus is conveyed to the underlying blood vessels and lymphatics, resulting in dilatation of them and increase in blood and lymph flow. This surface increase relieves congestion of deeper organs and internal mucous membranes. The body temperature is quickly raised, loss of heat being checked by the moisture, which is beneficial in conditions of subnormal temperature, chill, stiffness of muscles and joints, lumbago, etc. They are often given before a douche massage bath, and in many painful conditions due to neuritis, gout, or rheumatism.

There is a difference between the reaction effects of steam vapour and dry hot air, and consequently in their therapeutic value. A short table showing the comparison is given on p. 97.

CHAPTER V

COMPRESSES AND PACKS

HEAT can be conveyed to the body when only a local effect is required, whether it be the head, neck, trunk, or any portion of a limb, by means of hot moist applications. Similarly, heat can be abstracted from any portion of the body by means of cold moist applications.

The media used for this purpose may be water, peat, fango, paraffin wax, etc.

The simplest and readiest means of conveying heat or abstracting it is by water, which, as we have already seen, is peculiarly suitable for the purpose on account of its physical properties in regard to heat.

Hence we make use of the time-honoured cold compress for cooling purposes and the hot compress or fomentation for increasing the heat of any part of the body.

The Cold Compress

Cold compresses are made by soaking a few folds of cotton or linen cloth, swansdown or huckaback towelling in water at any temperature below 65° F. down to that of melting ice in extreme cases, and after wringing them out, which is usually done in a strong dry towel or in a wringer if handy, applying them to the affected part and keeping them applied by the compression (hence the name) of a bandage or binder and changing them as often as they begin to get warm.

Therapeutic Uses

Cold compresses are often used for application to the head to keep it cool and prevent congestion of the brain when hot treatments of any kind are being given to the rest of the body ; cooling compresses are also useful in relieving hyperæmia and congestion and in the relief of pain.

The Hot Compress or Fomentation

Hot compresses are prepared by dipping folds of cloth or towelling in boiling water and placing them in a warm dry towel and wringing them out so as to just remain moist. To avoid scalding his hands the attendant should fold the ends of the dry towel over sticks and twist them round until the enclosed cloth is wrung out. The hot compress should then be applied as hot as it can be borne, and changed and a fresh one applied as soon as the first becomes cool. In order to retain the heat a hot, dry covering is placed over the compress and secured by bandage.

Therapeutic uses

Hot compresses or fomentations rapidly relieve pain and spasm, assist inflammatory reaction and promote suppuration and the absorption of exudations.

PACKS

By the term " pack " we mean the method used for the application of heat to the surface of parts of the body by various media, such as mustard bran, peat, mud or fango (Italian for mud), either native or imported from abroad, and artificial preparations like antiphlogistine. They are easily prepared with suitable equipment. The pack room should be furnished with a wooden table upon which the

largest pack can be spread ; a sink supplied with hot and cold water about 2 feet long by 1½ feet broad and 1 foot deep. At one end of the sink should be fixed a small wringer for drying the hot flat pad or cover used for putting on the top of the pack when it is in position. There must also be a cupboard, kept hot by such means as steam coils to keep the towels, etc., hot ; also spoons or wooden knives for mixing and spreading, bucket, etc. The pack room will be adjoining the cubicles where the pack treatment is given. The cubicles will contain a sofa upon which the patient lies while the treatment is being given. Close to the cubicles will be a needle bath room, as this is often given for a few minutes at the end of the application of the pack.

Mustard Bran Pack

In preparing a pack of mustard bran the first thing the attendant must do is to put the materials ready on which he is going to spread the mustard and linseed. These consist of :—

(1) The outside pad, which is made of three layers of flannel quilted together, in size about 2 feet by 12 to 14 inches. This pad before use is heated by dipping it in boiling water, then passing it through the wringer so as to make it sufficiently dry.

(2) Two or three sheets of newspaper a little larger than the size of the pack so that it can be folded over the edge.

(3) Three or four layers of muslin or calico cloth.

(4) A dry huckaback towel hot.

(5) The containers of mustard bran and linseed meal, which are generally kept hot.

Having assembled the materials he proceeds to mix his mustard bran and linseed with boiling water by means

of a wooden spoon, making it soft and easy to spread. The proportion of these ingredients will be as follows :—

For a **mild** pack, three of mustard bran to three of linseed.

For a **medium** pack, four of mustard bran to two of linseed.

For a **strong** pack, five of mustard bran to one of linseed.

Next he heats the outside quilted pad, passes it through the wringer and places it upon the table.

On this pad are laid three layers of newspaper upon which is spread the hot mustard bran. The advantage of spreading the mustard bran mixture on paper is that when the pack is taken off most of the mixture is on the paper, and this can be thrown into the waste bucket without clogging up the cloths or the drains.

He then spreads the hot mixture on the layers of paper and turns the edge of the paper over the edge of the spread mustard. Over the mustard is spread one, two, or three layers of muslin, according to the sensitiveness of the patient's skin as judged by experience. Moist skins will want more and dry skins will require less. The whole pack is laid upon a hot towel and rolled up ready to be applied to the patient.

The temperature of the pack, which should always be tested before application, is usually about 115° F., though sometimes a greater heat can be borne.

Method of Applying the Mustard Bran Pack

The patient is prepared for the pack by being partially or wholly undressed, according to the particular part of the body to which it is going to be applied. In the case of a liver pack he should be fully undressed, both to facilitate the application and also because, on account of the general reaction and perspiration which takes place, a sponge

down of the whole body will have to be given or a needle bath.

In giving a **liver** pack it is advisable to protect the skin about the navel by smearing it over with vaseline and covering it with a piece of lint.

As soon as the patient has undressed, he lies upon a sofa which has been covered by a warm blanket and a sheet. The pack is them unfolded and applied to the local part (in the case of the liver the pack must extend from the middle line in front, round the right side, and across the full breadth of the back, and should measure from 8 to 10 inches in width). The pack is then fixed in position by the towel in which it was wrapped so as to keep it firmly in place ; then the sheet is folded over him and this covered by the blanket. A mustard bran pack is kept on for from ten to fifteen minutes, rarely longer. It is now removed and the patient covered by a warm towel and allowed to rest for five minutes. He then gets up from the sofa, is sponged down, dried, and told to rest for twenty minutes, or, instead of the sponge down, he is given a needle bath at a temperature of 102° F., cooling to 90° F. Then he dries and is wrapped up for the twenty minutes' rest before he dresses. It is well to apply, when the patient has dried himself, some talcum powder or vaseline if the skin is specially tender. If a patient reacts very slowly to a pack, a hot fomentation may be applied for five minutes beforehand.

Peat Packs

The peat which is used for making packs has to be prepared by cutting it up into a fine pulp. This material is heated in pans with steam coils or jackets, and when ready for application is soft enough to be easily handled, but not having the coherency of mud it is put into muslin bags in size and shape to fit the part of the patient to which

it is to be applied. For instance, in the form of a bag it can be wrapped round a joint such as the knee. Over the pack is fixed a thick pad and then hot dry towels, so as to assist in retaining the heat and keep the pack in position.

Peat packs can be applied to any part of the body, and are usually allowed to remain in contact with the skin for from twenty to thirty minutes' duration. As in other packs, the temperature of the pack should be tested before being applied so as to avoid burning the skin, though a temperature of 120° F. can easily be borne.

For therapeutic effects, see under Peat Baths, p. 52.

It is well to remember and remind the patient that to obtain the full effect of a local pack it is necessary to keep the part quiet for fully an hour after the treament has been applied.

Fango Packs (see Fig. 6, p. 32)

Fango or mud is handled differently to either mustard bran or peat when used for packs.

The material itself may be native, as in the case of Woodhall Spa and Harrogate, or it may be imported from Battaglia or Pystany. The fango when heated is of the consistence of putty and is easy to apply.

It requires to be heated in the pan with the steam jacket before use, or by surrounding it with water in a double pot and boiling the water. It takes a long time to heat through.

The fango is not spread on cloth, but is taken up in the hands and spread by the attendant over the part to be treated.

This may be a limb or the back, etc., the patient having been undressed and lying upon a sofa or couch.

After the fango has been applied, the mud pack is covered over with hot cloths or mackintosh so as to retain

the heat, which it does in a remarkable manner. The temperature of the pack will be about 120° F. The preparation of the patient and the after-sponge down or needle bath is given in the same way as after the peat and mustard packs.

Therapeutic Effects of Packs

Packs are a very convenient and effective method of inducing local reaction by means of moist heat. All nutritive processes are under the control of the nerves and packs can, through their stimulating effect upon the skin, affect the nerves going to the part treated and so influence the activity of the blood and lymphatic circulation in the part as to soothe pain and create intensive absorption of old inflammatory thickenings and fluid swellings about joints, by stimulating local metabolism. They have also a decongestive and derivative action upon organs lying more deeply, as is shown in the action of liver packs.

PARAFFIN WAX

Paraffin wax was used for treating various conditions during the Great War by means of full immersion baths, as well as local ones for the arms and legs.

Paraffin wax is a slow conductor of heat, three times slower than water. It melts at 120° F., so that for baths a special kind is used which melts below 110° F.; it is practically non-inflammable. It can be heated by either gas burners, steam or electric heater. For the full immersion bath a special bath was designed, so that the paraffin wax could be melted and kept warm by electric current. Full baths are not often used now, but local baths for arm or leg are used in most bath establishments.

Local Paraffin Wax Baths

Baths for the feet and legs are about 2 feet deep and $1\frac{1}{4}$ feet in diameter, so as to accommodate the lower extremity as far as above the knee, and those for the arm are in the shape of troughs about $1\frac{1}{2}$ feet long and 1 foot deep. The temperature at which the wax is used ranges from 110° to 120° F., but higher temperatures up to 140° F. can be used if the nerves are quite normal and the lower temperatures have been easily borne, though the higher temperatures necessarily entail greater risk of burning the patient.

Precautions

Be careful to test the temperature of the wax before use. It is not difficult to burn the skin, but the best way of preventing it is to begin with the lower temperatures until the skin's susceptibility has been tested, and, in any case, to warn the patient to keep the limb when once in the bath perfectly still, and thereby not disturb the wax coating which forms around it; this coating can be scraped off easily when it has cooled and solidified.

Paraffin Wax Pack

Another method of applying hot paraffin wax is to paint it on to any part, such as the knee joint, with a broad brush rapidly layer on layer, cover the paraffin wax thus applied with oiled silk, and over all a hot towel or piece of flannel. This method makes a good pack or compress; this easily peals off and leaves the skin hot, perspiring and smooth.

Therapeutic Effects

Enveloping part of the body with hot paraffin wax is a very easy and convenient way of applying heat locally,

and, owing to the fact that wax is a slow conductor of heat, it can be applied at higher temperatures than water ; it also retains its heat longer than many media.

We have already noticed that if the body is surrounded by a medium considerably denser than air, radiation of the body heat is prevented, with the result that the body temperature rises, so when a coating of hot wax is applied the heat of that part of the body rises in proportion, and the skin is stimulated to perspire, though the moisture is unable to escape for the time being, but does so as soon as the coating is removed. The circulation in the part is increased and also the metabolic changes.

It has been found that paraffin wax baths give great relief to such conditions as sprained and stiffened joints from rheumatism or gout, or fibrositic deposits round the joints ; they are also beneficial in phlebitis and chilblains or frost-bite.

CHAPTER VI

HOT AIR

HOT air, as a means of applying heat to the body, has been used for centuries in the form of Turkish baths.

