The Grand Pump Room, Bath, 18th Century (*after Rowlandson*).

NATURAL THERAPY

A MANUAL OF PHYSIOTHERAPEUTICS AND CLIMATOLOGY

BY

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WITH THIRTY PLATES
AND ONE HUNDRED AND TWENTY-FIVE ILLUSTRATIONS
MANY OF WHICH ARE ORIGINAL

See the wondrous water streaming,
Forth the fount of health is steaming,
Now rises higher
Life's true desire,
Hail to water! Hail to fire!
GOETHE

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TO

WILHELM W. WINTERNITZ, M.D.

PROFESSOR OF HYDROTHERAPEUTICS IN THE UNIVERSITY OF VIENNA,

TO WHOM THE MEDICAL PROFESSION OWES SO VERY LARGELY

THE KNOWLEDGE WHICH IT POSSESSES OF THE

SCIENTIFIC USE OF WATER IN THE

CURE OF DISEASE.

PREFACE TO SECOND ISSUE.

In its present form, while no change has been made or needed in the text of the body of the work, a chapter has been added on Climatology, with the kind assistance of Dr. Hay Forbes, and another suggestion has been fallen in with—the price of the book has been reduced.

The author takes the opportunity of thanking the reviewers for the cordial terms in which they dealt with the work when it first appeared.

PEEBLES, *November*, 1913. T. D. L.

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Some ten years ago the author conceived the idea of writing a book of this character. A commencement was then made, but owing to an unexpected change of environment and other circumstances, it was not proceeded with. During the past decade great progress has been made in methods of natural therapy, and particularly in the department of electrical treatment and electrothermal methods. The author feels that the time has now arrived when there is a distinct want for a book on "Natural Therapy" in this country, and he ventures to hope that it may be welcomed by the medical profession. In the preparation of the work no attempt has been made to give a complete or exhaustive account of any of the departments dealt with, but the author has endeavoured to embody the chief points of interest and importance, briefly and succinctly, in such a manner as to awaken interest, and lead to further study and consideration of the methods treated of on the part of the reader. A bibliography has been added at the end of the book, and to the authors of many of the volumes therein mentioned the author herewith gratefully acknowledges his obligations.

Throughout the text, footnotes, marginal references, and acknowledgments have been intentionally avoided, as embarrassing to the reader when frequently employed. The name of an authority is frequently mentioned in brackets.

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In the section on hydrotherapeutics it is difficult to mention any ascertained physiological fact which we do not owe to the work of Winternitz or Kellogg, and their names occur frequently.

The encouragement extended to the author on all hands when help in the production of the book was solicited has been most gratifying.

Thanks are specially due to friends for hearty co-operation in illustrating this volume, and in particular to Dr. Kellogg, of Battle Creek, and the F. A. Davis Co., of Philadelphia, for the use of Plates III, IV, V, VIII, X, XI, XXIV, and Fig. 18; to Dr. Cecil Sharpe, of Matlock, for the loan of photographs and help in various ways; to the Bath Corporation for the Frontispiece, Plates I, II, XII, XIV, XV, and other figures; the Harrogate Corporation for Plate XXII; Dr. Philp for Plate XX; Mr. A. M. Thiem, for Plate XXI; and to Mr. Dowsing and Mr. H. E. Greville for Figs. 44 and 45, and Plates XIX and XX. The author is also similarly indebted to The Fischer Kiefer Co., and other manufacturers, for the loan of various photographs and illustrations, which have added to the clearness of the text.

Many illustrations are from original drawings by Dr. Georges Dupuy, of London, and owe such merit as they possess to the combination of his artistic skill and medical knowledge.

Dr. W. T. Ritchie has kindly gone over most of the proof sheets, and has made many helpful and valuable suggestions.

The author finally expresses his obligations to the publishers for their uniform courtesy and untiring efforts to give the book every advantage so far as illustrations and production generally are concerned. That many imperfections remain in spite of all the time and care which have been expended the author knows full well, but encouraged by the favourable reception granted to previous ventures, he now entrusts the work to "the tender mercies" of the reviewer and the medical public.

T. D. L.

EDINBURGH,
September, 1908.

LIST OF PLATES.

LIST OF ILLUSTRATIONS.

FOREWORD.

MEDICINE has ever been subject to fashions ; though it must be at once admitted that some of the changes which have taken place in the methods of treatment and combating disease during the past twenty-five years are to be attributed to something other than mere fashion.

There are always seasons, we must allow, when some special drug or method of treatment is run to death. The antipyretic coal-tar derivatives in the treatment of influenza, the "old tuberculin" for phthisis, the intra-tracheal injection of menthol oil, the cacodylates, and lastly the formates—these may be mentioned as some of the comparatively recent fashions in medicine, and if we except the formates, they have had their day and for the most part died a natural death. The formates still linger with us.

The changes referred to above, however, are more radical and lasting in character, and depend largely on improved methods of diagnosis and surgical technique, and a lasting reaction against empiricism. Drugs are now much less freely prescribed both in good-class practice and in hospital. Going round a medical ward one cannot help being struck by the absence of long prescriptions, once so common, on the patient's bed-card. These are now seldom seen. There is the chart with respiration and pulse-rate, the temperature, blood-count, etc., and possibly away in the corner, in very small writing, "Hæmatogen ʒ j t.i.d.," or "Nuclein gr. ij," or "Thyroidectin gr. v." On all the cards the British Pharmacopœia takes a minor place.

Again, at one bed we see a man, with a pallid, puffy face, lying in a bed vapour bath ; at another an electrician is galvanizing a case of exophthalmic goitre from " the main " ; and as we leave the ward we notice a fair-haired Norseman enter, and are told that he is the masseur, who pays a daily visit.

The explanation is not far to seek. While in club and country practice it is often difficult or impossible to do without a liberal supply of B.P. drugs, still the modern physician does his best to cure such cases as the present-day surgeon leaves him, by stimulating by natural methods of treatment the *vis medicatrix naturæ*—always present, if often sluggish—and further, wherever possible he prescribes *specific* treatment, and promotes the general good health of the patient by suitable diet and hygiene. The physician is quick to recognize where his limit is reached, and to hand over to a surgeon the patient suffering from a surgical affection.

The value of many drugs is recognized, and they have their place, but polypharmacy is at a discount. The use of sera, vaccines, and animal extracts of various kinds is increasing, and, where these fail or are unsuitable, natural therapy is increasingly employed. Hydrotherapy, massage, electricity, and special diets are now freely prescribed every day. That their use is based on sound principles, and that they are not a passing craze, the following pages may help to show.

NATURAL THERAPY.

SECTION I.—*The Use of Water in the Treatment of Disease.*

CHAPTER I.

THE HISTORY OF BATHING.

TO the medicinal use of baths allusion is frequently made in Greek mythology. Homer speaks of Andromache preparing the bath of Hector, and of Penelope's use of baths and unguents to allay the melancholy which her husband's prolonged absence caused her. Again, mention is made of the weary Hercules being refreshed and strengthened by Minerva at the springs of Thermopylæ. The beneficial effect of warm bathing on old people suffering from what we now call "Anno Domini" was recognized at a remote period. Ulysses returning from Ithaca found his aged father Laertes in a condition of great weakness, and we are told he advised warm bathing, and spoke of one who, worn out and emaciated by age, by the use of baths regained health and appetite. Such was the common custom among old men.*

Hippocrates mentions the use of warm baths in fevers, and the use of hot springs and of watery and balsamic vapours. Plato refers to the value of baths in various diseases.

Sulphurous baths were advised by Aretæus for the cure of melancholy and leprosy; this writer was the first to recommend the exclusion of the head in vapour baths—a valuable observation. Cold baths in the treatment of fevers were recommended by Galen and Celsus, the former

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* *Odyssey,* xxiv.

emphasizing their value in the combating of hyperpyrexia. Subsequent writers, such as Pontus Ægineta (celebrated as a physician in the 7th century) and Oribasius, developed the theory of balneotherapy and extended its use.

By the use of pure water in the treatment of malignant dysentery in Holland, in the 17th century, Van der Heyden foreshadowed the methods which became systematized, early in the 19th century, by Priessnitz and others under the term "Hydropathy," signifying the treatment of disease by the inward and outward applications of water. In 1702, Sir John Floyer, a Lichfield physician, published his "History of Cold-bathing, both Ancient and Modern," which ran through no less than six editions within a few years, and was translated into German by Dr. J. S. Hahn, of Silesia, who was himself a strong advocate of the hydropathic treatment of small-pox, at that period such a scourge.

In the year 1747, the Rev. John Wesley, founder of the Methodist Connexion, published a small treatise entitled "Primitive Physic," which gives evidence of the existence at that period of a very considerable acquaintance with the remedial and hygienic value of water (*Plates I and II*). All the measures recommended Wesley declares he found useful and curative among the people with whom his evangelistic work brought him in contact. Such varied ailments as ague, apoplexy, cholera morbus, and mania were dealt with, and cold-water baths or applications were used in the vast majority of cases. Even so great an authority as Dr. Kellogg remarks at the present day, "One cannot help noting the sagacity and wisdom displayed in many of the recommendations, which in numerous instances could scarcely be improved upon in modern times, and which certainly evince extended and accurate observation of the effect of hydriatic procedures."

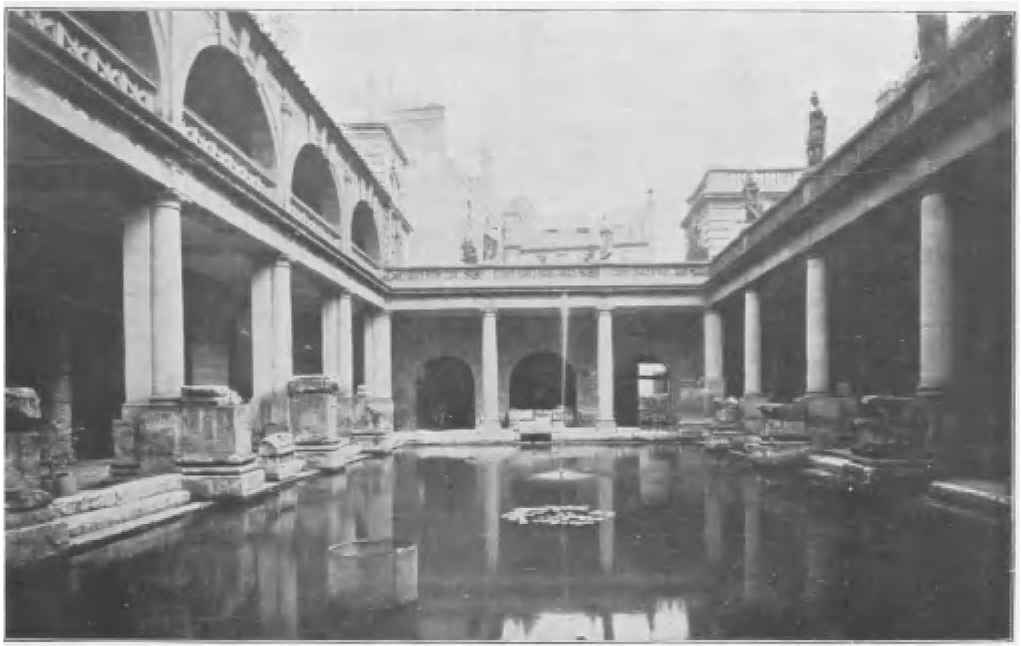
Further, Dr. Currie, of Liverpool, published, in 1797, "Medical Reports on the Effect of Water, Cold and Warm, as a Remedy in Fevers and other Diseases." This manual, which was widely read in this country, placed the subject on a more scientific basis, and was, like Floyer's, translated into German. Meantime much enthusiasm had been evoked among his countrymen by Hahn's writings, and many societies were established to promote the medicinal and

PLATE I.

THE KING'S BATH (AT BATH) 18TH CENTURY (*after Rowlandson's Sketch*).

" 'Twas a glorious sight to behold the fair sex
All wading with gentlemen up to their necks,
And view them so prettily tumble and sprawl,
In a great smoking kettle as big as our hall.
Every day many persons of rank and condition
Were boil'd by command of an able physician".

PLATE II.



The Old Roman Bath at Bath (*Restored*).

dietetic uses of water. Boerhave and Heberden were both interested in this movement, and freely prescribed bathing of various kinds. In 1804 Professor Oertel gave the water-cure a fresh impetus by his unqualified commendation of water-drinking as a sovereign remedy for all manner of diseases.

The actual birth of systematic hydropathy, however, may be said to date from 1829, when Vincenz Priessnitz (1801–51), a farmer of Gräfenberg in Silesia, began his public career on the paternal homestead, which he enlarged to accommodate the numerous patients attracted by the fame of his cures. This extraordinary man, when seventeen years of age, met with an accident resulting in numerous bruises and the fracture of two ribs, with such complications that the physicians who were called in gave him no hope of recovery. Being in this poor case, Priessnitz called to mind the benefit which he found his animals, when injured, derived from being treated with water applications, and he forthwith determined to resort to the same remedy for himself. He applied wet compresses to the injured region, and at the same time drank water freely, with the result that, whether *post* or *propter hoc*, he was very shortly quite restored to health. This happy issue made such a profound impression on his peasant mind that he resolved, so far as he was able, to make a complete investigation of the remedial powers of water, used internally and externally. Guinea-pigs had not at that time attained their present pre-eminence in experimental science, and Priessnitz began his researches on two ordinary porkers. He fed one on hot and the other on cold foods, and on killing them later, made a thorough examination of their intestines, when he discovered, as he affirmed, that the gut of the animal fed on cold foods was contracted, pale, and of firm, resistant character, while the intestines of the pig fed on hot food were red and relaxed, and so friable as to be useless for the making of sausages. The methods adopted by Priessnitz were, naturally, crude in the extreme, but the working basis of his system was the production of perspiration and the subsequent application of cold water. Natural sagacity soon led him to discover how variously different people reacted to cold applications, and he soon made a practice of always noting carefully how each patient reacted to the first application, and regulating his subsequent treatment accordingly. He succeeded in calling attention to the efficacy of various simple methods of applying water which had previously been quite unappreciated.

To Priessnitz, pure empiricist though he was, is unquestionably due the credit of formulating a complete system of hydropathy. Among people of every rank whom he attracted to Gräfenberg were numerous medical men, some being drawn by curiosity, others by thirst for knowledge, but the major portion by a hope of a cure for ailments which had as yet proved unyielding to drugs. Records of experiences at Gräfenberg were published, some enthusiastic in their estimates of Priessnitz's genius and acumen, and all more or less substantiating his claims. These constitute the only available account of his work and practice, for Priessnitz himself never expressed his views in writing.

In 1840 hydropathy, in the guise of the Priessnitz system, was brought back to England and popularized by a Captain Claridge, whose book, "The Cold Water Cure," passed through nineteen editions in as many months. He further delivered popular lectures on the subject, and made numerous converts. Dr. Gully (the father of the late Speaker) and Drs. Wilson and Edward Johnson joined in the movement, and large establishments at Malvern and Ben Rhydding were soon filled to overflowing. The craze spread even to America, where large hydropathic "Sanitaria" were opened.

The Battle Creek Sanitarium (*See Plate III*) is one of the best known of these, and has now attained gigantic proportions. In it are employed no fewer than a thousand servants, nurses, and attendants, controlled by over a score of physicians. These minister to the needs of upwards of a thousand patients. This huge establishment was reduced to ashes in 1902, but was at once rebuilt on a larger scale. Its extraordinary development and success is chiefly due to the genius and enthusiasm of Dr. J. H. Kellogg, the head physician.

The literature of this period of the water-cure is, as might be expected, somewhat polemical. The wildest optimism prevailed among the disciples of Priessnitz;

PLATE III.

THE BATTLE CREEK SANATORIUM.

they firmly believed and asseverated that in water and in water alone, when properly applied, existed a certain cure for all the ills that flesh is heir to. The innovation was a very natural reaction against the wholesale bleeding and purging which constituted the practice of the "allopathic" physicians of the time, but it was not to be expected that these more orthodox practitioners would welcome the movement or be readily converted. On the contrary, the allopaths condemned the water-cure roundly, and regarded the hydropathists as crazy fanatics. The hydropathists heaped condemnation and abuse equally freely on the "man of blood" and pompous prescriber of "blue pills."

A wild period of controversy and antagonism ended in a legal prosecution. This resulted in a Royal Commission, which had the effect of rendering Priessnitz and his system only more popular and favoured by the public than before. Hitherto some timidity had been manifested in employing the new method on enfeebled patients who were plainly seriously ill. The water-curers had concerned themselves mainly with the more robust types of *malades imaginaires* (as undoubtedly many of the cured ones were), and gouty folk, who were in a condition to withstand not only a very severe regimen but also a severe "*crisis*," * were allowed to run its course without restriction.

A Derbyshire manufacturer, John Smedley, of Lea, near Matlock, was the first to observe the need for an adaptation of the cure to the feebler folk and a tempering

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* *The crisis* was a peculiar method of treatment which Priessnitz himself devised. The term we owe to Hippocrates, as applied to the critical termination of any acute disease. Priessnitz found that the repeated application of wet compresses to restricted skin areas of patients suffering from various morbid conditions tended to give rise to a skin eruption, beginning in a papular form and going on to the formation of pustules and the free discharge of green and yellow pus. The discharge was encouraged and continued for some weeks or even months, but sooner or later gave place to a simple serous discharge, and finally ceased altogether. With the healing of the inflamed area of skin the patient appeared to have regained his health in many cases, or only required a little tonic treatment or change of air to completely restore him. From a perusal of the earlier hydropathic literature, and a personal observation of a

of the methods for "the shorn lamb." This worthy gentleman, melancholic and out of health, went to Ben Rhydding in 1852, and there, in his own person, "tholed his assize" of the cold-water cure. He was fully impressed with its severities as well as its benefits by a six weeks' course, and returning cured, if chastened, to Matlock, there

Fig. 1.—John Smedley.

established and practised among his employees a milder form of hydropathy. Commencing with a mere cottage on the hillside, he soon enlarged his borders and founded an establishment which was a counterpart of Priessnitz's at Gräfenberg. Modified as Smedley's system was, his

number of cases in 1894–1895 the author is compelled to admit that in some cases of gout, rheumatism, and chronic gastritis, benefit was derived. The modus operandi is obscure, for it is not merely counter-irritation. The argument of the hydropathist was that when a vicious circle existed, the chain was broken by this curious treatment, and also a free discharge of morbid materials (humours) took place through the crisis. It is noteworthy that in really healthy or merely neurotic people, it was usually impossible to produce a crisis. The method has now been practically abandoned. It required the utmost patience and endurance on the part of the invalid, and caused many sleepless nights, owing to the intense itching of the crisis area. Further, in many cases it was quite useless, and in others, where milder measures might have succeeded, so reduced the patient as to put recovery beyond hope.

régime was severe enough, if one is to believe the accounts of those who experienced his treatment in their own persons. He unquestionably did a great deal of good to a large number of people and a good deal of harm to not a few, as must ever be the case when a quasi-medical free lance treats invalids indiscriminately, without having had the necessary technical training. There are many people still alive who tell one most earnestly that they owe their lives to John Smedley and his system, and the huge and flourishing establishment which is now to be seen on the arena of Smedley's early triumphs and failures bears eloquent and convincing testimony to there being at least "method in his madness," and suggests that there is something *in* "the water-cure," be it hot or cold.

Handicapped as hydropathy or hydrotherapy was for many years by the gross ignorance, the insane optimism, and blatant self-advertisement of the majority of its advocates, it has finally survived and emerged as a recognized and valued curative method. The founding of a school of scientific hydropathy by Winternitz at Vienna has done much to establish it in its proper place in legitimate if not entirely orthodox therapeutics, and elevated it far above the level of empiricism. It may with truth be said that to Winternitz the medical profession owes nearly all that it has learnt of the scientific application of water in the cure of disease. He has developed hydrotherapy on scientific and physiological lines, with truly remarkable results.

Beginning in 1862 with a small establishment at Kaltenleutgeben, with accommodation for only a score of patients, in 1896 he was dealing with no less than 2000 invalids. A Chair of Hydrotherapeutics was founded in the University of Vienna, to which he has been appointed, and a clinic established in this subject at the General Hospital. Winternitz has demonstrated the importance of the primary action of water on the central nervous system and its secondary antithermic action in fevers, and how it can aid nature in combating toxæmia by stimulating the circulation and nervous system and aiding in the oxidation and elimination of toxic products. His doctrines are now almost universally accepted, and students, qualified and unqualified, have flocked to his clinics, while surgeons and orderlies in the Austrian Army are regularly sent to him for training and instruction.

Other workers in the field have been Brand, of Stettin, Jurgensen, of Kiel, and Liebermeister, of Basel, who between the years 1860 and 1870 employed the cooling bath in typhoid fever with results which were indeed striking. Barr, Caley, and American physicians such as Kisch Baruch, and Kellogg have confirmed their observations more recently, and shown the extreme value of the cold bath in reducing the mortality of typhoid and in the treatment of any hyperpyrexia.

In 1843 Scoutellen, who was sent to Germany by Marshal Soult to study the new treatment, on his return gave such favourable accounts of the method that hydrotherapy soon grew into favour with French physicians, and has so remained. Charcot was one of the best-known exponents, using balneotherapy largely in his practice with the most happy results. There has indeed been a marked contrast between the type of hydropathist in France and Germany, for in the latter country the unqualified and empirical "water doctor" has been the more common type. This is largely due to the influence at an earlier date of Priessnitz, who popularized hydropathy in the teeth of the opposition of the medical profession.

Scattered all over Germany are "Kaltwasser Kuranstalten," originally established by cobblers, tailors, and other humble tradesmen, whom the success of Priessnitz stirred to imitation. The law has stepped in and put a stop to a great deal of this irregular practice, but much still goes on, the lay practitioner being "covered" by some qualified medical man.

A few years back a great stir was made by a Bavarian priest named Sebastian Kneipp, who was entrusted with the cure of souls at Wörishoven. This individual founded a system of his own—"the Kneipp cure"—which consisted in cold-water bathing, spare diet, and the use of herb simples. He published a small brochure on the subject, "Mon Testament," embodying his principles, and treated many thousands of patients annually, with varying results.

France has never been invaded by the water quack, but hydrotherapeutic establishments have always been under the supervision of qualified physicians. Only in this way is it possible for the best results to be obtained, for, as will be shown, water is far too powerful a therapeutic agent to be wielded by any one who is unfamiliar with physiology and has not undergone the prolonged and arduous training of the modern physician.

CHAPTER II.

HYDROTHERAPY.

GENERAL PRINCIPLES.

THERMOTHERAPY consists in the application of heat as a therapeutic agent, at all temperatures and irrespective of the media by means of which the heat is conveyed. Thermal applications include hot- and cold-water baths, and air, vapour, electric light, and sunlight baths.

One of the commonest means employed for conveying thermic stimuli to the body is water, and in describing the temperature of such applications or procedures (*see also Chart, Fig.* 43), the following standard is customary :—

Very hot applications		temperatures	over 40° C.
Hot applications	..	,,	37° to 40° C.
Warm ,,	..	,,	of 34° to 37° C.
Tepid ,,	..	,,	of 27° to 33·5° C.
Cool ,,	..	,,	of 18° to 27° C.
Cold ,,	..	,,	of 12·5° to 18° C.
Very cold ,,	..	,,	of 0° to 12·5° C.

Hydrotherapy consists in the systematic application of water at various temperatures and in varying form to the surface of the body for therapeutic purposes. Water may produce its effects by (1) its temperature, (2) its volume, (3) mechanically, (4) chemically.

Water possesses such physical properties as render it an excellent medium for conveying temperature impressions. It has a remarkable capacity for heat absorption without material rise in temperature, and gives off heat without much temperature reduction. It takes a much larger amount of heat to raise the temperature of a pound weight of water 1° C. than an equal bulk of oil or metal. It is for this reason that water is used for "thermophores" and the domestic hot-water bottle, and on this fact depends the even temperature of insular climates. The heat-conducting power of water, as compared with that of air, is as 27 to 1, and much more powerful thermal impressions are made on the skin by water than air, the temperature being the same.

As a result of different temperatures water undergoes peculiar changes, solidifying at 0° C. and becoming gaseous at 100° C., the volume increasing 1700 times. The heat absorbed and evolved respectively in these changes in its molecular constitution is utilized in various ways in hydrotherapy.

The temperature of water, more than that of any other medium, is readily adapted to individual cases, and with great precision. The range of safety in temperature is from 1° C. to 48·5° C.; long-continued application of water above or below this temperature may produce tissue necrosis. Water is thus said to possess a high degree of *thermic flexibility* (Baruch).

The fluidity of water allows of its local and general effects being regulated with the utmost nicety and precision, and the size, form, and character of its application—in the form of a steam or douche—can be instantly changed. Therapeutic effects of great value are brought about by the mechanical action of water emitted under various degrees of pressure, varying from the mildest stimulation to intense irritation. Cold and heat, and all gradations of temperature, act as nerve stimuli. The result of bringing water, higher or lower in temperature, into contact with the body is a modification of the quality of innervation at the part of contact. The sensory peripheral nerve terminations are brought into a state of increased, diminished, or altered excitability.

The result depends on the degree of difference in temperature between the skin and the water or medium employed, on the suddenness of application, the duration of its action, the extent of body exposed, the variable sensibility of the subject treated, and the simultaneous mechanical and chemical stimulation. The effects induced are due to various continuations of these factors, and may be purely local or reflex. Secondary effects also result from the supply or abstraction of heat. Powerful therapeutic actions may be brought about by the excitation of peripheral stimuli, or by their inhibition. Digestion and metabolism may by this means be strongly stimulated or depressed; the vigour and frequency of the cardiac systole may be likewise influenced, and the general distribution of the blood and local and general nutrition affected. Widely different disorders of metabolism—various secretions and excretions—undergo alteration.

Local Cooling and Heating.—The effects of the local application of cold and heat are as follows :—

1. Cooling or heating of the surface in contact with the medium until the temperature is almost identical. The surface temperature is always slightly higher or lower so long as the application of cold or heat respectively be not excessive and harmful.

2. Local cooling or heating do not modify the body temperature unless the area exposed comprises a quarter of the body surface.

3. Any region of the body can be warmed or cooled to any desired temperature by the supply or withdrawal of heat for a sufficient period of time and intensity of degree.