The air so used is superheated and dry, that is, free from watery vapour, and considerably hotter than the ordinary atmosphere. It is employed for either heating the whole of the body as by means of a cabinet bath, or more locally by means of an " oven."

Various methods of heating the air are made use of. Most people are familiar with the effect of coal fire or gas fire on the heat of the air in a cooking oven. This is the method still used for heating the air in Turkish baths.

For cabinets, oil lamps and spirit lamps are used, but the air is often vitiated by the fumes they give off.

So that for the smaller cabinets and ovens the air is superheated by means of electrical currents passing through suitable resistance wires wound over porcelain frames, so that the air has free access, and either a smaller or greater number of electric stoves can be switched on as required.

One advantage of using the electric stove for heating the air in the cabinet is that it is entirely under control, and can be so easily regulated, whereas many accidents have happened with paraffin lamps and other methods.

Therapeutic Effects of Hot Air

Air is only used therapeutically when heated above

the neutral point, and in this respect differs from the way in which water is used.

Hot air is made use of chiefly because of its action upon the skin in producing three very beneficial effects.

(1) Stimulation of the cutaneous glands, causing profuse perspiration and excretion. This effect is desirable for reducing weight, and still more for eliminating toxins from the system.

(2) Dilatation of the superficial blood vessels, which will relieve deep internal congestion or engorgement of the circulation.

(3) Relief of pain, by the sedative effect it produces upon the nerve endings in the skin.

The application of hot air to the surface of the body has first of all the effect of quickening the heart-beat and circulation, and raising the blood pressure in the arterioles, but, when perspiration is increased, this effect passes off and the pulse slows in rate, and by the dilatation of the superficial blood vessels the blood pressure is diminished.

Both respiration and metabolism are stimulated and increased at first, but tend to diminish in rate.

It is to be specially noted that the body temperature is raised very slightly, if at all, by hot, dry air on account of perspiration being quite free to take place (see also Turkish Baths, p. 113).

The application of cold by means of water after the application of hot air prevents thermal debility, and should always be carried out either by cold sponge down or needle bath or a plunge bath. .

THE TURKISH BATH

Turkish baths date back to Roman times and before. Its present form was introduced into Great Britain by Mr. Urquhart, who built one at St. Annes, Cork, in 1856.

As usually constructed, the modern Turkish bath contains a series of three rooms containing superheated air free from moisture.

Before entering the first room there is a vestibule or ante-chamber, the air of which is kept at about 70° F., where there are marble slabs upon which shampooing is carried out, also needle baths and douches. Leading off from this vestibule is also the Russian steam vapour room, with a temperature of about 115° F. It is found that many people with dry skins begin to perspire easily if they spend ten to fifteen minutes in this vapour room before they enter the series of hot dry air rooms.

At the end of the vestibule is also a plunge bath with water at a temperature of 90° F., which some prefer to pass through before they retire to the cooling room and lie down upon the couches, which are provided for them to rest on before they dress.

In the series of hot rooms the temperature varies as follows :—

The air in the first room is kept at 130° to 140° F.
" " " second " " " 160° to 180° F.
" " " third " " " 180° to 220° F.

The first two rooms are large, as the greater part of the time of the bath is spent in them, but the third, which is the hottest of the three, is smaller, as only a short period of time is spent in it, and many do not need to go into it at all.

Method of Taking a Turkish Bath

Patients undress in their cubicles, and are provided with a towel or loin cloth, or, in the case of ladies, with a loose robe.

The patient enters the bath by way of the vestibule.

From this room he may either go into the Russian steam vapour room for ten to fifteen minutes until perspiration has commenced, or, if he knows he can perspire easily, he goes into the first of the three dry hot air rooms. He stays not more than ten minutes in this room before passing into the second hot room, where he should perspire easily. If he does not do so, he should go in a few minutes' time into the third room, where probably perspiration will soon become vigorous. As soon as this takes place he should return into the second room, and remain there until the amount of perspiration has been sufficient, in which case he can then go into the vestibule and wait for the shampoo. All depends upon the patient's power of reaction to the stimulation of his skin by dry heat, and it will be the duty of the bath attendant, in the case of persons who have not had this form of bath before, to watch their power of response and guide them as to their procedure, and especially the length of time they should spend in each room.

In the hot rooms the bathers either lie on couches or sit on stools while perspiration is taking place, and, if they are the subjects of a blood pressure above normal, or if they have any form of heart trouble, the length and intensity of the treatment must be regulated accordingly, and by medical prescription.

At the end of the perspiration the bather passes into the shampooing room, where he sits on a stool while warm water is poured over him to wash the perspiration off. He is then soaped all over, and the attendant shampoos, viz., uses friction by rubbing the whole of the body while the patient is lying upon a marble slab, paying special attention to parts which have been indicated by the doctor, or in the case of patients specially sent by him for Turkish bath treatment.

Water is poured over him to wash off the soap, and then

he is douched down or placed in the needle bath, using water at a temperature from about 105°, cooling to 80° or 70° F., or he may pass through the plunge. The attendant then dries him, and covers him with a hot Turkish towel. He lies down on a couch in the cooling and resting room, sleeps, smokes or takes coffee, etc., for about an hour. This being the completion of the treatment, he dresses and, if wise, goes home for further rest.

Precautions

There are certain precautions for patients who are taking Turkish baths for the first time which the bath attendant should keep in mind.

Any man over sixty, or woman over fifty, ought not to be exposed to a greater heat than that of the second room (maximum 180° F.) until the attendant has had an opportunity of observing his reactions in the matter of pulse rate, determination of blood to the head, or signs of excessive blood pressure, capacity for perspiration of the skin. It is a mistake for patients to spend too long a time in passing through the series of hot rooms; it may cause exhaustion of the circulation, with symptoms of faintness and depression, or there may be uncomfortable dryness of the skin with a sensation of burning, and congestion of the head.

It is a good plan in such cases for the bather to go at the beginning of the bath into the Russian vapour room, which will assist the action of the skin, and to pass fairly quickly into the hottest room with, if necessary, a cold wet compress wrapped round his head, and, as soon as perspiration has become established, return to the cooler rooms. He will then suffer very little discomfort, and run very much less risk of being upset by the treatment.

Therapeutic Effects of the Turkish Hot Air Bath

The Turkish bath well illustrates the effect of applying hot air to the whole body ; its effects may be summarised as follows :—

(1) The skin is cleansed, perspiration is greatly increased with no check, as the air is dry.

(2) Increased evaporation from the lungs.

(3) The heart-beat and pulse are quickened at first, later they are slowed to little above normal.

(4) The superficial blood vessels are dilated and the deep decongested.

(5) The blood pressure is at first raised, then lowered, when perspiration is free.

(6) There is no great rise of temperature, owing to a proportional loss of heat by free perspiration.

(7) There is an increase in metabolic rate (katabolic) in fat persons, though in depressed conditions the anabolic changes may be more marked.

(8) A loss of weight may take place up to 2 or 3 lb. in one hour.

There are many conditions for which the Turkish bath is too severe in its effects, and, if hot air treatment is desirable, the cabinet bath, where the patient can breathe cool fresh air, is less exhausting.

Local Application of Hot Air

Most of these cabinets and local ovens have been discarded in favour of those which supply not only hot air, but radiant heat and light. See p. 154.

INUNCTION

Inunction is the term applied to the rubbing into the skin of various ointments.

In some spas, especially those at which sulphur waters

are available, which have a time-honoured reputation in the treatment of certain skin diseases, it is the custom to combine with the sulphur water baths the inunction of special remedies in the form of ointments, which are absorbed by the skin. For it is well known that, though the skin does not absorb the various saline substances found in mineral waters, it can absorb gases, sulphur, boracic acid, iodine, and many other substances dissolved in oily or fatty bases. The bath is given first of whatever kind will best prepare the skin for absorption.

In the case of patients suffering from specific venereal skin disease the inunction of mercury ointment is still held by some authorities to be one of the most reliable remedies. Hence, in such cases, 1 drachm of the ointment is used for an adult at each sitting: it takes a quarter of an hour to rub in properly. The soft parts of the skin selected are for an adult the inner side of the thighs, the bend of the elbows and the sides of the chest.

For a child the skin of the abdomen is selected, and not more than $\frac{1}{4}$ drachm of ointment is used and the part covered with a binder afterwards. As a rule the inunction is carried out daily for six weeks and given twice a year.

Caution.—In using mercury ointment the gums and mouth must be watched and the inunction stopped if they become inflamed. Inunction is disagreeable because it is dirty, but it is effective because it is one of the quickest methods of getting mercury, etc., into the system.

THERAPEUTIC OBJECTS OF BATH TREATMENT

Having learned details of the many varieties of baths, douches, packs and methods of giving them and also their reaction effects, the next step is to administer them to patients. It will help a bath attendant to carry out a treatment for the physician correctly and intelligently if he has some idea of the reasons for which the particular

treatment has been selected. The verbal instructions of the physician to the attendant as to the nature of the case and the object of the treatment, besides the written prescription for the treatment, is really essential. The success of the treatment largely depends upon close collaboration between the attendant and the patient's physician.

The choice of a course of treatment which will be suitable for an individual case is one of no little difficulty. The physician, after examining his patient and ascertaining his condition, has to decide what results he wishes to obtain by the treatment he adopts, and by his knowledge and experience of what reaction effects are to be expected make his choice out of the ample means available ; but there are other factors in the matter of suitability which will determine him in his selection, viz., the urgency of relieving some symptoms before others, and, more important still, the amount of ability the patient possesses to react to treatment. The latter is often an unknown factor, so much so that the application of the first treatment, whether a bath, a vapour, or local pack, is always experimental in character, and therefore the reactions require careful observation for future guidance. This is an instance in which the collaboration of the attendant can be of great assistance to the physician, especially when the latter is prevented from observing them for himself. That the physician has many alternatives at his disposal is not without its advantages. The presence or absence of a particular symptom may turn the scale in favour of choosing one kind of treatment in preference to another.

The general lines upon which choice of treatment is made are as follows :—

If the object be to test the patient's reaction, soothe pain, relieve the stiffness of joints, the physician can

choose an immersion bath with a moderate temperature of 98° F. (sub-thermal) and duration not exceeding fifteen minutes ; this will demonstrate his reaction ability and give some relief. In the next bath the temperature may be raised 2° or 3° higher to 100° to 102° F. if a stronger reaction can be borne, while keeping the duration of the bath the same. Later the duration may be extended beyond the fifteen minutes.

If the object be, *e.g.*, to cause freer perspiration by a stronger heat stimulus, he may choose a hyper-thermal bath with a temperature of from 104° to 110° F. of short duration, four to ten minutes, thus avoiding exhausting reaction, and follow this with a cool sponge down or a needle bath of 90° cooling to 80° F.

If the object be a sedative bath for a nervous patient, then a subthermal or neutral bath (temperature 98° to 94° F.) for long duration from half to several hours may be given.

If he wishes during an immersion bath to apply extra heat to a painful knee joint or to the sciatic nerve he may add to the bath an undercurrent douche or spray at a temperature of 110° F. or more for five minutes to be gently applied to the part.

If on account of the state of the patient's heart or breathing the physician wishes to avoid any undue hydrostatic pressure upon the chest, then he can prescribe a three-quarter bath or gentle douche massage bath.

If it be desirable to obtain a more vigorous and stimulating action by the treatment, as for instance in a case of fibrositis in the lumbar or cervical region with chronic thickening, then he has at his disposal the effect of the douche combined with massage, as in the various forms of douche massage bath, or he can prescribe the douche by itself to begin with. If the treatment is to be directed to the back or to the back of the hip and thigh, as in

sciatica, then the Vichy douche bath is preferable, or the trough douche massage bath or the Harrogate variety.