4. Heating and cooling take place more rapidly the higher and the lower the surrounding temperature after the thermic application.

5. The promptitude and degree of reaction succeeding heat abstraction and heat supply are directly proportional to the intensity, and inversely proportional to the duration, of the application.

6. Active and passive movements of the part under treatment bring about more rapid restoration of heat or cold than occurs when it remains at rest.

7. Local warming is followed by cooling of the surface, and local cooling by warming, showing the alteration of heat distribution.

8. Metabolism is retarded in cooled and accelerated in warmed tissues.

General Heating and Cooling.—There are several automatic protective agencies against the general reduction of body temperature. Chief among these are :—

1. Reduction of the temperature of the surface of the body, diminishing the *heat tension* between skin and cooling medium employed, and so diminishing heat loss.

2. Diminution of circulation in the skin, and resulting collateral hyperæmia in muscular layer of the entire body. So, though the skin be cooled, the muscular tissue, supplied freely with blood, prevents too extensive chilling of internal organs.

3. The rise in temperature of muscles on the withdrawal of heat is induced not only by collateral hyperæmia but also by reflex thermal influences. While cold causes contraction of the cutaneous vessels, it induces dilatation of the vessels of the muscular layer.

4. The hyperæmia of the muscles tends to increased thermogenesis in the tissues.

It will thus be seen that the muscular layer of the body, by both storing and generating heat, is a most powerful agent in protecting the internal organs from excessive cold, and is in turn protected by the skin covering it.

Physiological Reaction after Hydrotherapeutic Procedures.—The intensity of the reaction occurring after any bath or thermal application, while partially dependent on the character of the procedure, varies greatly with the individual. To produce a proper degree of reaction after all forms of treatment is most important, and depends on the suitable adjustment of the stimulation to the individual, for the rapidity with which heat is restored after heat abstraction varies immensely in different cases. It is especially important in treating any case that the elevation of temperature of reaction following heat abstraction be carefully controlled. It is often requisite to diminish or increase its rapidity or degree. The proper restoration of heat depends on :

1. The degree of heat abstraction, *ceteris paribus* ; the greater the abstraction, the more extensive the rise of temperature in reaction.

2. The time taken in the process of heat abstraction. Gradual heat loss leads to a gradual reactive process.

3. The body temperature prior to the heat abstraction. If previous heating be applied, a better and quicker reaction is obtained.

4. The application of friction and other forms of mechanical stimulation, hastening the reaction.

5. Exercise subsequent to heat abstraction, quickening the outset of reaction, as does also the internal administration of stimulants such as alcohol and hot coffee.

6. The heat abstraction not being carried to excess, for in that case the reaction may be much delayed or incomplete.

Baruch's Test for Reactive Capacity.—The response of the cutaneous circulation to mechanical stimuli is an index to the probable reactive capacity of the patient. "Passing the back of the nail of the index finger rapidly but gently across the surface of the abdomen, and increasing the pressure of the nail with a parallel second stroke induces more or less reddening of the irritated skin. The rapidity with which the red line develops after the nail is removed, and the pressure required to produce it, give a fairly correct test, to the trained observer, of the patient's reactive capacity."

If good effects are to follow the application of hydrotherapeutic processes, a perfect and complete reaction is essential. We may desire to modify its character in various ways, to induce a slow or quick reaction, but an incomplete reaction is never beneficial or desirable. It is characterized by lassitude, pallor, poor pulse, a chilly feeling, "cold water down the back," shivering, etc. If repeatedly occurring, it will seriously disturb the patient's health.

The beneficial effects of the hydrotherapeutic procedures only resulting when a good reaction is obtained, thus intensifying the natural defensive powers of the organism, it follows that in enfeebled individuals it is necessary to take all precautions to bring about a complete reaction, and so ensure the maximum amount of good from physical remedial measures.

The automatic protective measures against heat are :—

1. Dilatation of the cutaneous vessels and acceleration of the circulation through the skin and subcutaneous tissues. By the application of heat to the skin the cutaneous vessels are dilated, the circulation is accelerated, the secretion of the skin is increased, and sweat is evaporated from the surface. Heat loss is thus effected, and the blood circulating in the skin cooled. It returns to the internal organs, and thus prevents their becoming overheated.

2. If heat application be prolonged, a large amount of blood will be retained in the skin in consequence of the loss of tone in the skin vessels ; the cutaneous circulation is *slower*, and the overheated blood prevented from returning to the internal organs, to their hurt.

3. The blood being diverted to the skin, a diminished amount of blood will remain in the internal organs, and their activity be accordingly renewed. Excessively rapid penetration of heat to internal organs is thus prevented, and unduly rapid elevation of body temperature checked.

Heat Regulation, or Thermotaxis.—As a result of the stimulating effects of cold, there first occurs contraction of the skin and its vessels, which by restricting heat loss leads to perfect compensation if the abstraction of heat be slight, partial compensation if heat loss be marked. In the latter case the body temperature will continue to decline in greater or less degree ; in the former it will remain constant. Alterations in thermogenesis depend on tonic and clonic muscular contractions (i.e., muscular tension or tremulous movements) that occur involuntarily (i.e., shivering) as the result of severe cold, just as they do in consequence of other sense irritations. These are less important as a thermotactic measure than the contraction of skin, for they cannot prevent reduction of body temperature.

Physiological Effect of Heat.—Primarily, heat acts as a stimulant or excitant. The activity of cellular protoplasm is increased, whether the cells be leucocytes, lymphocytes, or nerve or muscle cells. Such increased activity is but temporary, however, and secondary depression follows as the inevitable reaction. This reaction is due to increased heat production and lower blood-pressure. When cold is applied to the body—in moderate degree—heat production is increased, cardiac contractions are stronger, and blood-pressure is raised. Heat is therefore primarily an excitant and secondarily a depressant, while cold is the reverse.

The effect following the application of heat depends on the form, duration, and temperature of the application, but also largely on the condition of the patient. High temperatures are first excitant and then depressant, the degree of depression being in proportion to the length of the application. After a brief one the depressing effect may be insignificant. Applications of moderate temperature are followed by a less degree of excitement and depression.

The abstraction of heat causes increase in metabolic activity only if voluntary or involuntary muscular contractions occur at the same time. So long, therefore, as the temperature in the muscle layer is increased, and remains increased in spite of heat loss, the stimulation induced thereby will lead to increase of heat production, and this constitutes an important factor in heat regulation. Further, exercise so strengthens the heat-regulating powers of the body that they are rendered capable of compensating most completely the supply and loss of heat.

The functions of the skin control heat loss, voluntary or involuntary; muscular contraction and change, in turn, control thermogenesis. And each of these can be increased or lessened at will by thermic or mechanical influences.

GENERAL EFFECT OF HYDROTHERAPEUTIC APPLICATIONS.

General Effect on Metabolism.—The general application of heat, after raising the body temperature, causes increased oxidation and excretion of CO_2. The blood is rendered more resistant to morbid influences by the increase of alexins, and on this basis rests the belief that the elevation of temperature in the exanthemata and various inflammatory disorders is merely a protective measure, and is, indeed, remedial. The application of a fomentation or poultice to any inflamed region hastens repair by inducing increased flow of blood and causing a local leucocytosis. Cold increases oxidation and elimination of CO_2, and, the body temperature remaining constant, heat produces a reverse effect. The greater the thermic nerve stimulus, the greater will be the reflex increase in metabolism.

Systematic abstraction of heat causes secondarily an increase in body temperature, leading to the modification of the metabolic processes such as occurs in all febrile conditions. The reduction of the body temperature of a normal person by cold application will lead to a reactive process which tends to take the temperature back to the normal, or even above it. Repetition of such application produces in normal healthy people an increased reactive capacity, and a tendency to rise rapidly to the normal temperature.

Action on the Skin.—Contraction of the smooth muscle fibres of the skin is caused by brief application of intense heat, and " goose flesh " results. By prolonged application the sweat-glands are excited, and the amount of perspiration may be increased twenty-fold. Marked hyperæsthesia is caused by temperatures of over 50° C. Primary pallor of the skin quickly changes to redness as the cutaneous vessels dilate, and with the reaction later pallor returns.

Action on the Muscles and Muscular Tissue.—Increase and diminution in tension of all muscle tissues are induced by the application of thermic or mechanical stimuli, both voluntary and involuntary muscles being affected. The application of cold, and of massage or friction, increases the tone in all voluntary muscle tissue. The muscular tissue may simply be increased, or clonic or toxic spasm induced. There is increased production of heat, and of capacity for withstanding fatigue. Temporary application of heat will produce similar effects, but if prolonged this leads to fatigue and weakness, and lessens heat production.

Muscular energy is increased by brief hot appliances; relaxation results from longer applications. Practically we utilize this latter action in relieving cramp of a muscle, or of the stomach or intestine.

Action on the Nervous System.—Reflex excitement of the nerve centres is induced by brief applications of heat; exhaustion follows if they are prolonged. By warm or hot applications nerve sensibility is subdued, and a comfortable sensation induced, without depression or lassitude.

Effect on Blood Constitution.—The application of cold to the body surface usually induces a varying degree of leucocytosis and increase of erythrocytes, while the colour index also rises. The leucocytosis may amount to 18,000 or 20,000; the erythrocytes may increase by 1 or 1½ millions, and the hæmoglobin often by 12 or 15 per cent. These effects are usually obtained within an hour. The increase is only temporary, however, being comparable to the physiological increase in hæmoglobin occurring after an ordinary meal. Active muscular exercise has a very similar effect. If a good reaction be not obtained these effects are not produced, but on the contrary there may be a diminution in the number both of erythrocytes and leucocytes.

Warm fomentations and poultices cause a local increase in the leucocytes, and a diminution in red cells, while warm sitz baths cause a general reduction in both types of cells as well as in hæmoglobin percentage.

Winternitz considers there is a fallacy in this increased blood-count above spoken of. He points out the marked difference in composition of blood—as regards percentage of cellular elements—in a drop taken from the finger tip and one taken from the abdominal wall. He further attributes the temporary leucocytosis, etc., to brisker circulatory conditions sweeping out into the general blood-stream leucocytes and red cells which were stagnating in various internal organs. He points out that though the increase is only temporary in large degree, still gaseous interchange is encouraged here, oxygen being taken up and CO_2 thrown out in the respiration, and nutritive processes being heightened; while by methodical repetition of the thermic applications which lead to the temporary effect, a permanent one is attained.

Action on the Cardio-Vascular System—Application of cold at first quickens the cardiac beats, and later slows but

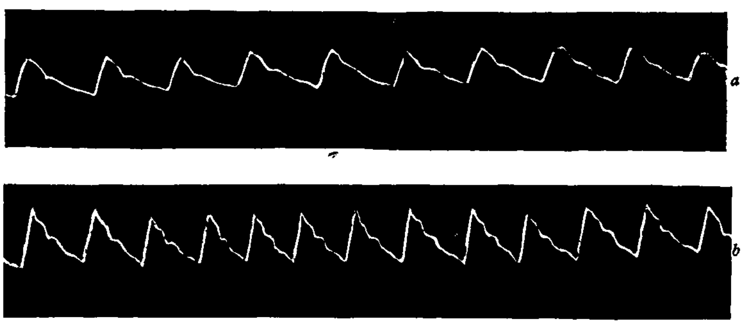


Fig. 2.—Effect of Cold Application on the Pulse Tracing: (*a*) Before; (*b*) After.

strengthens them, whilst hot applications produce the reverse effects. There is a lengthening of the diastole, with improved cardiac nutrition. Similarly, as regards the peripheral circulation, there is a primary vasoconstriction and then vasodilatation. The blood-pressure itself rises after the application of cold as much as 30 mm. of Hg in many cases, and is lowered to a somewhat similar extent after application of heat. In both cases dilatation of the vessels occurs, but cold is a vasomotor stimulant. While very hot applications produce a degree of cardiac excitement, the major effect is vascular dilatation and lowered blood-pressure.

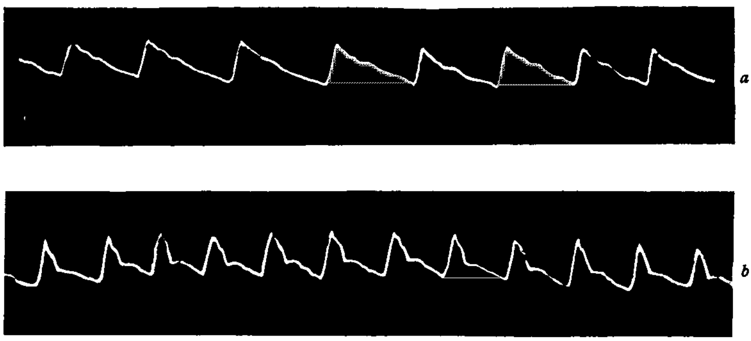


Fig. 3.—Effect of Hot Application on the Pulse Tracing: (*a*) Before (*b*) After.

Primary contraction and secondary relaxation of the blood-vessels are produced by heat, this passive dilatation causing reddening of the skin through cutaneous vessels. The effects of local applications of hot compresses, hot baths, etc., depend on the fact that, while the peripheral vessels of any area are in a dilated, hyperæmic condition, those of the central or remaining portion are contracted, a compensatory anæmia of the region, be it internal organ or joint, resulting.

When we consider that the cutaneous vessels are capable of containing two-thirds of the total amount of blood, we are able to see how powerful an influence is exerted on blood-pressure and internal congestion by the dilatation of the whole or any part of the cutaneous "heart." The red blood cells are diminished by the general or local application of heat, while a leucocytosis is induced. The alkalinity of the blood is lowered also. The volume of the blood is lessened by the prolonged application of heat, owing to loss of fluid by the profuse perspiration thereby induced.

Action on Respiration.—Dry heat hinders the respiratory gaseous exchange, quickening the rate of respiration, but rendering it less efficient and deep. The rate of respiration is increased by a general hot bath, and after a little the respirations are deeper in character. The skin is rendered active, with resultant diaphoresis, but in addition, much moisture and toxic material is thrown off by way of the lungs.

The *body temperature* is raised by a bath over 37° C., owing to interference with heat elimination. The amount of the rise will depend on the temperature and duration of the bath and the body-weight of the patient. A bath at 37° C. for half an hour, the patient being an average size male adult, will cause a rise of only 2° C. to 3° C., while if the temperature be 38° C. the rise may be as much as 1·5° or 3° C. The dilatation of the skin vessels induced by a brief hot bath will often cause a fall of temperature, owing to increased heat loss.

Action on the Internal Organs.—It is a notorious fact that the application of a *cold* bath in an abdominal examination induces rigidity of the abdominal wall, owing to increased tone of the muscles; whilst the relaxing effect of heat is frequently made use of in the reducing of herniæ, and the relief of spasms, colics, etc. If however, cold be applied to the abdominal muscles, not only are they themselves contracted, but the involuntary muscular tissue of the stomach, intestine, gall-bladder, etc., also contracts. Relaxed abdominal muscles lead to diminished intra-abdominal tension, portal engorgement, and congestion of the viscera. Gastric dilatation, indigestion, and constipation may result, with consequent malaise and malnutrition.

Blood may be diverted from any inflamed or congested viscus by the application of intense moist and dry heat to the skin surface, and the circulation through any of the viscera may be variously influenced by the alternate application of heat and cold. In this way morbid processes may be powerfully influenced and functional activity increased.

The drinking of very hot water, in sips, excites both the motor and secretory activity of the gastric wall and stimulates the circulation.

Very hot and cold applications to the epigastrium also increase both secretion and peristaltic activity. Warm applications have the reverse effect.

By hot applications to the right hypochondrium increased secretion of bile is induced, and the hepatic circulation generally stimulated. This action is increased if a hot fomentation be followed by a "heating" compress. Distinct contraction of the spleen is effected by similar treatment.

A general hot application, sufficient to induce free perspiration, greatly relieves acute or subacute inflammation of the kidneys ; a hot bath, short of perspiration, increases renal activity and promotes free flow of urine.

General Indications.—The stimulating effects of heat are utilized in dealing with conditions of extreme exhaustion from over-exertion or toxæmia. The diaphoretic effect of heat is of immense value in the treatment of many conditions, e.g., acute and chronic rheumatism, severe chill, uric acid diathesis, diabetes, parasyphilides, bronchial catarrh, chronic inflammations of the gastro-intestinal tract, kidneys, or pelvic viscera.

Deep-seated inflammations are treated by means of local applications to the appropriate cutaneous surface or by general applications. In pelvic inflammation, e.g., pain is greatly relieved by a hot hip pack, a general blanket pack, or hot full bath.

Toleration of Exposure to Heat.—The degree of heat which can be safely borne by a human being is dependent on the rarity or density of the medium supplying the heat, and its capacity for absorbing moisture. When a medium is very absorbent, perspiration is encouraged, and scalding avoided, even when a very high temperature is employed. A full bath at a temperature of 45° C. is tolerable for eight minutes by the average European (the Japanese can take considerably hotter baths with comfort and safety). General hot-air baths of 127° C. can be borne for the same time, and local hot-air applications at considerably higher temperatures. Sweating is easy in a hot-air bath, more difficult in vapour baths, and most of all in hot-water baths.

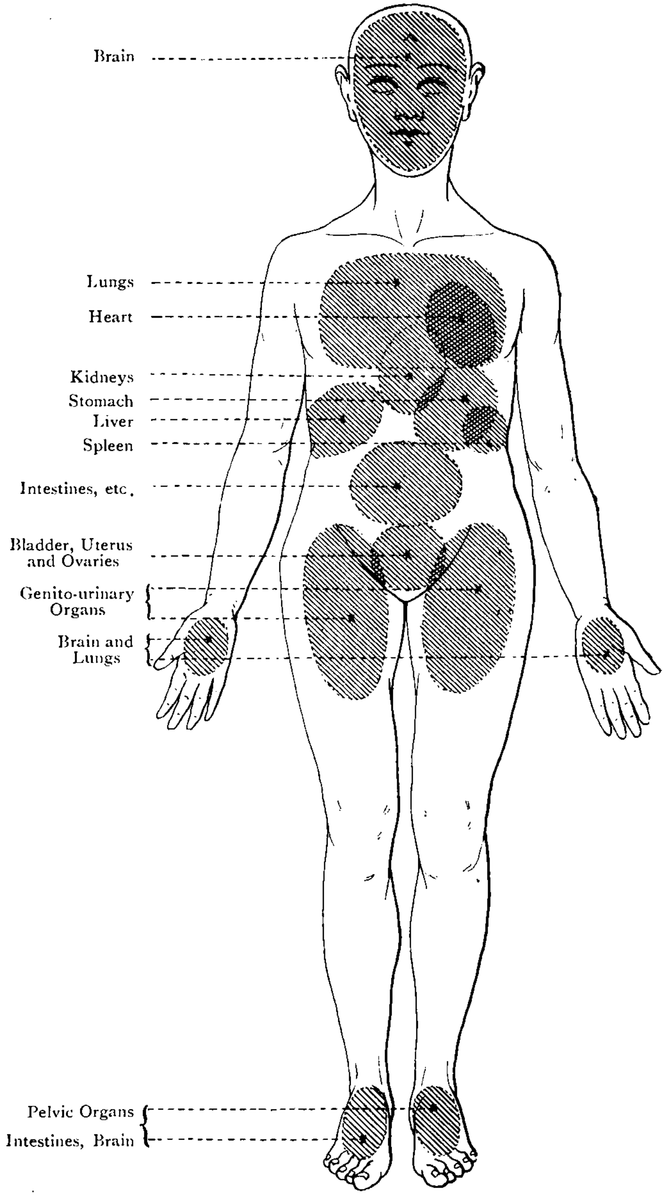


Fig. 4.—Anterior Cutaneous Areas reflexly associated with Internal Parts.

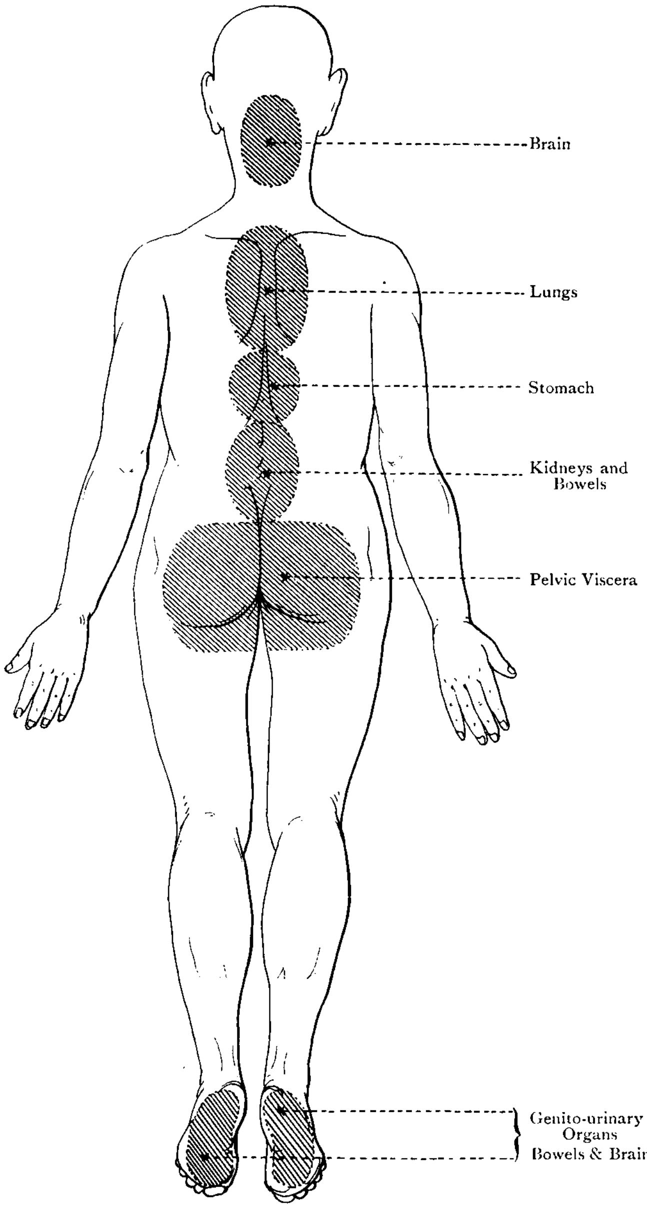


Fig. 5.—Posterior Cutaneous Areas reflexly associated with Internal Parts.

The Basis of Hydrotherapeutic Applications.—For an intelligent understanding of the therapeutic effects of hot and cold applications, one must consider the anatomical facts. The effects resulting from applications of heat and cold to the body surface depend on—

1. The general body temperature and the temperature induced locally by the application ;
2. The remote changes reflexly produced by nervous influence ;
3. The local vascular connections.

Nerve reflexes.—As regards nervous influence, there are definite cutaneous reflex areas for each viscus from which the most intense reflex impressions are received.

The theory of counter-irritation is dependent on the correlation of the afferent visceral and somatic nerves, to which is also due the well-known phenomenon of " referred pain." The existence of definite cutaneous reflex areas for each viscus has been above referred to. If, from disease, a centripetal impression originates in any viscus, this induces a further stimulation in the nerve fibres coming from the corresponding segmental skin area, and gives rise to " referred pain."

The afferent visceral and cutaneous nerve fibres come into close relation in the ganglion of the posterior root, and the reflex impulse starts here or in the grey matter of the cord.

Conversely, any form of counter-irritation on the appropriate skin area in visceral disease usually acts beneficially.

Vascular areas.—It has already been demonstrated that there is an intimate and direct relation between the visceral blood-vessels and the superincumbent cutaneous vessels. There are particularly free and ample connections with the skin surface as regards the brain, middle ear, nose, and orbit. The vessels of the lungs are related collaterally with the skin over the arms, chest, and upper portion of the back. The pericardium and parietal pleura of the interior portion of the chest are related with the overlying skin through the intercostal arteries. The posterior parietal and visceral pleura are collaterally related with the intercostal vessels. In addition there are free connections through the inferior thyroid and the bronchial arteries,

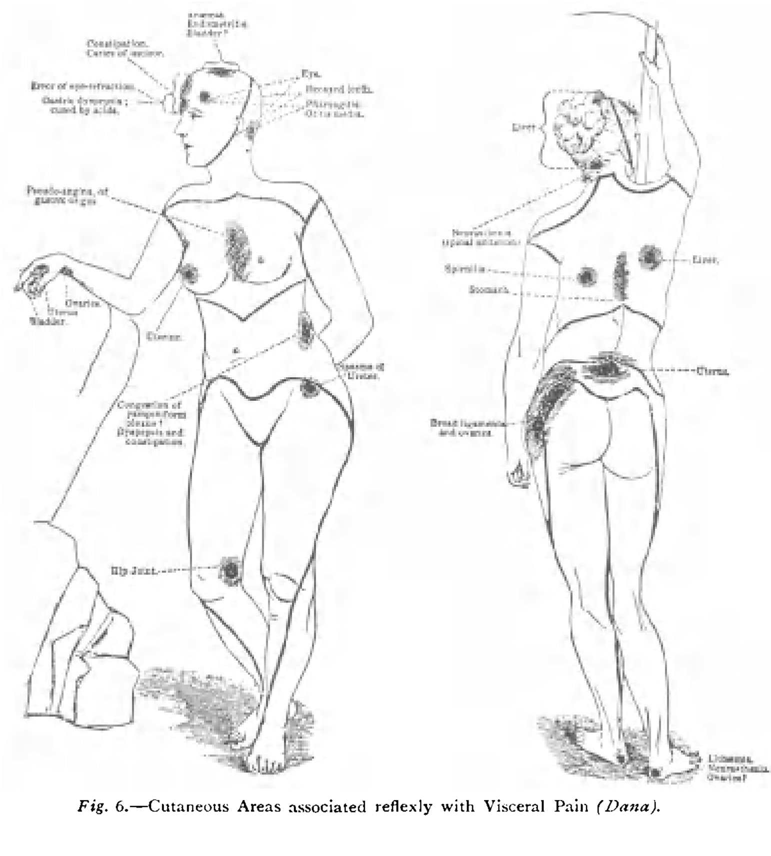


Fig. 6.—Cutaneous Areas associated reflexly with Visceral Pain *(Dana).*

the azygos, bronchial, and intercostal veins. The kidneys are associated with the skin covering the loins through the renal branches of the lumbar arteries. There is a collateral venous and arterial relationship between the stomach, liver, spleen, intestines, and pancreas. The intimate relationship between the portal and general circulation is well known.