If the patient has a tendency to high blood pressure then the Aix douche massage bath is preferable to the Vichy douche bath, and the temperature will be kept subthermal rather than thermal and the massage graduated.

When the sedative or toning effect is required by the douche massage bath then the temperature will be kept subthermal, the douche pressure low, and the massage confined to effleurage manipulation, and these conditions are best fulfilled by the Vichy douche massage bath method.

Patients suffering from established high blood pressure (hyperpiesis) must always be carefully handled and watched. If an immersion bath is prescribed it will probably be a subthermal one (98° F. and lower), at any rate to begin with, and the duration not longer than ten to fifteen minutes. If the Nauheim bath is chosen, it will be a still bath without effervescence and short duration.

Where the treatment is specially for high blood pressure, accompanied by heart trouble of not long standing, then it is more than likely that a course of Nauheim baths will be chosen, beginning with a series of still baths with graduation of strength of water, temperature and duration, and finishing with the effervescing form.

If the patient is suffering from obesity, the physician again has alternative treatments to choose from depending upon the strength of the patient and his age. If of the robust type, a sweating and reducing process will be adopted. To attain this object a Turkish bath may be given, or a heat and light cabinet; or if the skin is dry and torpid, a steam vapour cabinet or Russian vapour bath which will promote perspiration. Then,

again, muscle-metabolism may be stimulated by the massage manipulations of an Aix douche massage bath or by the application of the Faradic current by the Bergonie method. The latter treatment may be combined with the application of heat and light by surrounding the Bergonie chair with a cabinet containing incandescent lamps, so as to stimulate the action of the skin simultaneously.

Cases of gout and neuritis are instances of conditions which require great care in handling, gout because of the inflammatory nature of its manifestations and neuritis because of its extreme tenderness and easily roused pain, so that soothing rather than stimulating treatment will doubtless be adopted, especially at the beginning of the course. For these reasons also an immersion bath will be selected rather than an Aix douche bath for a case of gout, and steam vapour perhaps rather than dry heat in neuritis.

In cases of sciatica and arthritis the extreme comfort afforded by the buoyancy of the brine bath to anyone who has experienced it will not be overlooked.

There are a variety of means for applying heat, moist or dry, locally, and the physician will doubtless select his remedy according to whether he wishes to soothe pain and tenderness in some part of the body or whether his object is to stimulate, intensify or quicken local reaction in chronic conditions.

When only a comparatively mild application of heat is desirable, he can select a compress or pack, giving a temperature up to 115° F., made with mustard bran or peat or mud (fango). The local paraffin wax bath for arm or leg is often convenient because of its quick and easy application and effective reaction, also permitting slightly higher temperatures to be reached in a series, viz., 120° up to 135° F.

When more intense heat and light stimulus is required, he will resort to one of the many forms of electrically-produced heat and light apparatus, such as the Dowsing, luminous heat and light, Greville infra-red, leucodescent lamp, and other more powerful varieties by which much higher temperatures (up to 400° F.) can be reached ; or he may prefer the local application of the diathermy current.

Local applications are both valuable and suitable when general treatment as by an immersion bath is contra-indicated. They are commonly given on alternate days in the cases where general treatment is being given.

The above examples will give the student some idea of the conditions and objects for which different means of treatment are selected, and will, at the same time, demonstrate how hydrotherapy can be adapted to meet different needs.

Up to comparatively recent times hydrology was entirely empirical, that is, based on the result of experience, but now much research and experiment have placed it upon a sure scientific basis, which acts as a guide to the physician in his selection of treatment and to the attendant who carries out the technique.

A WORD OF WARNING

The duties of a bath attendant are often onerous, but they will always be interesting, as no two cases are alike, and the work, though requiring much care and patience, will stimulate his thoughtfulness and intelligence and his power of encouraging the ill and depressed by inspiring hopefulness. His duties, however, bring with him serious responsibilities, because not only must he take care to carry out every detail of the treatment prescribed, but he must see that while doing so the patient receives no

injury or harm. Particularly is this the case in applying, for example, hot treatments of any kind, such as a hot douche, or needle bath, a steam application, or paraffin wax bath whereby a patient may be scalded or burnt. There are other ways in which injuries may occur as in radiant heat and electrical treatments.

The attendant should make it a rule to test all temperatures not only by the thermometer but by his own hands, and to warn patients not to approach needle baths or steam vapour treatments until he has so tested them and says he is ready for them.

The attendant must remember that if an injury should take place, either through his fault or want of warning, both he and the owners of the establishment will be held responsible and become liable to compensate the patient for any injury received.

LIST OF DISEASES IN WHICH HYDROTHERAPY AND PHYSIOTHERAPY ARE USED

ANCHYLOSIS, fixation of a joint by fibrous or bony adhesion.

ANÆMIA, a condition of the blood in which there is a diminution of the number of red and white corpuscles caused by hæmorrhage, poisons or defective nutrition.

ARTERIO-SCLEROSIS, hardening of the arteries.

ARTHRITIS, inflammation of one or more joints caused by rheumatism, gout, blood infection and other diseases.

BILIOUSNESS, a condition considered to be due to too free secretion of bile and congestion of the liver.

BURSITIS, inflammation of the bursæ (or lubricating bags) near joints, commonly occurring at ankle, knee or shoulder joints.

CALCULUS, a hardened concretion or stone. They may

occur in the kidney, bladder, gall-bladder and elsewhere, and are formed from hardened deposits from the urine or bile, etc.

CATARRH, inflammation of a mucous membrane, such as of the nose, air passages of the lungs or of the stomach.

COLITIS, inflammation of the large bowel.

CONGESTION, dilatation and distension with blood of the arteries, capillaries, and veins of any portion or organ of the body.

CONSTIPATION, delay in the passage of food through the bowel and in the evacuation of its residue.

CREPITUS, a grating, creaking noise heard in a joint on movement.

CYSTITIS, inflammation of the bladder.

DEBILITY, a general condition of the body characterised by weakness, loss of tone and lack of vigour in function of the nervous and muscular systems and also of the heart.

DERMATITIS, a superficial inflammation of the skin caused by some external irritant.

DIABETES, a metabolic disorder due to disease of the pancreas, causing impairment of the ability to digest starchy and fatty food, resulting in the passage of sugar and acetone bodies in the urine and many other symptoms.

DISEASE, may be functional or organic, acute, subacute or chronic.

DISEASE, FUNCTIONAL, a condition of disease in which there is disorder of function without perceptible alteration of structure, *e.g.*, neuralgia.

DISEASE, ORGANIC, a condition of disease in which there is both disorder of function and morbid changes in structure, *e.g.*, arthritis.

DROPSY, accumulation of fluid in the tissues, usually in

the most dependent parts, due to disease of the heart or kidneys.

DYSENTERY, a disease caused by two kinds of germs resulting in persistent diarrhœa and exhaustion.

DYSPEPSIA, difficulty in digesting foods which may be due to disease of the stomach or other organs.

ECZEMA, an inflammation of the skin due to irritation from without or within in persons specially susceptible, as by gout.

ERYTHEMA, a congestion of the blood vessels of the skin not necessarily followed by inflammation.

ERYTHEMA NODOSUM, painful reddened areas under the skin, usually of the legs, occurring in rheumatic patients.

FAULTY METABOLISM, metabolism which, by faulty disassimilation or katabolism, produces abnormal substances which are carried into the blood and may accumulate in the body, *e.g.*, gout, obesity.

FIBROSITIS, inflammation of the fibrous structures such as tendons, sheaths of muscles and nerves found in cases of muscular rheumatism, sciatica, etc.

GASTRITIS, inflammation of the stomach.

GLYCOSURIA, the presence of sugar in the urine due to disease.

GOÎTRE, enlargement of the thyroid gland in the neck.

GONORRHŒA, a disease due to specific infection by the gonococcus which sometimes causes inflammation of the joints.

GOUT, a disease of the blood and tissues due chiefly to faulty metabolism, with production of deposits of biurate of soda in joints, causing inflammation and acute pain.

HEART DISEASE, any functional or temporary disorder of the heart's action or any organic disease of its muscle, valves or arteries.

HEMIPLEGIA, paralysis of the nerves of one side of the body.

HIGH BLOOD PRESSURE (HYPERPIESIS), excessive degree of pressure of the blood in the heart and blood vessels.

INFLAMMATION, the reaction of the bodily tissues to any chemical, physical or living irritant resulting in the four cardinal signs of redness, swelling, heat and pain of the part affected.

INFLUENZA, a too familiar disease due to infection by germs, which is often followed by inflammation of the joints.

INSOMNIA, inability to sleep.

JAUNDICE, yellow discoloration of the skin and conjunctiva of the eyes due to leakage of bile from the gall-bladder into the blood owing to blocking of the bile-duct.

JOINTS, DISEASE OF, may affect the synovial or lining membrane, the cartilage, the bones or the ligaments and capsule of the joint.

LOCOMOTOR ATAXY (TABES DORSALIS), a disease of the spinal cord characterised by disturbance of sensation and inability to control muscular movements, with destructive changes in one or more joints.

LUMBAGO, acute exudation into, or inflammation of (fibrositis) the sheaths of the lumbar muscles of the spine, causing much pain.

MUCOUS COLITIS, a chronic colitis, accompanied by discharge of excess of mucus from the bowel.

MUSCULAR RHEUMATISM, rheumatic inflammation chiefly affecting the muscular structures of the body.

MYALGIA, pain felt in the muscles, generally due to rheumatism.

MYOSITIS, inflammation of the muscular structures.

NEPHRITIS, inflammation, acute or chronic, of the kidneys.

NEURALGIA, periodic or spasmodic pain in a nerve trunk.

NEURASTHENIA, exhaustion, weakness and debility of the nervous system due to strain, illness, or injury.

NEURITIS, inflammation of the sheath of the nerve, sometimes of the nerve trunk itself.

OBESITY, excess of fat owing to faulty metabolism, dietary errors, want of exercise, etc.

ŒDEMA, technical term for dropsy.

OSTEO-ARTHRITIS (" RHEUMATIC GOUT "), a chronic disease affecting all the structures of one or more joints, seen usually in people past middle life. It does not affect the heart like rheumatism, but thickens the joints by bony outgrowths, but does not anchylose them.

PANNICULITIS, inflammation of the subcutaneous fat of the abdomen.

PARALYSIS, loss of function in a sensory or motor nerve or group of nerves.

PELVIC ORGANS, Diseases of, term used for diseases of the uterus, ovaries, and other organs situated in the female pelvis.

PERIARTHRITIS, inflammation or disease affecting the capsule or structures surrounding a joint.

PHLEBITIS, inflammation of the veins.

PLEURODYNIA, pain in the intercostal nerves and muscles of the chest due to strain or rheumatic inflammation.

PORTAL CONGESTION, congestion of the portal vein and its branches which carry the blood to the liver from the abdominal organs.

PRURITUS, itching of the skin, commonly occurring round the anus and vulva.

PSORIASIS, a skin disease characterised by patches covered with shiny scales occurring on the scalp, extremities, or body, frequently on knees and elbows.

PYORRHŒA, septic inflammation of the tooth sockets and gums with loosening of the teeth.

RHEUMATISM, a generalised disease which produces inflammation of the joints and muscles and may be acute or chronic, the acute form known as rheumatic fever often causing heart disease.