In similar manner the upper portions of the body are related to the lower. The regions below the umbilicus are collaterally related with the head, arms, and upper half of the trunk ; the legs have a close collateral connection with the pelvic viscera.

With these facts before us, it is easy, therefore, to understand how the volume of blood in any viscus, it matters not how remote from the surface, may be diminished, either by a general hot application to the skin, or by a local application to a less extent. In this manner is to some extent explained the good effect of a hot foot bath or sitz bath on an arterial congestion or common cold, the relief afforded to infantile croup by a hot sponge on the larynx, and the comfort afforded by a fomentation to an aching stomach or an icebag to a dry pleurisy.

The facts above considered constitute the scientific basis for many thermal and hydrotherapeutic applications, and for the whole practice of counter-irritation. For our knowledge of the various communications between the skin areas and the viscera dealt with above, we are indebted chiefly to the work of Winternitz, Rosbach, Foster, and Head.

THE INTERNAL ADMINISTRATION OF WATER.

1. **By the Mouth.**—Water, when introduced into the stomach, is taken up by the tissues of the body with greater or less rapidity, and remains in contact with the tissues for a considerable period of time. It comes into immediate contact with the various portions of the digestive canal. It has a special influence on the most intimate nutritive processes by reason of its chemical constitution and the

equalization of its temperature with that of the body. It further renders the tissues throughout the body permeable by all water-soluble substances taken in the form of food.

The effect of drinking a quart of cold (18° C.) water rapidly, is to diminish the *pulse* frequency by 22 beats in 30 seconds; in ten to twelve minutes it becomes normal again. If the water temperature be lower the pulse declines rather more rapidly.

The temperature of the body declines with the pulse beats to the extent of about ·5° C., but in about ten minutes returns to the previous level.

By drinking *cold* water the temperature of the stomach is lowered considerably—to the extent of at least ·5° C.—and the original temperature is not regained for several hours. If the rectal temperature be taken, it will be found that a lowering of over 1° C. takes place rapidly, and this lower temperature is continued for upwards of an hour. An intimate reaction evidently exists between stomach and rectum, for if a person be given a large cold-water enema, the temperature of the stomach declines nearly 1° C. (Winternitz.)

It is thus evident that the body temperature can be influenced by the imbibition of water, and further, the temperature of various deep-seated organs can also be influenced. There is a sound basis furnished for the prescribing of systematic water drinking, and the marked local and general therapeutic effects obtained are explained. It must be borne in mind that the vasomotor system also has considerable influence.

The rapidity with which *the absorption of water* takes place depends on a variety of circumstances. The lower the blood-pressure at the moment of taking the water, the more rapidly will it be absorbed into the blood-vessels. After considerable fluid loss from the body owing to normal or pathological causes—such as free diuresis, profuse perspiration, diarrhœa, or bleeding—rapid absorption of fluid from the intestinal tract will take place.

Pure spring water, containing little saline matter, is more rapidly taken up by the blood-stream than water containing much saline matter. A carbonaceous, gaseous water is more grateful to the stomach, and more rapidly absorbed.

than a still, alkaline water, which may cause gastric discomfort and "fullness," even if drunk in small quantity.

After free consumption of water, the blood is somewhat diluted temporarily, and the blood-pressure rises. The larger the quantity of water drunk the greater and the more enduring is the effect on the blood-pressure, which does not, however, continue for above three and a half minutes. The increase of the water in the blood can only be demonstrated for a very short time. In less than an hour the blood has regained its former density. In one hour water which has been imbibed begins to appear in the tissues, and, normally, the entire amount is eliminated in three and a half hours. Large quantities are relatively more rapidly eliminated than small quantities. It follows that such a condition as hydræmic plethora is an impossibility, even when excessive quantities of water are consumed. Not only is this so, but the drinking of cold water acts as a diuretic, and aids in the removal of water not recently imbibed. Warm water, while it will for a short time stimulate the kidneys to increased action, soon results in perspiration. The diuretic action of water depends not so much on the quantity actually imbibed, as on the general increase of blood-pressure and freer circulation through the kidneys at greater pressure. With the increased output of water the solid constituents of the urine are also increased, especially urea and uric acid.

Method of Prescribing.—The method adopted in prescribing water will obviously vary with the effect we wish to produce.

If we desire to flood the body tissues and raise the blood-pressure, water is given in single small doses of 5 or 6 ounces, repeated every twenty minutes or half-hour for a considerable time.

On the other hand, if the object is to promote the absorption of fluid transudates, a pint or more of water should be given every six to eight hours, and all fluids withheld in the interval. Not only may the removal of dropsy or other effusion be thus greatly helped, but the absorption of inflammatory exudates is greatly accelerated.

The loss from the body is greatly increased by the free drinking of water, and, food being restricted, the blood regenerates itself from the tissues, leading to a retrogressive metamorphosis.

While moderate consumption of water, with suitable food, causes a gain in body-weight, excessive water drinking causes loss of weight.

The processes of oxidation are stimulated and rendered more efficient, as can be demonstrated by the large quantities of CO_2 eliminated and the small quantity of uric acid and kreatinins formed in the blood. Metabolism throughout the whole body is increased and accelerated.

The chilling of the stomach caused by drinking cold water (*vide supra*) evidences the undesirability of excessive drinking during meals. Apart from this, the drinking of *cold* water stimulates the liver, quickens the flow in the portal vein, and increases the secretion of bile.

2. **By the Rectum.**—Rectal injections of water at various temperatures are used for many purposes, e.g., to procure an action of the bowels, to restrain diarrhœa, to soothe pelvic pain, to get rid of intestinal parasites, particularly *Oxyuris vermicularis*, and to compensate for fluid loss from hæmorrhage or otherwise. So far as relief of the bowels is concerned it must be clearly understood that an enema seldom accomplishes its purpose by merely washing away fæcal matter. As a matter of fact, it quite often scarcely reaches the fæcal matter which may lie high up in the colon. It rather effects its purpose by inducing a more vigorous peristaltic action.

By the distention with water of the lower portion of the bowel, a local vermicular action is started which spreads along the bowel. If the enema be too small in bulk, distention of the rectum is not effected and failure results.

The amount as well as the temperature of the water required varies greatly with circumstances and individuals. Anything from half a pint to three or four pints or more may be needed. Warm and hot enemata are more stimulating and effective than cold.

If a large injection is to be given, the patient should lie on his left side, with knees drawn up, and fluid be slowly pumped into the rectum. After a varying time the patient feels unable to retain more and has a colicky pain in the abdomen, and desires to relieve the bowels ; this desire may be gratified, or, if a large enema is deemed necessary, the patient is asked to endeavour to retain the water, and helped by means of a folded towel pressed over the anus, pumping having, of course, ceased in the meantime. The desire to defæcate will soon pass off, and then more water can be introduced. It is often more convenient to use a douche can, and allow the water to enter by gravity only. Less straining is thus induced, and by this means the patient can carry out the procedure unassisted.

When complete irrigation of the colon is desired, as many as six to eight pints may be introduced by this method; but the frequent use of large enemata induces, eventually, an atonic condition of the bowel, and the last state of the patient is worse than the first.

In some cases when constipation is obstinate and long-standing, as is common in mental disease and diabetes, the injected water may come away quite clear, and have no relieving action on the bowels. Under such circumstances, if even warm enemata do not accomplish their purpose, kneading the abdomen along the course of the colon must be employed as an adjuvant, and even actual removal of the fæces by digital efforts or a spoon may be necessary.

Where it is desired to introduce fluid to be actually retained and absorbed by the patient, the use of a long rectal tube is often an advantage.

Warm injections often materially lessen the pain of cancer of the bowel, and relative distressing tenesmus and straining. They are also of use in cystitis, prostatic abscess, and parametritis. Irrigation of the colon for chronic mucous colitis is now very extensively employed, a special feature being made of it at Harrogate.

In gastric dilatation, etc., where it is desired to give the stomach a complete rest from fluid, the tissues may be kept properly supplied per rectum, with great ease, and much to the patient's comfort and well-being.

The value of large injections of plain or slightly alkaline water in the condition of mucous colitis has long been known. Recently this has been done from above downwards by means of a small opening formed for the purpose in the colon by the operation of appendicostomy.

IRRIGATION.

Vaginal Douching or **Irrigation** (as Kellogg thinks it should more properly be called).—This consists in the injection into the vaginal canal of a stream of cold, hot, or tepid water, under but slight pressure.

Its value in various uterine, ovarian, and other pelvic disorders to which women are subject, is generally recognized.

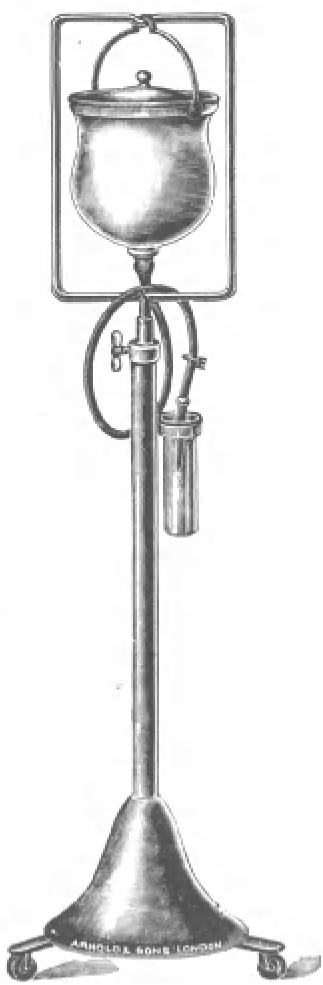


Fig. 7.—An adjustable Gravity Syringe.

To obtain the best results some little attention to the details of the technique is requisite. A gravity syringe is usually employed, the water being contained in a can or glass reservoir which rests on a shelf or stool some three feet above the patient, or special appliances are made (*Fig.* 7). The water is conducted to the vagina by means of a rubber tube, terminating in a glass or vulcanite nozzle. The patient lies on her back, and the water passes out of the vagina into a suitable receptacle arranged to catch it. Dr. Kellogg has devised a special form of table made of marble. The table being hollowed to fit the patient's back, and an opening provided to conduct the water rapidly away without wetting the patient's clothing, asepsis is specially easy to maintain.

In introducing the vaginal tube, care is needed to pass it into the posterior vaginal fornix as far as possible, and thus avoid any chance of injecting the water into the uterine cavity.

The idea is to allow the water to circulate freely around the neck of the uterus and in the vagina, bringing every part under its influence. The mucous membrane is directly, and the pelvic viscera reflexly, affected.

Effects.—Both hot and cold applications are useful in relieving hæmorrhage due to uterine congestion, chronic metritis, etc. Cold water is generally more efficient in this respect than hot. Hot douches lessen, and even completely arrest, uterine contractility and excitability, which cold douching increases. Further, cold douches may cause painful uterine contractions and aggravate neuralgic uterine and pelvic pains, so that water of the higher temperatures is most commonly employed. A douche of a temperature of 32° C. is of great service in relieving pelvic congestions. Temperatures below 6° C. are practically never employed, but a douche of 25°–27° C. is very frequently of service.

Very hot irrigations are employed to check hæmorrhage, a temperature of 50°–55° C. being utilized. Hot irrigations of 45°–47° C. relieve pain, and promote the absorption of exudates in parametritis and pelvic cellulitis ; they are of service in chronic metritis, ovaritis, and endometritis.

For intra-uterine irrigation only distilled or sterilized water must be used.

Rectal Irrigation.—The rectal irrigator (*Fig.* 8), or psychrophore of Artzberger, is a faucet-like hollow instrument, permitting the inflow and outflow of water, the temperature of which will vary with circumstances.

Fig. 8.—Rectal Irrigator.

Before introduction into the rectum, the irrigator should be well lubricated with vaseline or lanolin, and the patient —placed in a suitable posture—asked to " bear down."

The temperature of the water (which should be flowing from an ordinary douche-can at an elevation) used at the commencement, should not be lower than 20° C. in most cases; and if there be any inflammatory condition in the region of the bladder neck, very disagreeable strangury and tenesmus may be excited. The effect of the application is both tonic and to some extent soothing and anæsthetic.

This procedure is serviceable in hæmorrhoids and various chronic and acute inflammatory conditions of the rectum and its vicinity. Hot, cold, and hot and cold water alternately, are variously employed, according to results desired.

The Urethral Cooling Sound or Psychrophore of Winternitz.—This is an ordinary two-way catheter (*Fig.* 9). It is introduced just like an ordinary catheter, but should stop short of the bladder cavity, just as the sphincter vesicæ grips the instrument. A fairly large (No. 12–14) size is generally used, at any rate after the first time. The water temperature at first should be 20°–22° C., and be reduced to 10° C. gradually. Prior to the introduction of the sound the patient should empty his bladder.

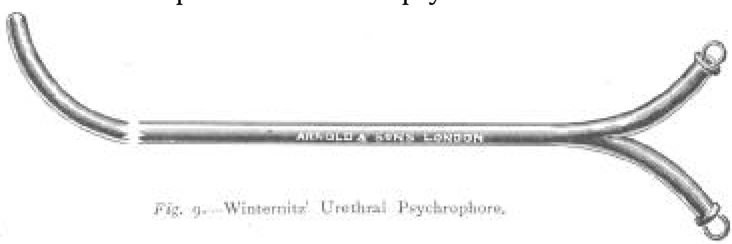


Fig. 9.—Winternitz' Urethral Psychrophore.