RHEUMATOID ARTHRITIS, a disease now generally called INFECTIVE ARTHRITIS because due to infection by germs, which produces destructive inflammation of joints with marked tendency to fixation by adhesions, also muscular wasting and bodily exhaustion. It begins acutely, but progresses slowly and cripples greatly if not cured.

RHEUMATOID ARTHRITIS, this term is now usually reserved for the arthritis with fusiform swelling of the joints and softening of the bones occurring mostly in young women, in which faulty metabolism and glandular defect are probably the chief causes, rather than infection by germs.

RICKETS, a disease due to the lack of vitamin D in children's food, which causes deformity of the growing bones and their joints.

SCARLET FEVER, a good example of the many infectious diseases which often cause inflammation of the joints.

SKIN DISEASES are often treated by baths with sulphur and other waters, especially those which are chronic, *e.g.*, eczema.

SPASM, contraction of muscles which may be sudden, clonic (alternating contraction and relaxation) or tonic and prolonged.

SPRAIN, injury to muscle tendons or joint structures resulting in swelling, pain and hæmorrhage (subcutaneous bruising).

STIFFNESS of joints or muscles is due to previous inflammatory exudation causing interference with their action or adhesions.

SYNOVITIS, inflammation of the synovial or lining mem-

brane of a joint, giving rise to fluid in the joint, and when this disappears to crepitus or creaking noises on movement of the joint.

TENOSYNOVITIS, inflammation of the sheath of a tendon.

TOXÆMIA, the presence of poisonous substances (toxins) in the blood introduced from without or formed in some diseased organ of the body itself.

TRAUMA, injury or wound due to violence.

TUBERCULAR JOINTS, disease of the joints caused by the action of tubercle bacilli.

URTICARIA, a skin disease which begins with wheals like nettle rash, with much irritation, and is usually due to the presence of a foreign proteid substance in the blood absorbed from food.

VARICOSE VEINS, irregular enlargement of the veins.

VERTIGO, the feeling of giddiness.

PART II

PHYSIOTHERAPY

CHAPTER VII

VARIOUS kinds of physical treatment, dependent upon the use of electricity and radiant energy in the form of heat, light, and more recently actinic or ultra-violet rays, are so frequently prescribed in conjunction with hydrotherapy that bath attendants are often called upon to give some of these treatments.

After all, hydrotherapy is only one of the many forms of treatment included in the term Physiotherapy, so that attendants should make themselves familiar with other branches of the subject. For the above reason, though it was the author's intention to deal with the subject of hydrology alone, it has been thought well to append a rapid survey of the other fields of physiotherapy in order if possible, to assist the attendant, when he comes to a closer study, to understand more easily what must always appear to a beginner difficult and complicated subjects to learn.

RADIANT ENERGY

In physiotherapy the first thing we have to do is to understand clearly the nature and properties of the physical forces included in the term Radiant Energy, which can be used for treatment, and then see how they

are employed. The forces or rays used medically are electro-magnetic, heat, light, actinic, X-rays and radium rays.

Radiant energy is that form of electro-magnetic force which is given out by the sun into space, and it is the main source of all the energy of our earth. The rays of energy travel through the ether to the earth at the enormous speed of 186,000 miles per second, a distance equivalent to about eight times round the earth. The sun's radiant energy contains heat, light and actinic rays of force mixed together. They can be separated into their different kinds by suitable means, and one form can be converted into another.

Each kind of ray travels with an exceedingly small wave-like motion or vibration, and the size and rate of travelling of these minute waves can be measured.

If we watch the ocean we can observe waves of all sizes from Atlantic rollers to little ripples passing along the surface of the water, so in analysing and measuring the sun's rays we find that the waves of the heat rays are longer from crest to crest than those of light rays, and the waves of the light rays are longer than those of the actinic rays. Even the small range of light waves vary in size and length, and this fact explains the rainbow and spectrum.

The sun's rays are made use of for medical treatment (heliotherapy) without alteration, as is done on the mountains of Switzerland, where there is little cloud to intercept them.

The heat rays are mostly invisible, but produce the sensation of heat and warmth. The light rays are visible and give the sensation of light. The actinic, or ultra-violet, rays do not cause the sensation of heat or light, but they produce chemical reactions between substances, as for instance those on a photographic plate.

Besides the three kinds of rays known as solar, others have been discovered. They are as follows : magnetic and wireless (Hertzian) rays, both having much longer wave-lengths than the heat, light and actinic (solar), and, passing beyond the actinic in the other direction, we come to the Roentgen X-rays, and beyond these the gamma rays of radium, with wave-lengths very much shorter than the solar rays, which fact probably explains their greater power of penetration.

Though the waves of the several rays differ considerably in size and length, they all travel through space with the same enormous velocity, no matter whether they come from the sun or are produced artificially.

The discovery and development of the means to produce artificially the various kinds of radiant energy has made such rapid progress during recent years that it is now possible to apply any particular form we desire for medical and other purposes.

We will discuss the subject of electricity first, because it is not only used therapeutically by itself, but it is employed in most cases as the chief agent in the artificial production of the other kinds of radiant energy, as heat, light and actinic or ultra-violet (U.V.) rays.

After the subject of Electrotherapy has been surveyed, the treatments involving the use of heat and light rays will be considered together, as they are in practice usually combined.

Actinic or ultra-violet (U.V.) treatments will then be briefly discussed, but, as treatments based on the use of X-rays and radium rays form a special department, not coming within the sphere of a bath attendant's work, they are only mentioned to demonstrate the continuity in the range of rays which are used in Physiotherapy from those with very long wave-lengths to those with exceedingly minute ones.

ELECTRICITY

The common forms of treatments in which electricity is used as the therapeutic agent are the following : static electricity, galvanism, faradism, sinusoidal currents, ionisation, high frequency, diathermy and Bergonie treatment.

Limits of space do not permit detailed description of apparatus to be given, nor full particulars of methods of application. These must be obtained from the text-books on medical electricity, and learned under the guidance of a qualified teacher.

Attention, therefore, is focussed upon the more important elementary facts of electricity, which will enable the attendant to understand the general principles upon which it is made use of in the above treatments, and the chief points in the construction of the instruments employed. Brief mention is made of the special therapeutic effects obtained, and some of the precautions which must be observed while giving electrical treatments.

Electricity is a form of energy or force which behaves in some respects like water. For instance, water can be held up or stored in a tank, or flow from the tank along a pipe by the pressure it exerts, so in an analogous manner the force of electricity can be held up or condensed on insulated metal balls or plates, or in a condenser called a Leyden jar, in which form it is called static electricity, or it can flow or oscillate along a wire conductor by its electromotive force like a stream of water, when it is known as current electricity.

Until 100 years ago electricity produced by friction in its static or stationary condition was the only source available for medical or other purposes, and in this form it is still used for treating certain cases, but during the last forty years current electricity, produced in different

ways, has been much more extensively employed, owing to the many methods by which it can be applied and controlled.

It was early discovered that there are two kinds or conditions of electricity, one called positive or vitreous, which can be produced by rubbing a glass rod with a piece of dry silk, and the other called negative or resinous, produced by rubbing a piece of resin or sealing wax with dry flannel. That they differed was demonstrated by the fact that if the rubbed sealing wax be brought near a suspended pith ball, the ball is at first attracted, and then, if contact take place, repelled. If the rubbed glass rod with its positive charge is brought near the pith ball after it has touched the sealing wax, it strongly attracts it because the pith ball has become charged with negative (resinous) electricity from the sealing wax. Positive electricity attracts negative but repels positive. When a glass rod with a positive charge is brought near an insulated metal cylinder, it will attract the negative electricity in the cylinder to the end nearest the glass rod, and the positive electricity will be repelled to the other end of the cylinder. This repulsion is spoken of as induction.

By means of a static machine, such as that known as Wimshurst's Influence Machine, positive and negative static electricity can be obtained by friction and induction and utilised for treatment. A static machine must be kept perfectly dry, and will only work properly in a dry atmosphere ; it is usually kept under a glass case and in a warmed room.

Static electricity can also be obtained by means of the D'Arsonval transformer from a main (dynamo) supply of constant current.

We shall now consider the nature and properties of current electricity.

Production of Current Electricity

In the first place, the electric current has to be produced. This can be done on a small scale by the use of a cell containing substances between which chemical action takes place ; while the chemical reaction is taking place electric current is evolved.

A battery is a collection of cells linked together to increase the supply of current and placed in a box which can be carried about. A battery is often convenient because of its portability.

There are two kinds of cell which can produce a supply of electrical current : (1) a cell containing solids and acid liquid, such as the bichromate cell ; (2) the dry cell, which contains solids but no liquid, such as that known as the Leclanché Dry Cell.

The dry cell is obviously the more convenient, as there is no cleaning to be done and often no glass to be broken, but it cannot be used after the chemical action is exhausted.

In bath establishments batteries are now seldom used, because a supply of electric current can be obtained more easily and abundantly from a dynamo machine or the " main " supply, and plugs conveying it can be placed in any required position.

Conduction of Current Electricity

We have seen that there are two kinds of electricity—positive and negative. In every cell there are two poles, one supplying positive and the other pole supplying negative electrical current, and in order that the current may flow from the positive pole to the negative pole, they must be joined together by a conducting wire to complete the circuit outside the cell, so when electricity is supplied to a house from the mains there are always two wires, one bringing the current and the other returning it to complete the circuit.

The wires are usually insulated with rubber or other material to prevent the current escaping.

If the current in a circuit is to be utilised, the circuit must be broken and the ends (terminals) of the wires—one being the positive and the other the negative—must be fitted with suitable handles and electrodes to enable the current, when applied to the skin, to pass through the body from the positive pole to the negative pole, and so back to the cell; it must go the round of the circuit just in the same way as it passes through the electric lamps in a house. The negative pole or terminal can always be distinguished from the positive one, because if it be made to touch a piece of moistened red litmus paper it will turn it blue.

Different Forms of Current Electricity

There are four kinds of current electricity, viz.: Galvanic, Faradic, Sinusoidal and Oscillating or High Frequency.

The Galvanic Current (D.C.) is that form of electrical current which flows from its source in one direction continuously through wire conductors, and is called a constant or direct current (D.C.); it may be produced by chemical action in cells or by a dynamo machine. When the conducting wires are joined to form a circuit, the current flows from the positive pole of the cell to the negative pole. A galvanic current can be interrupted in its flow at regular intervals by a special apparatus; its strength can be varied by what are called resistances in the same way as water may flow from a tank through a large pipe or a small one.

The direction of flow from the cell is always the same, *i.e.*, from positive to negative pole, viz., from higher pressure to lower, but that in the conductors can be changed by

means of a reverser or commutator without disconnecting them.

The Faradic or Induced Current (also called interrupted current) is one which is caused to flow in an independent and separate closed circuit of wire coiled round a large bobbin, called the secondary coil, by (1) the approach to or withdrawal from it of a magnet; (2) the interruption of a constant current (produced by a cell) in another closed circuit called the primary coil in its vicinity.

A faradic or induced current does not flow continuously like the galvanic, as it is only produced at intervals, *i.e.*, at the make and break of the current in the primary coil, and it is of short duration when it is induced, so that it is sometimes called an interrupted current. It also passes each time in opposite directions. Currents which keep changing their direction are called alternating. The apparatus for producing the faradic current is called an induction coil; it has two coils of wire, the primary and secondary, the secondary usually sliding over the primary.

The Sinusoidal or Alternating Current (A.C.)

A sinusoidal current is one which is continually changing both its direction and its strength with a low frequency rate.

It differs from the faradic current (1) in the evenness and regularity with which it passes without any abrupt jerk or gap from one direction to the other, and there is no interruption of the current, only an even variation in its force; (2) it is produced not by an induction coil, but by the rotation of a copper coil or closed circuit, sometimes called an armature, between the two poles of an electro-magnet.

Oscillating or High-frequency Currents

These are currents which oscillate or change their direction with a very high frequency rate (often more than a million times a second).

They can be produced by highly charging a condenser, and then discharging it through resistances and spark gap.

ELECTRICAL TERMS AND UNITS

The meaning of some terms which are frequently used in regard to electricity should be learned.

Electro-motive Force (**E.M.F.**) is that which causes electricity to move from one point to another when connected.

Potential means power to move or exert force.

Current means the passage of electric force along a conductor.

Electrode is the end or terminal of a conductor, through which a current of electricity is applied to the body.

Frequency refers to the rate at which a current is interrupted or changes its direction.

Voltage is the pressure at which electricity is stored up or flows through a conductor.

Transformer is an apparatus by which a current is changed from direct (D.C.) to alternating (A.C.), or its voltage raised or lowered.

Resistance is that which resists the passage of a current, sometimes called a rheostat.

UNITS

Unit of Measurement of Electro-motive Force is 1 VOLT (the E.M.F. of one Daniell cell).

Unit of Measurement of Resistance is 1 OHM (= a column of mercury 1 metre long and 1 millimetre thick).

Unit of Measurement of Current is 1 ampere (E.M.F. of 1 volt acting through a resistance of 1 ohm).

Medical Unit of Current is one-thousandth of 1 ampere, called a milliampere.

MEDICAL ELECTRICITY

The following are some of the methods of applying static and current electricity for medical treatment :—

STATIC ELECTRICITY

Static electricity is used for medical purposes with the object of charging the patient with positive or negative electricity and allowing it to escape, *i.e.*, to discharge either gradually or rapidly. To enable this to be done, two things have to be done : (1) he is made to sit upon a chair resting upon an insulating platform ; that is, one of which the supports are made of glass, glass being a non-conductor of electricity prevents the electric static charge escaping from the patient to the ground, which otherwise it would do ; (2) to receive the charge the patient must be connected with the influence machine, either directly or through the platform, by means of conducting rods.

When the charge begins to escape it is, of course, no longer stationary or static, but current electricity.

There are five different ways of giving static treatment :—

(1) The static simple charge or bath.
(2) The static breeze or effleuve.
(3) The static spark, direct or indirect.
(4) The static induced current.
(5) The static Morton wave current.

For details of the different ways in which the patient on the platform is connected with the machine, the text-

FIG. 7.—THE FOUR-CELL BATH.

(By courtesy of Harrogate Corporation.)

[*To face p.* 136.

[To face p. 136.

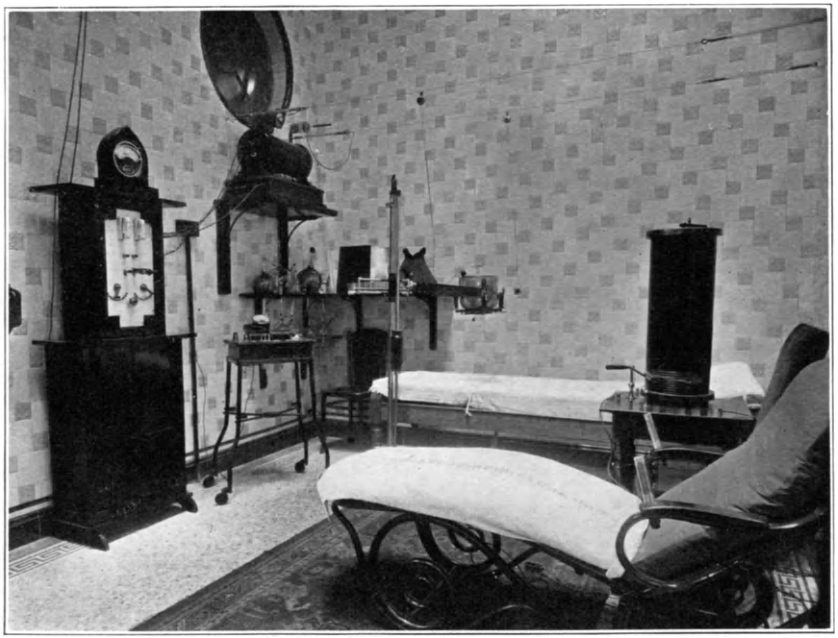

FIG. 8.—D'ARSONVAL HIGH-FREQUENCY APPARATUS.

(By courtesy of Harrogate Corporation.)

[To face p. 136.

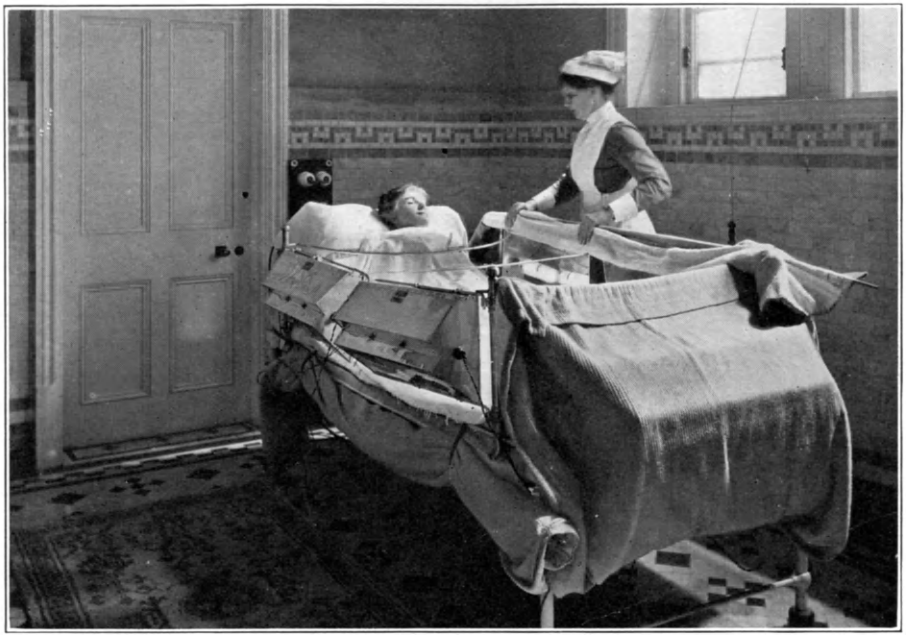

FIG. 9.—THE DOWSING LUMINOUS HEAT "BATH."

(By courtesy of Bath Corporation.)

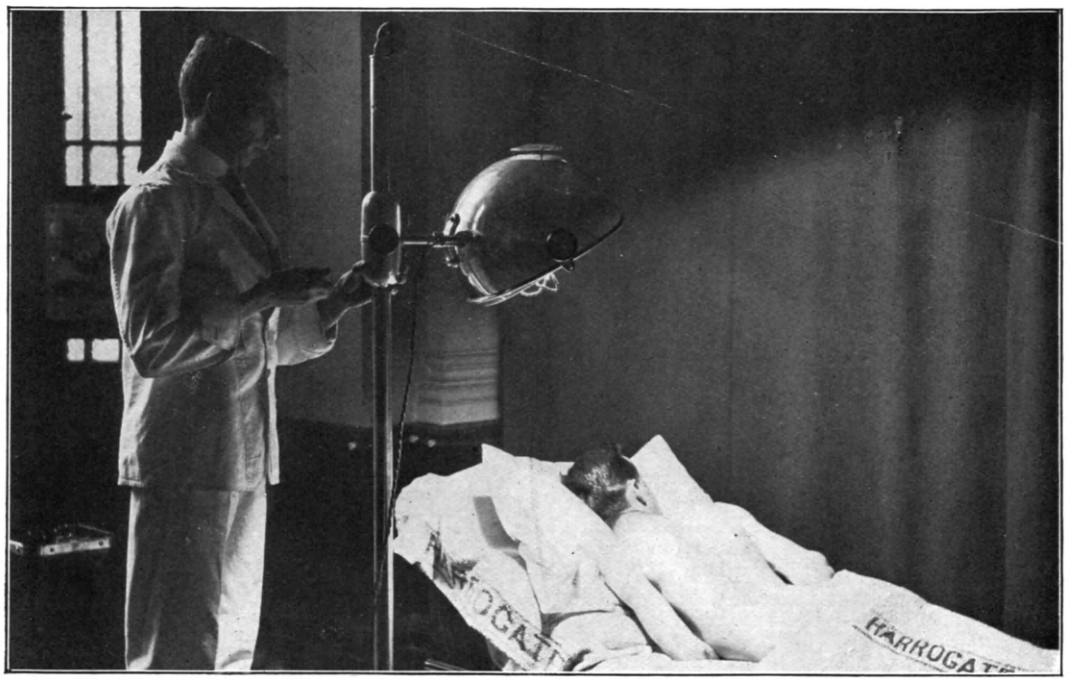

FIG. 10.—ULTRA-VIOLET RAY TREATMENT.

(By courtesy of Harrogate Corporation.)

[To face p. 137.

book must be consulted, but it may be noted that in the first three the patient is put in relation with the machine by the platform being connected with its negative pole, and the poles and spark gaps are well separated, and the positive pole is grounded, while in the last two the patient is directly connected with the machine and the spark gaps closed.

Therapeutic Effects

Static electricity, as given by the first and second method, has a decongestive and sedative effect; the third method is a strong stimulant; the fourth produces strong muscular contractions and can be used for obesity; the last method is decongestive in effect.

Precautions

See that the machine is in good working order before connecting the patient with it. Take care in regulating the strength of the current, especially in giving the breeze or spark treatment.

CURRENT ELECTRICITY

The following are some of the methods of applying electrical currents for medical treatment :—

Galvanism

The galvanic current, produced either by cells or dynamo, is conducted to the patient by wires from its source and applied by means of electrodes, consisting of metal discs attached to handles or flat metal plates, copper gauze or chain electrodes, covered always with wash leather or pads of lint or Turkish towelling.

More often than not, when the current is running, neither electrode when once applied is moved. The dry

skin being a bad conductor, both skin and electrodes must be kept moistened with a 5 to 10 per cent. salt solution. The amount of current can be increased or lessened without sudden jumps by means of a " galvanostat " resistance.

Therapeutic Effect

The galvanic current stimulates the dissociation of molecules of substances in solution into simpler substances, called ions, and their migration towards the poles of the cell (chemical action).

When applied to the body similar changes take place in the fluids of the body, and heat is produced. It stimulates both the nerves and the muscles, and can cause contractions of the muscles when the nerves are degenerated.

Precautions

All connections and screws must be kept tight, as any sudden break in the current will cause shock, and, if much current is being used, watch the skin under the electrodes that it does not get burned.

Ionisation

This is an arrangement by which a galvanic current is conducted to the body through pads of cloth soaked with solutions of different medicinal substances in water. The substances in solution are decomposed into simpler substances, called ions, which carry charges of either positive or negative electricity. By this means some of the ions can be introduced into the body through the skin, though not very deeply.

The active electrode, viz., that with the pad, holding the solution is usually at least 3 or 4 inches square, the

size varying with the area of the part to be treated. The indifferent electrode is larger, and is applied as near to the active electrode as is possible.

Precautions

See that the pads are evenly applied and that the connections are tight, so that there shall be no burning of the skin or shock.