Although some vesical tenesmus may occur at first, it soon passes off. The effect of the procedure is in the main cooling and tonic.

The sound should remain in position for four to five minutes at first, and then longer—up to thirty minutes. It is generally used on alternate days.

THERAPEUTIC INDICATIONS.—This measure is useful in testicular neuralgia and in nocturnal enuresis. It is also of use in atonic psychical impotence, in spermatorrhœa, prostatorrhœa, and chronic gleet, a very wide bore, up to 20–24, being used for this last affection (Keyes).

CHAPTER III.

ON THE TAKING OF BATHS.

THE technique of hydrotherapy has reached a very high degree of development, and such a variety of baths are employed at the present day, and there are so many modifications of them, that it is now possible to adapt special hydriatric procedures to each individual case coming before us for treatment.

In every variety of bathing procedure the points of the highest importance are, the temperature of the water applied, the amount of pressure under which it is applied, the friction produced, and the duration of the application. By varying these, the same effects can be produced by very different methods. Winternitz lays great stress on the importance of the measure of stimulation in each.

It is customary to cool the head thoroughly before every cool or warm application, and to keep it wrapped up in some cool covering during the whole of the process. This helps to prevent ill-effects through the blood being driven inwards by the cooling of the skin surface, and inducing what Winternitz calls " retrograde hydrostatic congestion " of any of the internal organs, but more especially the brain.

If a hot application be used, cooling of the head is also desirable; for here again internal congestion is caused, and in old and plethoric patients there is a tendency to apoplexy.

It is of course essential when any bath is ordered by a physician that a specific statement be made as to the temperature of the water to be employed and the duration of the application.

GENERAL PRECAUTIONS AS TO THE TAKING OF BATHS.

1. A careful examination of the cardio-vascular system should be made before the physician prescribes any bath or set of baths.

2. Extreme temperatures are specially undesirable in children and elderly people, and also in women at the time of the climacteric. During the catamenial flow hydriatric procedures should for the most part be suspended.

3. Every bath has an effect which is either stimulant or sedative; which of these predominates will depend on various circumstances, such as the range of temperature and duration of the procedure, also the time of the day and general condition of the patient.

4. Care is very necessary not to prolong thermal baths sufficiently to cause depression or lassitude.

5. Hot-air and vapour baths should never be employed in febrile conditions, unless in incipient catarrhal conditions and chills.

6. Too stimulating procedures or a prolonged course of treatment are often followed by circulatory depression and considerable debility.

7. In chronic diseases, during the first week or two of treatment there is often some exacerbation of symptoms, which is not an unfavourable sign, and passes on into healthier conditions.

8. Physical exercise usually requires some modification during a course of bathing, etc. The reaction of the cooling processes is hastened and assisted by a short brisk walk; rest and cooling are frequently beneficial after warm applications. If much exercise be taken during a full course of treatment, loss of weight will result.

9. After a course of hydrotherapeutic treatment, a change to a more bracing climate, or a short sea trip, is often beneficial. This constitutes what is known on the Continent as the "after-cure." Patients who feel exhilarated by their better health should be warned not to over-exert themselves and so induce a relapse.

THE TECHNIQUE OF BATHS, PARTIAL AND GENERAL.

The Arm Bath.—This is chiefly used in surgical cases, in severe burns and skin diseases (*Plate IV*), and requires no detailed notice here.

The Foot Bath.—The bath itself is a familiar household utensil, made either of metal, porcelain, or wood, and requires no further description (*Fig.* 10). There are, however, many varieties of application of the bath, so far as the temperature and duration are concerned. The following are the most important :—

Fig. 10.—An Improved Foot Bath.

1. *Cold.*—Two inches deep, for thirty minutes, the feet to be kept on the move all the time and rubbed against each other. The action of the bath is intensified if the water is flowing through the vessel used, and thus constantly changing and always at the same temperature. Water of a temperature of from 10°–15° C. is commonly employed. At the conclusion the feet should be well dried, and the patient take a short walk.

This bath is a powerful derivative, inducing a hyperæmia in the vessels of the feet and legs. It helps to relieve congestion of the brain and viscera, and is of high value in cases of habitually cold feet. The general effect is tonic.

Caution.—This bath should not be used, nor indeed any cold foot bath, in any bladder, rectal, or ovarian inflammation, nor in sciatica.

2. *Treading in cold water*, one inch deep, for two to three minutes. This is a useful measure in cases of cold feet from poor circulation, and, given at bedtime, for insomnia.

3. *Cold sponging* of feet and legs over a bath, one limb at a time, for two to three minutes. The feet should be well rubbed with a rough towel until quite dry, and a brief quick walk taken. The action is similar to that of Nos. 1 and 2.

PLATE IV.

The Arm Bath.

The Leg Bath.

The Foot Bath.

4. *Alternate hot and cold.*—Two foot baths are placed side by side, one containing hot water at 38° C., and the other cold at 18° C. The patient's feet are placed in the hot water for half a minute, and then shifted to the cold for a like period; the process is repeated several times, the whole bath lasting from seven to ten minutes, and finishing with cold water. This is a very stimulating form of the bath, and is useful in chilblains, in early Raynaud's disease, and in habitually cold and sweating feet.

5. *Hot.*—Water at a temperature of 40°–50° C. is employed, beginning at a temperature of 40°–42° C., and gradually increased. The feet should be completely immersed—indeed, the deeper the water the more intense the effect. The patient sits with a blanket or sheet enclosing the bath and limbs as high as the waist. The duration of the bath is from ten to twenty minutes, rarely prolonged to half an hour. At the conclusion the feet and ankles should be sponged with cold water and briskly rubbed until dry.

6. *Very hot.*—Water up to 51° or 52° C., as hot as can be borne, is used, the temperature being maintained by pouring a cupful of boiling water against the side of the bath every two minutes, as much water being removed in advance; the wrappings should be as little disturbed as possible. Duration, twenty minutes.

7. *Mustard.*—A breakfast-cupful of mustard bran or tablespoonful of table mustard is used for each quart of water—of a temperature of 48°–52° C.—as hot as can be borne. Duration, fifteen minutes, or less if uncomfortably hot.

The ultimate effect of all these baths is to render the brain anæmic and quicken the pulse-rate. The hot foot-bath is *par excellence* a derivative measure, relieving brain and visceral congestions. At the same time the vascular activity of the pelvic viscera is increased, and by means of these baths delayed or suspended menstruation may often be brought on. The value of a hot foot bath at bedtime in incipient coryza is well known, its action being intensified if it contain mustard. Whitla also recommends this in any congestive headache. It is also of great value, combined with elevation of the hands, in epistaxis.

The Hand Bath.—Immersion of the hands in cold water exercises a much more powerful influence on the pulmonary and cerebral vessels than would be naturally expected (Kellogg). The pulse is slowed, and the pressure in the brain arteries lowered, by the use of a cold hand bath, while the opposite effect is induced by a hot hand bath.

In epistaxis the bleeding is readily checked if both hands be completely immersed in cold water, or a piece of ice be held in the palm of the patient's hand. In the same way pulmonary hæmorrhage may be beneficially influenced.

There seems to be some reflex connection with the genito-urinary organs also, for the fact that placing the hands in cold water often causes the desire for micturition is well known.

The Head Bath.—The head of the patient should rest comfortably on the rim of a suitable vessel, charged to within an inch of the brim with water at a temperature of 27° C., which is continuously taken up and poured over the patient's head by means of a breakfast cup. After fifteen or twenty minutes of this, the vessel is slipped away and the head held up by the hand. A towel is laid loosely over the hair and another is laid on a pillow on which the head is now rested. The patient is left thus for half an hour or more, if agreeable.

Some little modification is required in the case of women, on account of their usually long hair. The face only should be dipped into the bath, or if the whole head be dipped, special precautions will be required in drying, and the patient should stay indoors for some hours with the hair wrapped up in a silk handkerchief.

The patient lies on his back, with the shoulders raised by pillows to the level of the edge of the bath, from the sharpness of which the back of the neck is protected by means of a pad. The feet and legs are well covered up, with the addition, if necessary, of a hot-water bottle.

Should a regular head bath not be available, an ordinary washstand basin with an inverted soap-dish in the middle, and capped with a sponge, will suffice. Comfort in position is essential, and care should be taken to avoid haste in rising from the supine position.

By means of the head bath anæmic headaches are often relieved and sexual excitement allayed. Hughes Bennett recommended this bath in delirium tremens.

Simple head bathing for a very few minutes is often of service in a feverish or congestive headache, or in the headache due to exposure to the sun. The brow and temples are sponged with cold water (18°–20° C.) for two to three minutes, the patient stooping the while over the basin of water.

The refreshing effect of the application of a cold sponge or wet napkin to the posterior auricular region is well known to the epicurean. The mental obfuscation induced by a good dinner and the accompanying wine is thus quickly removed, hence the name of "the alderman's nerve," applied to the posterior auricular.

The headache of coryza, and the feeling of stuffiness in the nose, is relieved if the forehead and nose be sponged with water as hot as can be borne, for a couple of minutes.

The Leg Bath.—A deeper vessel is used for this than in the foot bath (*Fig.* 11), and the temperature of the water will vary according to the effect desired.

Fig. 11.—An Improved Leg Bath.

Hot leg bath.—Water 37°–45° C. for ten minutes, followed by tepid sponging. Mustard may be added to enhance the effect if there be no contra-indication.

Cold leg bath.—Temperature 10°–15° C., for ten minutes.

The sweating leg bath.—The bath figured above, or a deep pail, is filled to within three inches of the brim with water at 37°–38° C. The patient is undressed and seated on a chair covered with a warm flannel pad, with his legs in the bath. He is completely enveloped in a blanket, previously warmed (*Plate IV*). The temperature of the water is gradually raised by pouring a pint of boiling water into the bath every two minutes—against the side of the bath—a similar amount having been removed in advance. The temperature should be raised as high as the patient can bear—about 45°–47° C.,—and the bath continued for twenty minutes. The patient will perspire profusely. At the conclusion he is dried lightly with warm rough towels and put to bed between blankets, sweating being encouraged by means of extra bed-clothes and hot drinks.

This bath is an extremely handy, inexpensive, and readily procured sudorific and derivative measure. It is always of service where diaphoresis is indicated and the more elaborate and modern methods and apparatus are not available. It is useful in suppressed menstruation, in dysmenorrhœa, and ovarian congestion.

The Sitz Bath.—The ordinary sitz or hip bath is too well known to need much detailed description. It may be made of porcelain, metal, or wood (*Plates V and VI*).

The best form of bath known at present is probably that of the Fischer Kiefer Co., which is made of plated metal with an automatic self-emptying arrangement, which maintains the water at a constant level. The male sitz bath usually measures 20 in. by 15 in. in breadth, and has a nearly straight back. The female sitz bath is usually narrower across the brim, in order that the clothing of the patient may be kept out of the water, and undressing be avoided if so desired. A hot-water can or tub is usually placed at the patient's feet, and a wet cloth around his head, while the bath lasts (*Fig.* 12). The water should reach to the level of the patient's umbilicus, and about five or six gallons are usually required.

If the bath is of anything but the briefest duration the patient should be carefully protected from cold by means of a blanket, which encloses the whole bath, with his feet and legs.

The temperature of this bath will vary from 10°–45° C., and will depend on whether we desire it to be cold (10°–20°), tepid (20°–30°), warm (30°–38°), or hot (40°–45°). Many

PLATE V.

The Sitz Bath.

PLATE VI.

GENERAL BATH AND DOUCHE ROOM.

SITZ BATH, NAUHEIM BATH, AND PACKING COUCH.

people will be unable to stand anything over 42° C. The duration will vary from two to thirty minutes.

Kellogg considers that the flexion of the limbs entailed by this bath interferes with its efficacy, by restricting the circulation.

Modus operandi.—The action of this procedure depends on the temperature of the water and the time for which it is kept up. The pelvic and abdominal viscera are reflexly stimulated: a cold bath of any duration causes them to

Fig. 12.—Sitz Bath, with Friction.

contract, while a hot bath causes dilatation. In the reaction after a cold bath dilatation in all probability ensues, but the effect of the cold lasts for some time and induces anæmia of the viscera.

Intestinal peristalsis is stimulated by brief cold baths, but long-continued cold baths lessen peristalsis.

Varieties of the Sitz Bath:—

1. *Cold sitz bath.*—The water should cover the groins and no more. Wrapped in a blanket the patient remains in it for ten minutes, the attendant rubbing the back and

abdomen if at all chilly. It is not necessary to undress completely, but only sufficiently to keep the clothing out of the water. The patient is carefully dried, and should take a short sharp walk to get thoroughly warm.

2. *Tepid.*—27·5° for ten minutes, with a little cold water run in at the finish.

3. *Flowing.*—Cold water is kept running through the sitz bath all the time. Duration, two minutes, or less if the cold be felt too keenly.

4. *Dipping.*—The bath contains cold water three inches in depth, and the patient keeps moving up and down all the time. Grasping the sides, he rises clear of the water and then sits down again, and does this every second or two for two minutes.

5. *With water as hot as can be borne.*—The bath is full of water at about 38° C., and a foot bath of the same temperature is placed in front of it. Hot flannel pads are placed, one on the back of the bath and the other floating in the water. Completely undressed, the patient sits down, and is enveloped from head to foot in warm blankets. A cold, wet cloth is wrapped around his head. A minute after, a pint of boiling water is poured gently against the side of the bath (as in the sweating leg bath), removing as much beforehand by means of a cup or the overflow pipe. The wrappings must be disturbed as little as possible. Add boiling water thus every minute until the bath is as hot as can be borne (44°–46° C.). After twenty minutes have elapsed the patient gets up from the bath, is carefully dried with hot towels, and put in bed between blankets. The room in which this bath is given should be comfortably warm.

6. *Hot and cold alternate, by gradual transitions.*—Begin with 38° C., and raise the temperature as high as can be borne (43°–46° C.). Then slowly reduce as before, taking about two minutes for each change, and ten minutes in all for the bath. The patient's clothing is entirely removed.

7. *Hot and cold alternate, by sudden changes.*—Two sitz baths are used, side by side, one containing water at 18° C., and the other hot water at 42° C. The patient moves from one to the other every two minutes, beginning with the hot and ending with the cold water. The bath is continued for eight or ten minutes.

8. *Warm sitz bath, with cold affusion to the abdomen.*—The patient is seated in water at 38° C., with the bath full to the overflow pipe. A pint of cold water (18° C.) is poured over the lower part of the abdomen every two minutes from a height of a foot or so. The surface of the abdomen is rubbed all the time, either by the attendant or the patient himself. The bath concludes with cold sponging of the parts, and lasts for ten minutes.

9. *With mustard.*—This bath is the same as No. 5, only a tablespoonful of table mustard or a cupful of mustard bran is added to each gallon of water.

THERAPEUTIC INDICATIONS.—Cold sitz baths of from two to five minutes' duration are indicated in various abdominal and pelvic diseases and affections, such as ovarian and uterine neuralgia, chronic prostatic congestion, and bladder atony; in chronic gastric catarrh, chronic intestinal catarrh, and hepatic congestion; in constipation, amenorrhœa, and sometimes in spermatorrhœa and impotence. Although the cerebral activity is often markedly increased, in some cases of insomnia sleep is induced by this procedure.

Care must be taken never to use cold sitz baths in any acute inflammatory condition of the abdominal viscera, or in cystitis.

Prolonged cold sitz baths, from three to eight minutes, exsanguinate the intestinal surface, and are useful in various diarrhœas and dysentery, in piles and proctitis, chronic menorrhagia and pelvic congestion (especially if combined with hot vaginal douches).

Warm sitz baths, from twenty minutes to one hour in duration, have a sedative and anodyne effect, and are useful in acute and chronic inflammatory conditions, in constipation, and the anæmia often associated with it.

The hot sitz bath is useful in restoring suspended menstruation, in vaginismus and ovarian neuralgia. In renal colic, neuralgia of the testicles, sciatica, tenesmus, and any painful non-inflammatory affections of the pelvic or lower abdominal viscera it is indeed a powerful analgesic. The mustard sitz bath is at all times a derivative, and it is often employed effectually in amenorrhœa.

The cold sitz bath produces a profound effect on all the bodily functions. There is lessened activity of the skin, "goose flesh," contraction of the cutaneous vessels, and slowing of the pulse.

A hot sitz bath acts as an anodyne, antispasmodic, and derivative measure. The pelvic circulation is increased, and blood diverted to the pelvic viscera.

The Back Laving.—The patient, partially dressed, or covered with a blanket, sits across a sitz bath half full of cold water, while the attendant with a sponge laves the entire spine for five minutes with :—

1. *Cold water.*—If the clothing be removed, the patient should be carefully covered up in front by means of a specially made blanket (*Plate VII*).

2. *Tepid to cold.*—At 27° C. for four minutes, and cold for one minute.

3. *Hot and cold alternate.*—The water is run gradually from warm (32° C.) down to cold, and then up again to as high a temperature as can be borne (46°–47° C.), and once more down to cold. The back is laved for five minutes in all.

4. *Hot and cold alternate, with rapid changes from hot to cold*, each for half a minute. This is done by having a couple of cans or buckets side by side, with hot and cold water, and using a separate sponge for each. Duration, five minutes in all.

5. *With mustard.*—A breakfast-cupful of mustard bran (or a tablespoonful of table mustard) is used to each quart of water, which should be as hot as the patient can bear it. Duration, four minutes, or less if felt too acutely. The bath is finished with cold water for fifteen seconds.

The Back Spouting.—1. *Cold.*—A jet of cold water is played up and down the whole length of the patient's back, the patient being partially undressed and seated on a board placed across the sitz bath. One minute will suffice.

2. *Warm to cold.*—Begin at 32° C., and run gradually down in the course of a minute to cold, at which it is continued for two minutes or more.

3. *Hot and cold alternate.*—Hot (45° C.) at first for half a minute, then cold for half a minute. Keep changing from one to the other for three minutes, and then conclude with cold.

PLATE VII.

BACK LAVING OR SPONGING.

PLATE VIII.

THE HALF BATH WITH AFFUSION.

PLATE IX.

THE HALF BATH WITH FRICTION.

These are all tonic bracing applications. The hot and mustard applications are best suited to the old, and patients with feeble circulation. The back spouting is only adapted to the more vigorous type of patients.

The Half-Bath.—An ordinary shallow household bath is used, about half full of water from 20° to 30° C., according to the effect we desire to produce. After cooling his head with water, the patient enters the bath and sits down so as to be about half immersed. He lowers his body for a moment so as to immerse the shoulders, and then returns to the sitting posture, while an attendant freely douches the upper portion of his body. He again lowers

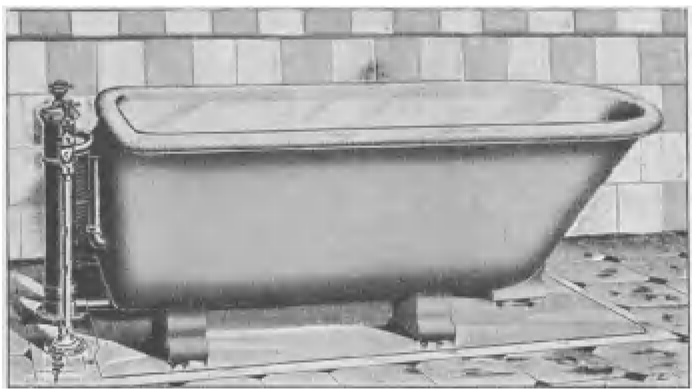


Fig. 13.—Modern Type of Set-in Bath.

himself into the semi-recumbent position while the attendant briskly rubs the chest, abdomen, and limbs with bare hands or friction gloves (*Plates VIII and IX*). The bath is then completed, and the patient wrapped in a warm sheet and dried.

This bath is stimulating, and a good reaction is encouraged by the friction movements ; generally speaking, the warmer the temperature of the water, the less the stimulating effect of the bath. The quicker the reaction, the greater is the amount of heat abstracted.

This bath is of great service as an antipyretic, but should not be used for more than a very short period where the patient is weak and collapsed. In such cases it is well to give the patients a warm and even stimulating drink immediately before the bath is administered.

INDICATIONS.—Cool baths (22°–26° C.), of three or four minutes' duration, may be used regularly in the morning as a hygienic measure for people in ordinary health. They may be combined with friction, and are exceedingly pleasant and refreshing.

In diseases of digestive character, such as gastric irritation, or atony, or hyperchlorhydria, this bath, combined with hot and cold douching to the abdomen, is exceedingly helpful and beneficial. The douching can be carried out by the patient himself by means of a tin basin, or more efficiently by an attendant.

In affections of the spinal cord, etc., the temperature of the water should be from 28° to 30° C. If the lesion be an irritative one, such as ataxic paraplegia, chorea gravis, or paralysis agitans, the water may be even warmer with advantage. In myelitis and other paralytic conditions a brief cool bath is best.

The use of the half-bath in typhoid and other fevers.—Although scarcely within the scope of this work, it may be well to allude briefly to the extreme value of the cooling bath in typhoid, as advocated by Brand, Barr, and others.

The Plunge Bath.—The temperature of the water should be cool or cold, from 22° down to 15° C. The duration, one to three minutes. The bath should be about half full, to admit of the patient moving and splashing freely without upsetting much water. This bath has a marked stimulating effect on the circulation and respiration. The brief application of the cold water should induce a quick and good reaction, and make the patient feel warm and comfortable. This effect is enhanced if the patient be previously warmed in a hot-air bath or before a fire, and cold water (15° C.) be used. While thermolysis is somewhat avoided by this procedure, thermogenesis is proportionately increased by the stimulus of the cold.

THERAPEUTIC INDICATIONS.—Cool and cold plunge baths are of service when general stimulation is desired without lowering of temperature. While primarily stimulating from the bracing effect of the brief exposure to cold water, they are secondarily sedative; not a few people who suffer from insomnia find that sleep is induced by this bath, particularly if they do not dry themselves, before returning to bed.

The Full Bath (Cold), or Shallow Bath.—This is now an ordinary household bath, six or seven feet long by three feet wide (*Fig.* 13). The water is cold (8°–12° C.), and should be kept so by running in fresh water all the time. The duration is very brief—not more than sixty seconds.

The patient, having previously cooled his head by wetting it under the tap or with a wet towel, completely submerges the body once or twice, and then gets out. The bath is intensely stimulating and produces a brisk reaction.

The respirations are much quickened, the patient often gasping; the circulation, general and cutaneous, is strongly stimulated (*Fig.* 14), and the skin markedly reddened.

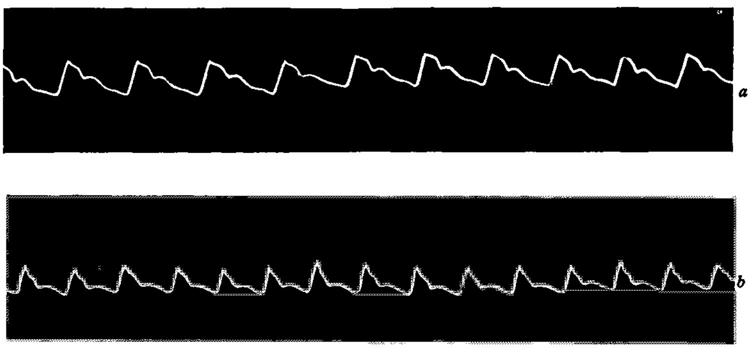


Fig. 14.—Pulse-Tracing: (*a*) Before, (*b*) After a Full Bath.

This bath is frequently used as a sequel to a vapour bath or hot pack, but is only so employed when the patient is robust.

If followed by a half-bath at 16°–20° C., this procedure has a distinct antipyretic action. The cool half-bath, by way of comparison, seems tepid to the patient.

THERAPEUTIC INDICATIONS.—Where it is desired to strongly stimulate metabolism in cases of gout, syphilis, and obesity, and also in certain cases of tuberculous disease.

For debilitated and exhausted patients it is unsuitable and even harmful.

THE DRIP SHEET.

The patient having previously been moistened or wrapped in a damp towel, and standing in a warm shallow (half-inch deep) foot-bath, a sheet (two by three yards) folded lengthwise is drawn through cold water and wrapped about him in the following manner: The attendant, approaching from the front, unfolds a portion of the folded border, fixes the free edge of the sheet under the right armpit, (*Figs.* 15, 16, 17), and passes it across the patient's chest, below the left axilla, and around the back and over the right shoulder, so as to completely envelop him.

Fig. 15.—The Drip Sheet.

The patient's entire body is then vigorously chafed and smacked through the sheet. An active stimulus is provided by the cold, and also by the manipulation. The skin is reddened and the circulation rendered increasingly active, the respirations are quicker and deeper.

The duration of the drip sheet varies. The attendant should keep up the rubbing until the patient feels warm. The effect of this procedure is enhanced, and a good reaction more quickly attained, if the patient has a few minutes' warming in the hot-air cabinet or Turkish bath before the sheet is applied.

The use of the shallow warm foot-bath is of particular importance when the patient is weak or sensitive. On a good reaction being established, he is thoroughly dried and allowed to rest for some time on a couch or bed, well covered. As a rule a good reaction is sooner obtained if cold water be used, rather than tepid or warm.

Very little antipyretic effect is produced by the drip sheet, but if it is desired to cause heat abstraction, the sheet should be freely re-wetted with cold water and the bath somewhat prolonged.

Fig. 16.—The Drip Sheet. Further stage.

This application may be varied in several ways. The sheet may be wrung out of cold water before application, and applied merely moist, constituting the "cold rub": given in this way it is a milder and less stimulating application; or it may be preceded by a hot sheet, wrung out of water at 40° C., and applied for half a minute. In the case of delicate and bedridden patients, what is known as the "*partial rub*" may be employed. A small sheet is used, and each limb dealt with in turn, care being taken to keep the rest of the body warm. This last is an excellent substitute for the half-bath in febrile conditions.

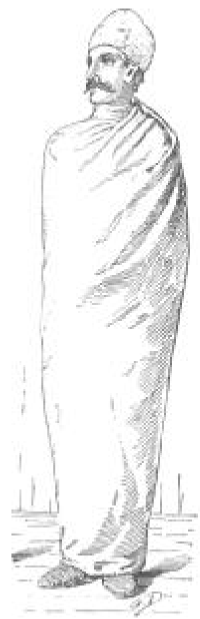


Fig. 17.—Patient completely enveloped.