Faradism

When the faradic current is used, the current from the secondary coil of the induction coil is led to the body by wire conductors, and the electrodes used are of the same kind as those used for the galvanic current, the difference being that, when using the faradic current, one electrode, the indifferent, is often applied to the skin and fixed there by a rubber bandage, while the other, the active, is moved about over the skin wherever the application is required. The current from the primary coil, which is an interrupted current, may be used, but the induced current of the secondary coil is the one which is mostly used, and is both interrupted and alternating (changes its direction).

Medical Uses and Therapeutic Effects

The faradic current causes muscular contraction only when the nerve going to the muscle is intact (compare with galvanic current), it is therefore used for diagnostic purposes.

It stimulates a sluggish circulation (heart muscle) and wasted muscles and nerves, and restores their tone.

The Bristow Coil

A modification of the faradic coil is that known as the " Bristow," which is used for treating cases of muscular

paralysis and sprains and other injuries to the muscles and joints.

The three chief advantages of this coil are :—

(1) The current is uniformly interrupted.

(2) Three different sections of the secondary coil can be used.

(3) The strength of the current can be still further increased or diminished by pushing in or withdrawing the primary core. By these means perfectly graduated and rhythmic contractions of the muscles are obtained.

The Faradic current is used also in the Bergonie treatment for obesity.

Precautions

See that the induction coil is working evenly and that the electrodes and skin are well moistened before application, and always begin with weak currents to test the patient's response.

Sinusoidal Currents

These currents can only be obtained by the special apparatus already mentioned, but the current is conducted to the patient by wires to which one large pad for fixing is attached and another smaller electrode for moving about the body can be used, or it can be conducted through the water of a bath.

The rate of alternation can be regulated so that it can be rapid or quite slow, *i.e.*, 100 down to 2 per second.

Therapeutic Uses

To improve circulatory stasis and stimulate the tissues, specially nerves and muscles, and is very often given by baths.

Precautions

Not to use the current too strong for weak muscles and not to apply it near the heart.

Four-cell Bath (Schnee) (see Fig. 7, p. 136)

There is no new current or principle involved here, but it is merely a very convenient arrangement of four porcelain troughs of warm water whereby either the galvanic, faradic or sinusoidal currents, or a combination of two, may be given to the limbs of a patient through the water.

The whole of the current will pass through the limb, and its direction reversed as desired.

The troughs are arranged on either side of the patient, who sits on a chair between them, and are usually entirely insulated.

The supply of the various currents used is brought through a switchboard on which are assembled, beside the switches, the resistances, amperemeters, voltmeters, etc., and other controls.

Therapeutic Effects

Are the same as for each separate current.

Precautions

To see that all the connections are secure and that the patient keeps quiet while the current is running.

Electric Water Bath

This is the method of giving electric currents of either of the three kinds through the water of a bath in which the whole body is immersed. It does not follow that all the current used passes through the body immersed, and in this respect differs from the four-cell bath.

Large flat metal electrodes are brought from a switchboard supply and hung over the sides of the bath into the water, but not touching the body of the patient. One is placed at the head and the other at the foot of the bath or a paddle electrode may be substituted for one of them to concentrate the current upon a particular part.

Therapeutic Uses

It is the best means of applying a stimulating current to the whole body, as the whole surface of the skin receives the current.

Precautions

No method of applying electrical treatment requires more care than an electric bath. In the first place special arrangements have to be made to prevent the patient from receiving a shock ; this is done by choosing a supply of current which is safe to use, and by seeing that the bath itself is completely insulated, and so placed that the patient when in the bath cannot reach any of the supply pipes and make a short circuit to earth. The bath should be filled with water and the current turned on and tested by the attendant before the patient gets into it.

The current from the main should never be used except through a transformer and efficient resistances.

The Bergonie Treatment

This is a method by special apparatus of applying the faradic current in such a way as to distribute the current to all the muscles of the body at the same time, so as to make them contract rhythmically.

There is only one induction coil used, but its secondary coil is a powerful one, so that the current induced in it is sufficient to supply all the strength required (500

m.amps. at 12 to 20 volts). The current has to be passed through sets of resistances (rheostats) arranged on the switchboard in groups to make it sufficiently low to be applied to the body without causing painful contractions of the muscles and to regulate its strength.

The secondary current is interrupted by a special form of reversing metronome, giving 120 beats a minute.

The current is conducted to the patient by twelve electrodes, each connected with a rheostat.

The patient lies in a chair, the back and seat of which are formed into four large electrodes, and the others are placed on the abdomen, arms and legs, and kept in position by sand-bags, which also act as loads for the muscles to support. The chair is often surrounded by incandescent lamps, giving heat and light rays, to simultaneously warm and increase the perspiration of the skin.

Therapeutic Effects

Rhythmic and painless contractions of the muscles are produced ; there is an increase in metabolism and heat production and consumption of excess of fat accumulation, with reduction of weight.

Precautions

See that the metronome is working properly and the resistances, and that the latter are fully on before the current is turned on. See that the sandbags are properly applied, then gradually lower the resistances as required.

HIGH-FREQUENCY CURRENTS

D'Arsonval High-frequency Treatment (see Fig. 8)

This is an electrical treatment in which the current used is a high-frequency oscillating one.

In the previous treatments described the alternating

currents used are those which alter their direction or polarity at a low frequency rate, *e.g.*, 500 times a second or much less frequently ; but when we speak of oscillating high-frequency currents we mean that the current of electricity changes its direction with a frequency as high as a million, or even more times, each second, because it is passing backwards and forwards or oscillating under very high pressure or voltage. For this reason it is sometimes called a high tension alternating current. So rapid are the oscillations until equilibrium is established between the positive and negative electricity that the muscles do not contract under it.

To obtain what for brevity is called a high-frequency current from, *e.g.*, a main alternating supply, two things have to be done :—

(1) The tension or voltage of the main current must be considerably raised, and this is effected by a step-up transformer or a powerful induction coil.

(2) The frequency rate of the alternation of the current must be enormously increased, and this is done by the addition of two Leyden jars or metal plate condensers with a spark gap, and a resistance of twenty turns of thick wire coiled spirally called a solenoid.

The Method of Application

The current is conveyed to the patient by insulated wires connected with the solenoid, and may be applied in different ways :—

(1) *The Direct Method.*—The conducting wires are attached to the ends of the solenoid and the current is brought through flat metal plate electrodes covered with cloth and moistened with saline solution and placed firmly upon the skin. One of the electrodes is the active one and the other the indifferent of larger size.

(2) *Indirect Method* (*Auto-condensation*).—In this in-

stance the patient lies upon a " condenser " couch which has the indifferent electrode represented by a long metal plate connected with one end of the solenoid and separated from the patient by the mattress upon which he lies. The other end of the solenoid is connected with a metal handle (active electrode) (usually attached to an arm of the couch) which the patient holds, or it may be attached to a flat electrode placed on the skin of the special part to be treated.

(3) *The High-frequency Effleuve.*—By increasing the size of the solenoid by connecting it with a " resonator " the voltage is proportionally increased and by attaching a special kind of brush electrode to its extremities fine sparks are produced, which can be used for local application.

(4) *Condenser Electrodes.*—These are closed glass tubes of various shapes, the interior of which is a partial vacuum. They are pierced by a platinum wire and connected by the wire conductor from it with the resonator. High-frequency currents are induced on the surface of the glass electrode and easily applied thereby to the skin.

Therapeutic Effects

The principal effect of high-frequency currents is to produce heat of the part to which they are applied. They are too rapid to produce chemical effects or stimulation of muscle contraction, but the rate of metabolism is increased. Local applications of effleuve or spark produce erythema or local congestion and can relieve pain.

Precautions

The means of altering the strength of the current by the regulation of the solenoid and resonator and the spark gap must be learned, and care in using the effleuve and sparking electrodes so as to avoid burning the skin.

Diathermy Treatment

High-frequency oscillating currents are used in the apparatus for this treatment. The same type of instrument in principle is used as that for high frequency, but certain modifications of structure have been gradually introduced in order to make the current oscillate without the intermissions which take place with the D'Arsonval high-frequency machine :—

(1) Leyden jars are not used, but a more effective condenser consisting of insulated metal plates.

(2) The spark-gap is a multiple one to prevent overheating and overcome the intermissions between the oscillations of the D'Arsonval machine, and in the latest type is a three-phase valve.

(3) The voltage is increased by a step-up static transformer.

(4) The condenser is connected with a flat, watch-spring shaped oscillator instead of a spiral solenoid.

(5) The resonator also is not spiral, but curved on the flat like the oscillator. It is quite separate, but can be moved over the oscillator and is connected with a hot-wire ampere-meter to register the strength of the current going to the patient from the resonator.

Therapeutic Effects

The chief effect of these continuous high-frequency currents is to produce heat, owing to the resistance of the body, as shown by a rise in the temperature of a thermometer in the parts of the body through which they pass, both superficial and deep (*i.e.*, both epithermy and diathermy); the heat produced can be concentrated locally and used for the the destruction of diseased tissue (surgical use).

Method of Application

The current is conducted to the body by well-insulated wires and flat metal electrodes of various shapes and sizes according to the nature of the part to be treated, and covered by cloth pads well soaked with saline 10 per cent. solution. They are firmly and evenly applied. If one electrode is larger than the other the heat will be concentrated towards the smaller one. The electrodes are held in position by elastic bandages.

If the diathermy is to be applied to the whole body a special couch is used of a similar kind to that used for high-frequency auto-condensation, with slight modifications, such as a changing box, etc.

Precautions

The chief care in giving diathermy treatment is to see that the skin does not get blistered or burnt, by watching the effect of the current and seeing that the pads or bare electrodes are properly applied. Also that the patient does not suddenly turn faint owing to the heat being too great.

Rules Applicable to all Electrical Treatments

Before applying electrical treatment to any patient :—

(1) Learn every part of the particular apparatus to be used. There are, for instance, many different machines for diathermy owing to improvements which have gradually been introduced, therefore study the one you have to use until you understand thoroughly how it works. One of your duties will be to keep it in good working order as well as to use it.

(2) See that the apparatus, *e.g.*, an induction coil, is working properly and smoothly.

(3) See that all connections held by screws are quite

tight, whether part of the apparatus or of the terminals or electrodes of the conductors.

(4) See that the electrodes which are to be fixed are making good and even contact with the skin and are moistened with saline solution, and that those which are to be moved about are well connected.

(5) Where possible try the current on yourself before applying it to the patient.

(6) NEVER leave a patient while the treatment is going on. If it be unavoidable turn off the current before leaving.

CHAPTER VIII

THERMOTHERAPY BY RADIANT HEAT AND LIGHT

FOR centuries water, steam and air, as well as other media such as mud (fango), have been used as agents for the application of heat to the body, and until comparatively recently they were the only means except the sun's rays which were available.

Now, however, it is possible to make use of radiant energy in the form of heat rays artificially produced, and it has been found that radiant heat can be applied safely at a much higher temperature than when heat is conveyed by water, steam or air.

HEAT AND LIGHT RAYS

Nature and Properties.

Anyone going into a well-equipped physiotherapeutic department for the first time will be struck by the number and variety of apparatus for giving heat, light and U.V. ray treatment, and it might appear difficult to distinguish one from another, as they all seem to be producing heat and light.

To get some clear idea of this section of Physiotherapy, we must keep in mind the difference in the ranges of the solar rays and the order in which they come according to their wave-lengths.

Taking the whole range of electro-magnetic rays according to their wave-lengths, commencing with the longer

and passing along the scale to the shortest, the order in which they come is :—

Electro-magnetic, wireless, infra-red or heat, light, actinic or ultra-violet, X-ray and radium rays.

The light rays come next in order to the heat, and the actinic (U.V.) come next after the light rays.

If we compare the ranges of the rays which can produce either heat, light or actinic effects, we find that in the sun's rays, as they reach the earth, there are 78 per cent. which give heat, 13 per cent. which give light and 7 per cent. which give actinic effects.

When heat, light and actinic rays are artificially produced, the light rays are only a small range, distinguished by being perceived by the eye, sandwiched in between a larger range of the U.V. rays and a still larger range of heat rays. There is no abrupt interval or gap between heat rays and light rays, any more than there is between the colours of the rainbow, the one kind merge into the next, and the same is true of the light and U.V. rays. The heat rays next to the light are slightly luminous, but those beyond with longer wave-lengths (infra-red) are non-luminous.

If substances are heated beyond a certain point they give out a red glow, in other words, they begin to emit light as well as heat rays, and if they are made very hot they emit white light, which shows the close association between heat and light rays.

Most of the apparatus to which we have to refer under the head of heat treatments produce both heat and light rays, but there is one apparatus, originally designed by Mr. Greville, by which infra-red or heat rays can be produced without giving out light or actinic (U.V.) rays. There is no apparatus which can produce the small range of light rays without at the same time producing heat or U.V. rays, and generally some of

both, though the latter can be cut out of the field when necessary.

We can easily understand the difficulty in producing rays of either kind in pure form when we consider that the only difference (which is very small) between heat and light rays is the length of their wave or vibration, and this applies also to light and U.V. rays, so that most apparatus for heat give a mixture of heat and light.

Radiant heat is that form of the sun's energy which can pass through air without heating it, but is converted into sensible heat when it strikes an object or the skin. These heat rays can be detected by a thermometer and give the sensation of warmth.

Radiant light is the form of the sun's radiant energy which, when it strikes the eye, produces the sensation of light.

Both heat and light rays can be reflected, refracted and absorbed. There are various apparatus by which heat rays may be produced artificially and applied to the body generally or locally.

One of the first of these which was really efficient was the Dowsing Luminous Heat Lamp.

Mr. Dowsing, as the result of experiment, found that the particular metal filament and glass he used for his lamps produced a maximum quantity of heat rays, the proportion of luminous rays being small, and by suitably designed reflectors they could be both reflected and concentrated.

In using this heat-producing apparatus you have to bear in mind that you are not making use of the heated air only, which as in a Turkish bath is the means of diffusing the heat by conduction and convection, but you are using the heat waves which are radiating directly out from the heat-producing mechanism, and being concentrated by the reflectors upon the parts to be treated.

These heat waves radiate out from the lamp in rings or circles in the same way as the waves of water flow out from the spot where a stone has been thrown into a pool.

We have stated that, though these heat rays pass through the air medium, they do not cause an appreciable increase in its temperature during their passage; the heat does not become apparent until the waves strike some object such as the surface of the skin. This is one reason why this form of applying heat is borne more easily than that of a Turkish bath. The skin is able to act quite freely and throw off its perspiration into the dry air, which quickly absorbs the moisture.

The rise of temperature of the body and the rate of metabolism are much greater when radiant heat is used instead of hot air, and the treatment therefore by this method is more intense.

The Dowsing Luminous Heat Bath (see Fig. 9, p. 136)

For the general application of luminous heat a bed is used with an asbestos-lined mattress and blanket, and at the side of the bed on a level with the patient are arranged on metal supports five highly-polished reflectors which hook on to the supports, each holding two lamps, two at each side and one at the foot of the bed. The current going to the lamps is conducted by sets of wires which pass through a resistance with regulating switch which controls the amount of current used. Cross bars hook into the supports and carry an asbestos-lined felt cover to spread over the patient when lying on the bed.

Method of Giving the "Bath"

For a full bath, turn on the lights by sliding the regulating switch handle a quarter of an hour before the patient arrives. Put a clean towel on the bed and a sheet

of flannelette which has been soaked in tungstate of soda (¼ lb. of tungstate of soda to 1 pint of water) so as to render it uninflammable.

When the patient has undressed and is laid down on the bed, wrap the sheet well round his body and tuck in the sides. Take note of his pulse rate and temperature before the commencement of the treatment, also half-way through and also at the end. When the cover has been placed fully over the bed tuck a towel round the patient's neck to keep the heat from the head. If the patient complains of great heat in any particular spot place a piece of lint over the spot so as to lessen the heat on it. Take note of the temperature inside the cover by hanging the special thermometer on the rods which are fixed across the bed. When the patient is thoroughly warmed, give him hot water to drink through a glass tube in order to facilitate sweating. Apply cold wet compress to the head if necessary on account of his feeling congested, and change them as often as required. During the bath the pulse rate can be taken from the artery in front of the ear.

The temperature of the bath should be regulated according to the rapidity and amount of reaction as shown by the pulse rate and perspiration ; usually the temperature is raised up to 260° F. for the first bath and at subsequent ones to 320° F. or higher, according to the ease with which the reaction takes place. This often increases in a series. The duration of the bath is usually twenty minutes for the first time, and can be prolonged up to thirty minutes at the second or third application.

When the time is up, put the regulating switch back slowly and take out all the plugs ; draw back the cover and put a towel over the patient and draw out the damp sheet and put a blanket over the towel. The patient should rest at least twenty minutes to cool before he dresses. Sometimes a water bath is given for a few

minutes at about 95° F. to wash off the perspiration, or a short needle bath for the same purpose, or to check excessive perspiration before the patient lies down to rest.

Dowsing Local Apparatus

There are three or four modifications of the large bath adapted for giving this treatment to the shoulders and arms, half bath for the body, and others for the knees and feet. The method of using them is the same as that for the large bath, but more care has to be taken not to burn the skin, as the lamps are rather nearer the patient, so that a feeling of burning is more easily felt. Protection is afforded by applying where and when necessary one or more layers of the lint previously dipped in the tungstate solution, which are always to be kept ready.

Therapeutic Effects

There is marked reddening of the skin, free perspiration, acceleration of the pulse with diminution of irregularity where this symptom was present, temporary increase of the patient's temperature and also of metabolic rate, with augmentation of expiration of carbonic acid gas from the lungs and of the excretion of solids in the urine. It is used in cases of arthritis, obesity, anæmia and gouty and rheumatic conditions.

A prominent advantage is that owing to the patient breathing fresh unheated air the patient can stand very high temperatures without danger of exhaustion.

Electric Light Cabinet

This is a cabinet bath in which a variable number (sixteen to thirty or more) small electric incandescent lamps are arranged in upright rows round the patient as he sits inside with his head outside the lid in the same way as in

a steam vapour cabinet. As heat rays are given out by these lamps as well as light the application is a mixture of heat and light rays.

A temperature of 120° to 130° F. can easily be given, and it is often a convenient form of treatment and less exhausting than steam vapour.

They are sometimes fitted with an arc lamp to increase the light and U.V. rays given off.

Electric Light "Bath"

This is merely a modification of the foregoing by making the enclosing frame long enough to contain a couch made with a wooden frame with glass bars placed at intervals so that the light and heat rays can penetrate to the body, and at the same time low enough to allow the patient's head, while reclining on the couch, to be exposed outside the lid of the frame.

The lamps are arranged all round the patient and give out both heat and light rays.

Therapeutic action is to produce good perspiration of the skin without undue exhaustion.

Precautions

Warm the "bath" before the patient enters it, and guard the lid lamps with a piece of gauze in case of their fracture causing injury.

The "Leucodescent" Lamp

This apparatus is used as a means of applying locally both light and heat rays simultaneously in a constantly varying angle and direction. The small amount of ultra-violet (U.V.) rays also produced are mostly filtered out by the glass bulb.

It consists of a large metal polished reflector, into which

is fixed an electric carbon filament lamp which is capable of giving a light of 500 or more candle-power as well as heat rays. The amount of current required is about 8 amps.

The lampholder is suspended by a cord and counter-weight working over a pulley fixed on a bracket or by an automatic swinging apparatus so that it can be moved up or down or sideways, in fact, in any direction or distance from the patient. Its application to the neck or shoulders or any part of the body is very easily carried out by the attendant; at the same time it is found that its penetrating action on the skin is very powerful, so that to obviate burning or relieving the sensation of heat, if the lamp be held too close, the attendant must, while directing the lamp with one hand, stroke the skin gently with the other and keep the lamp moving over the part being treated so that the application to one spot shall not be too prolonged.

The duration of the application varies from ten to twenty minutes. The reddening effect upon the skin must be watched, especially at the first application.

Therapeutic effect of this lamp includes the relief of superficial and deep-seated pain in nerves, muscles and joints in a marked way, and the power to sterilise the skin in cases of acne, boils and other septic conditions.

The Sollux Hanovia Lamp

This is another lamp which has been recently introduced for local treatment in which a tungsten filament is employed to give up to 2,000 c.p. It produces intense heat rays with a certain proportion of light rays. It is smaller in size than the leucodescent and therefore more portable, and in certain cases more convenient for applying the heat. It can be adapted for either alternating (A.C.) or direct (D.C.) current.

INFRA-RED RAYS

Infra-red or pure heat rays occur, as we have seen, below the red light end of the sun's spectrum, hence their name. They produce no sensation of light in the eye nor do they have any chemical effect on a photographic plate. They are pure heat-producing rays, and can be detected by their effect in heating a thermometer when exposed to them. This was how they were discovered in 1800. Their range in the scale of wavelengths is eight times larger than the range of light rays, but of this large range only those with the shorter wavelengths (one twenty-sixth part of the range) are used medically.

Infra-red rays are absorbed by water, quartz and cobalt blue glass.

Mr. Greville devised an apparatus for producing these rays and applying them for general or local treatments.

The Greville Radiant Heat Bath

The heat rays in this form of treatment are produced not by lamps, but by passing electric current through a special form of metal wire resistance, which can produce pure heat (infra-red rays) without any luminous ones. The apparatus consists of asbestos covers, containing the resistance and wires, shaped so as to be capable of application to all parts of the body ; it is also made with metal containers made in sections, so that the heat can be applied either to the whole body at once or to the arms and shoulders or the legs ; that for the whole body is arched, so that it covers it from neck to feet without touching it, and the other sections are adjustable to the shape and length of the limb. Each section is also perforated, so that a thermometer can be inserted through

the hole into the space between the covering section and the body, so as to register the temperature being used.

The treatment is given either on a bed or, in the case of the smaller local ones, in a chair. The bed has a horsehair mattress covered by an asbestos sheet to keep in the heat. On the sheet is placed a large Turkish towel. Each section has its set of wire conductors, which have to be supplied with current obtained from a switchboard with its usual controls. The current used is the direct one (D.C.).

Method of Giving the "Bath"

The patient must undress and lie on the bed, which is warmed if necessary. The large section is lowered by a pulley rope over him, so that he is covered from his neck to his feet. Over him are placed three layers of cotton sheeting, reduced in number according to reaction effects. The ends of the arched section must be closed by asbestos curtains. The attendant sees that the conducting wires are tight and the current running correctly.

He takes the patient's pulse rate and notes the time, and then turns on the current. It may take up to 15 amperes of current to heat the large apparatus. The thermometer in the section must be watched, and also the way the patient reacts. The temperature of the bath will soon rise to above 300° F. At the first application it is not advisable to go higher than 320° F.; it is more important to observe how the patient reacts, and regulate the degree of temperature at successive applications accordingly. It is often helpful to a patient to give him sips of hot water to drink to assist perspiration.

The duration of the bath is usually half an hour, but it is wise to give less than this at the first application until the patient's capacity for reaction has been tested, and subsequently the amount of temperature and the

length of duration can be regulated accordingly. Patients react very differently to this form of heat, but, after three or four applications, a maximum temperature of 380° F. can be borne, and as high as 400° F., and even more, in a local section. It is not often that such high temperatures are required, satisfactory reactions taking place long before such high temperatures are reached.

Precautions

There should be no difficulty in preventing overheating in giving this treatment, as the heat can be regulated by the amount of current, and the number of layers of cotton cloth can be regulated according to the sensitiveness of the exposed parts.

Local Application

Sections for local treatment vary in shape and size, but the method of using them is carried out in the same way as for the large bath. The use of the flexible asbestos covers, which contain the heat mechanism without any metal part, has facilitated the treatment of the shoulder and neck. Great care must be observed in regard to the degree of temperature used for the local treatments, as burning may take place more easily than with some of the larger apparatus. In all cases the patient should be instructed to tell the attendant if he feels a sensation of burning at any part. As in other cases, experience in giving this kind of treatment is the great guide.

Therapeutic Effects

The principal effects of these forms of radiant heat treatment is first to redden the skin by dilating the capillaries which it contains and to stimulate the sweat glands to a high degree, so that an abundant perspira-

tion takes place with its associated eliminative effect. Coincidentally the pulse rate increases, the blood pressure after an initial rise becomes lowered, and decongestion of deeper parts (derivative action) takes place ; this often relieves tension and pain. Though high degrees of heat are used in the treatment, the rise in body temperature is comparatively small, owing to the dryness of the surrounding air favouring free perspiration. These physiological effects are applied for the relief of many different conditions, both general or local, such as neuritis, rheumatic and gouty joints, muscular rheumatism and lumbago, and for their general effects in heart or kidney disease, obesity and general arthritis.

Infra-red Local Apparatus

There are now available different types of apparatus on supports (by several makers) for producing infra-red rays of wide range, so that local treatment by these particular rays can be very effectually carried out.

CHAPTER IX

ACTINOTHERAPY OR ULTRA-VIOLET RAY TREATMENT

The Ultra-Violet Rays

ACTINOTHERAPY is the name given to the medical use of those actinic rays which are found beyond the visible violet rays of the sun's spectrum, hence their name ultra-violet, or U.V. for short. They are invisible to the human eye, but they can be detected by the chemical action they produce in a photographic plate. They do not affect a thermometer like the heat or infra-red rays. Their wave-lengths are less than those of light, and they do not produce the sensation of light, but if the rays strike and enter the eyes they inflame them, so that the patient's eyes must be protected from them.

Wave-length

For several reasons it is important in applying ultra-violet rays that the meaning of the term wave-length is understood if the treatment is to be carried out intelligently.

It will be helpful, therefore, to refer again to what has already been said as to the difference between heat, light and actinic rays, which consists in their wave-lengths. This difference in wave-length helps to explain why one range of rays have the property of causing heat, the next the sensation of light, and why the ultra-violet rays we are discussing cause another effect, viz., that of chemical action.

All the rays, whether wireless, heat, light or actinic, are essentially force or motion, which is similar in nature in each case, imparted to or associated with ether or matter, but with this important difference—that the size and length of their waves or vibrations steadily diminish and the rapidity at which they vibrate increases just as a short clock pendulum will oscillate faster than a long one to keep the same time. As they all travel at the same enormous speed, except when they are stopped by an object or absorbed, they must vibrate quicker and quicker as they get smaller so as to "get over the ground." This last feature—diminution in wave-length—helps us to understand that, in general, as they get smaller they can penetrate further, just as a mouse can get through a hole the cat cannot pass through. X-rays, with their minute vibrations but great rapidity and force, can penetrate where even the actinic cannot get through. This power of penetration also throws light upon the disturbing influence the small-waved rays possess upon the atomic structure of matter, which gives rise to their characteristic chemical effect. All the wave-lengths were measured by Professor Ångström some years ago, and his name has been given to the unit of measurement which he selected, which in consequence is called the Ångström unit, or A.U. for short. This minute length is that of the wave-length of certain short X-rays, and is equal to one-ten-millionth part of a millimetre.

It is a great advantage, especially in Actinotherapy, to know what this measurement is and what is the meaning of the Ångström unit, because groups of U.V. rays with different wave-lengths are given out by the various kinds of lamps used, and, as their range of output of rays is calculated in Ångström units of measurement, it helps in their selection and use as to dosage.

It has been found that the actinic rays begin with wave-

lengths of about 3,900 A.U. and diminish in length to 1,850 A.U.

Those which are used therapeutically fall into two groups :—

(1) Those rays with wave-lengths from 3,800 A.U. to 2,960 A.U., the chief feature of which is their penetrating power.

(2) The rays with wave-lengths of from 2,960 A.U. to 2,100 A.U., distinguished chiefly by their germicidal effects.

All the rays, however, which have wave-lengths between 3,900 and 1,850 A.U. produce actinic properties, though varying in degree, and the choice of those which are selected for use in a particular case depends upon the effects which it is desired to bring about.

HELIOTHERAPY

The application of the rays as they come from the sun without alteration for the healing of disease is called heliotherapy ; it is a very old form of treatment, for we have records that the ancient Egyptians used them for healing. It has been found that their application in graduated doses produces profound effects in a variety of diseases.

To obtain the full benefit from the sun's U.V. rays it is necessary to go to the higher altitudes, where these rays are not obstructed and absorbed by clouds, dust or excessive moisture of the air. In the mountains of Switzerland, as already mentioned, these conditions are obtainable during most of the year, and are being freely utilised, Drs. Bernhard and Rollier having been pioneers in developing the best way of using them.

In Great Britain it is very difficult, if not impossible, to find these suitable conditions fulfilled, so that in this country, where the amount of beneficent U.V. rays

which reach the earth's surface is so much smaller, the solar rays have to be supplemented by artificial means in order to bring about similar good results.

The U.V. rays are the most essential for medical purposes, and in this country most of them are absorbed by the excess of cloud and by the dust of our great cities.

Therapeutic Uses of the Sun's Rays

Seeing that they contain all three kinds of rays, they produce all their characteristic effects, viz., increase in the warmth and vigour of the circulation in the blood and lymph vessels and a general toning effect upon the whole body, including the nervous and muscular systems. The skin is stimulated to increased activity, and after several exposures becomes pigmented. The U.V. rays have a strong bactericidal effect and cause chronic wounds and ulcers to heal quickly, and cure tubercular disease of the bones, joints and glands ; they also have the power of curing rickets by assisting in the production within the body of those vitamin food factors of which the rickety subject is deficient.

Precautions in Application

The chief care to be taken concerns the gradual and proper dosage of the exposures, for which directions will be given by the physician.

ACTINOTHERAPY

The full value of the application of the pure sun's rays has been established by Drs. Bernhard and Rollier, but only recently generally recognised.

Over thirty years ago Dr. Finsen, of Copenhagen, tried to cure lupus by the action of the sun's rays, but failed because he could not get enough U.V. rays from them in

Denmark. Knowing that they were the chief rays upon which the cure depended, he sought for the best means of producing them artificially, with the result that he devised the carbon arc lamp, which in improved design is still used.

Since that time, as a result of much research in order to ascertain the most efficient means of producing U.V. rays, three different kinds of apparatus have been evolved. They all depend upon the passing of a direct current of electricity through electrodes holding substances which can be heated to a high temperature, and at this degree of heat give out the rays of ultra-violet light. They all give out at the same time rays of heat and light, but these can be cut out if necessary.

Artificial Means of Producing Ultra-violet Rays

Those in most use at the present time are as follows :—

(1) Carbon Arc Lamps

By passing a strong (8 amperes) direct current through carbon electrodes so as to form a carbon arc ; the electrodes are opposite one another and the current passes across the small gap between the two ends, heating them greatly. This apparatus is called the carbon arc lamp, and produces only 2 per cent. of U.V. rays, the rest being mostly heat rays. The U.V. rays are given off at the positive electrode.

It has the disadvantages of requiring a lot of current, and therefore being expensive ; it also creates carbonic acid gas, and therefore the room where it is being used must be well ventilated. In its improved forms it is useful for general treatment, and to patients with sensitive skins, and for application of the rays to a number at a time.

(2) **Quartz Mercury Vapour Lamp** (see Fig. 10, p. 136)

By passing a direct current through mercury held in a quartz container and causing it to become greatly heated and evaporate, U.V. rays are given off from the vapour, and heat and light rays as well. The lamp mostly used in this country is called the Quartz Mercury Vapour Lamp as exemplified by the Kromayer, K.B.B., &c. The heat rays are absorbed by the quartz of the container, re-radiated from the quartz and carried off by circulating water (convection), so that the U.V. rays remain behind in a fairly pure state.

Besides the water-cooled lamp there are three other varieties, viz. :—

(*a*) The air-cooled, with wide field for general and local use.

(*b*) The vacuum-cooled, giving more U.V. rays, but quartz soon spoiled.

(*c*) The gas-filled, which is more effective and does not require tilting.

The water-cooled variety is a small lamp and convenient for local applications. Moreover, by using the many kinds of quartz applications, the rays can be brought to and concentrated upon any special part, as quartz has the unusual property of conducting these rays without any diffusion.

(3) **Tungsten Arc Lamp**

Here, again, by passing a direct current of electricity through, instead of carbon, specially prepared tungsten electrodes with their ends opposite one another, the electrodes become highly heated and then give off rays rich in both U.V. light and heat radiations. This form has the advantages of being rich in U.V. rays, taking a comparatively small amount (4 to 5 amperes) of current,

and the electrodes last much longer than carbon ones; also no CO_2 gas is given off, but a vapour which has therapeutic value if inhaled.

Therapeutic Effects

The ultra-violet rays are absorbed by the skin and by the blood circulating in the capillaries of the skin. They cause erythema of the skin, and later pigmentation of it after repeated applications. They induce chemical action in certain substances. They affect metabolism by assisting in the anabolic or building-up processes, including probably the synthesis within the body of vitamins. They increase the hæmoglobin content of the blood corpuscles. They induce the cell fixation of salts, iron calcium, phosphorus and iodine, hence their value in rickets and anæmia. They have a definite bactericidal action.

By such actions as these they heal tuberculosis of the bones, joints, glands and peritoneum, chronic sores and ulcers and septic wounds, and indirectly give tone to all parts of the body.

The simultaneous application of heat and light rays with the U.V. rays tends to assist their action, providing the heat rays are not in too great an excess, so that it may be advantageous not to cut them out altogether. It is found, in fact, that if an overdose of U.V. rays has been given, an application of heat rays will counteract the harmful effect.

Precautions

(1) Make sure that the direct current is applied to the lamp in the right direction before turning it on, or otherwise the lamp may be irreparably damaged.

(2) See that the lamp is running steadily before applying the light to the patient.

(3) Protect the patient's eyes before treatment is commenced by such spectacles as the " Arkos," and the operator should wear them too.

(4) The patient must be at the right distance from the lamp.

(5) The correct dosage must be calculated before being given ; especially is this the case with the local mercury vapour lamp.

Roentgen X-rays and Radium Rays

The use of X-rays produced by electric currents from X-ray tubes, both for purposes of diagnosis and treatment, and also the employment of the radiations or emanations from radium and its derivatives, for the treatment of malignant growths and other diseases is quite a special branch of Physiotherapy, and forms far too large a subject to be more than mentioned here.

Attention, however, is drawn to the fact that in both cases the essential agents are the intensely penetrating rays which are produced, with very much smaller vibrations even than the actinic rays we have been discussing, in order to demonstrate the extraordinary range of rays which are now used in physiotherapy and the continuity of the nature of the agents.

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