General Indications. — The drip sheet is a general stimulant and invigorating procedure, improving the circulation and increasing metabolism. It is of service in catarrhal conditions of the gastro-intestinal tract, feeble circulation, and defective metabolism.

Caution.—It should not be employed in patients who show arteriosclerosis, in exophthalmic goitre, in the highly nervous, or persons suffering from skin inflammations.

DOUCHES.

A douche consists of a single or multiple column of water directed against some portion of the body. The three main factors in this procedure are :—

1. Temperature of the water employed, which ranges from 10° to 40° C.

2. The pressure of the water, which ranges from ten to sixty pounds per square inch, but is usually about thirty pounds. More than this is often unpleasant and may be unsafe. The water is usually projected under pressure, or a mechanical stimulus may similarly be obtained by allowing it to fall from a height on to the patient.

3. A third factor is the volume of the douche, or in other words, the pressure will vary with the size of the orifice through which the water is projected. The orifice is commonly about half an inch in diameter, but it may be filiform; or, in the descending gravity douche, a full inch and a half in diameter. The pipe of supply should be at least one and a half inches in diameter, and have an independent and separate connection with hot and cold water supplies.

With the douche should be connected a reliable pressure gauge and thermometer. Where it is proposed to use the vapour douche, a steam-pipe with suitable nozzle must be also available.

The best connection apparatus are those of Kellogg and the Fischer Kiefer Co., of Zurich. Whatever appliance is used, it is in the first degree essential that accuracy and precision of dosage, as regards temperature and pressure, are not only possible, but easy to obtain.

The chief varieties of douche are the following:

The Horizontal jet;
The Percussion douche;
The Rain douche, horizontal or vertical;
The Fan douche;
The Needle bath;
The Scotch douche;
The Filiform douche.

Local douches may be applied to the lungs, liver, or spleen (that is to say, the skin surface over them), to the abdomen or perineum.

Modus operandi.—The douche is one of the most powerfully stimulating procedures in the range of hydrotherapeutics. Its actual effects will depend on the temperature of the water employed, its pressure, duration of the application, form and size of the stream, the region to which it is applied, and the extent of its application.

By the use of the douche the heart is markedly stimulated, with resultant quickened circulation, and the flow of lymph is likewise accelerated, as in general massage. A rapid and powerful reaction is induced. The cold douche is a powerful tonic, and the Scotch douche and alternate hot and cold douche are very powerful excitant applications.

The Horizontal Douche.—This is the most useful and probably most commonly employed form of douche. It may be in the form of a single jet (*Fig.* 18), or the jet may

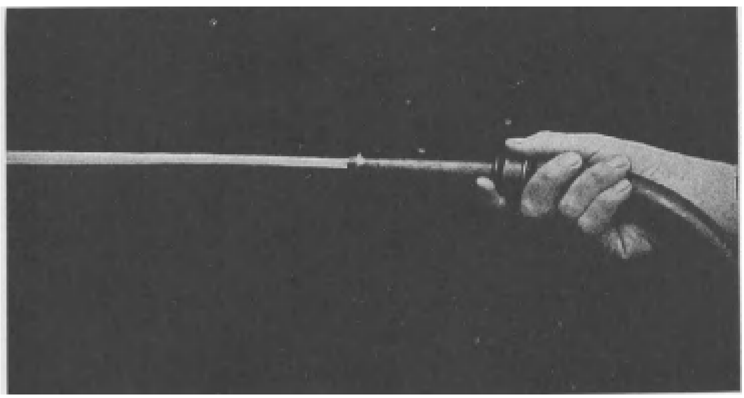


Fig. 18.—Horizontal Douche.

be broken and spread out in fan-like fashion (*Plate X*). The usual size of the nozzle is half an inch in diameter. The force of the jet may be varied by use of the operator's finger at the nozzle.

Care is always necessary not to project the water under too great pressure, especially in the case of nervous subjects.

The Percussion Douche.—This is a special form of douche, 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 water bullets, which Kellogg likens to the discharge of a Gatling gun (see shape of nozzle in *Fig.* 19). The pressure under which the water is projected is higher than in the ordinary douche, and a stinging sensation is produced as the water strikes the patient's skin (*Plate XI*).

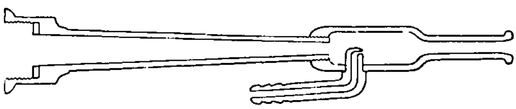


Fig. 19.—Kellogg's Nozzle.

One of the advantages of this application is that the powerful stimulating effect of the percussion allows the use of water of a higher temperature than would be suitable in the ordinary douche, and by many patients who are intolerant of cold water this is much appreciated.

The Scotch Douche.—This consists in the alternate application of the hot and cold horizontal douche. The hot water lasts for from one to four minutes, and the cold is continued for about ten to thirty seconds. The application may be general or local, as in the treatment of sciatica. The derivative effect of the application of the hot water is greatly intensified by the subsequent cold water.

The Rain Douche.—This is a common bathroom appliance (*Fig.* 20). The water is projected through a watering "rose," or perforated disc of varying size, falling upon the patient in a number of fine streams.

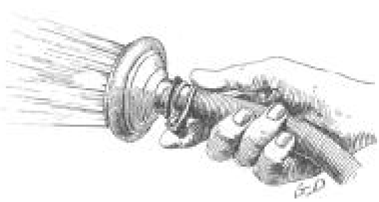


Fig. 20.—The "Rose" for Rain or Spray Douche.

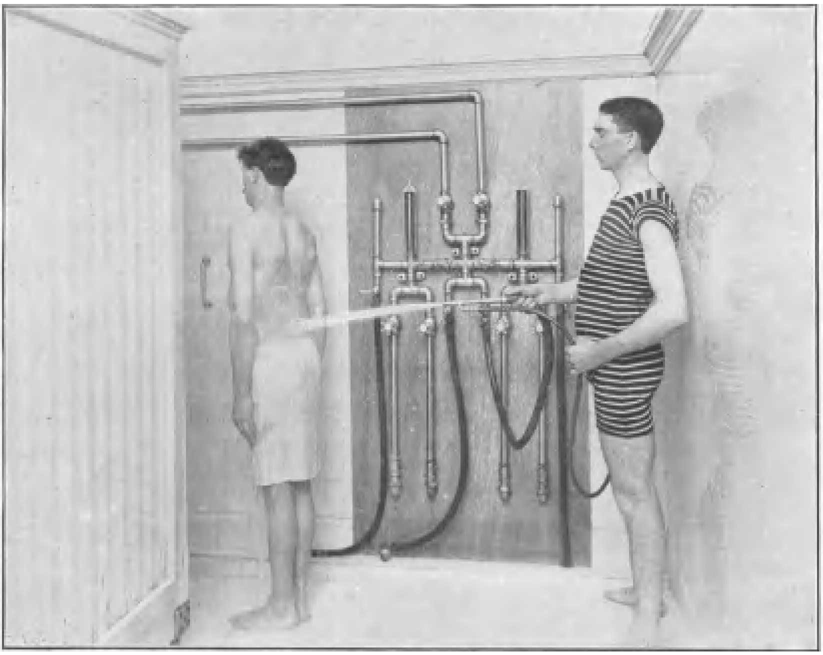
The pressure of the water is lower in this application, and the reaction follows more slowly than after the horizontal jet.

This bath was much prescribed by Priessnitz, and Kellogg regards it as an indispensable part of a completely equipped hydrotherapeutic establishment.

PLATE X.

THE BROKEN HORIZONTAL JET DOUCHE.

PLATE XI.



THE HORIZONTAL PERCUSSION DOUCHE.

PLATE XII.

THE CIRCLE DOUCHE BATH.

Combination Needle and Douche Bath.—This consists of a vertical cage, constructed of tiers of circular tubing supported by uprights, and pierced with innumerable pin-holes, through which the douche is projected upon the patient standing within (*Plate XII*). The pipes conveying the hot and cold water meet in a mixing box, in which a thermometer enables the operator to regulate the temperature to any desired degree. This bath is commonly combined with the preceding.

The Filiform Douche.—In this the jet of water is horizontal, and issues from an exceedingly small opening, capillary in character. The water is forced under great pressure, and becomes a cloud a short distance from the apparatus. This douche may be applied for any time up to ten minutes, and is strongly counter-irritant in action. It may, indeed, even induce bleeding.

THERAPEUTIC INDICATIONS FOR DOUCHES.—The cold douche is à tonic procedure of the highest value; it is both alterative and restorative (*Fig.* 21). Under its influence "the

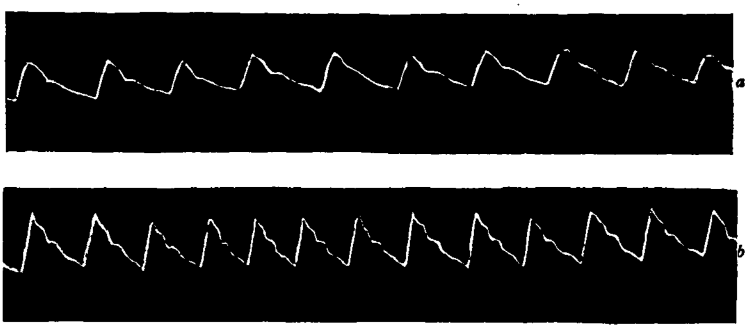


Fig. 21.—Pulse-Tracing: (*a*) Before, (*b*) After a Spray Douche.

individual begins to live a more vigorous life, physically, mentally, and we may say even morally" (Kellogg). It is of value in most forms of cardiac disease, in rheumatism, and neuralgia. Neurasthenia, chlorosis, and all the curable forms of anæmia, are markedly benefited by it, as also are various dyspeptic conditions and chronic alcoholism.

It should not be used in acute or chronic nephritis or in badly compensated cardiac disease.

The Scotch douche is of extreme value in various paretic conditions, in sciatica, neuralgia, gastralgia, and lumbago. The cold or alternate douches are also useful in various sexual disorders, such as amenorrhœa, dysmenorrhœa, sexual neurasthenia, and impotence. The combined needle and rain bath is a morning rouser and refresher *par excellence*. The filiform douche is indicated wherever counter-irritation is required, as in sciatica, lumbago, and chronic rheumatism.

The Aix Douche, or Massage Douche, is a most valuable balneological agent, and is extensively used.

The patient is seated on a wooden stool, or reclines on a board, and a continuous needle spray is directed against the spine, while massage is administered by one or more attendants under a warm douche, conveyed by a flexible

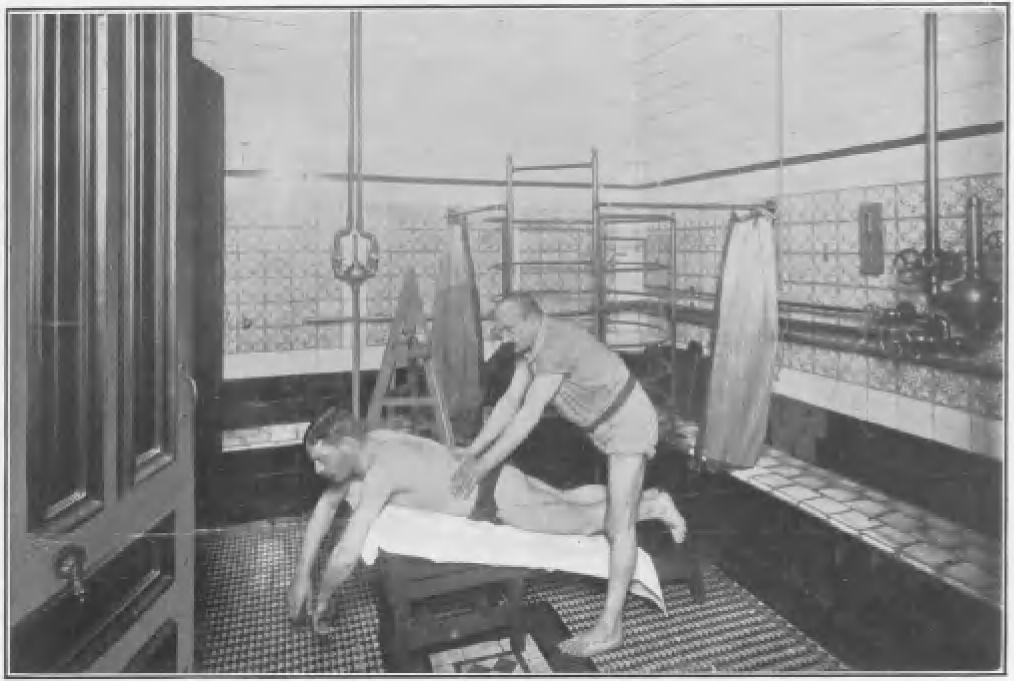
Fig. 22.—The Aix Douche with Two Attendants, as at Aix.

tube passing over the shoulder of the masseur (*Fig.* 22 and *Plate XIII*), and playing between his hands. This may be followed by a local hose douche, and the bath terminates with a needle spray, warm at first, and graduated slowly to tepid, cool, or cold, according to the requirements of the particular case. The duration of the bath is twenty minutes. It is useful in a variety of affections, the chief of which are chronic gout and the gouty state; chronic

PLATE XIII.

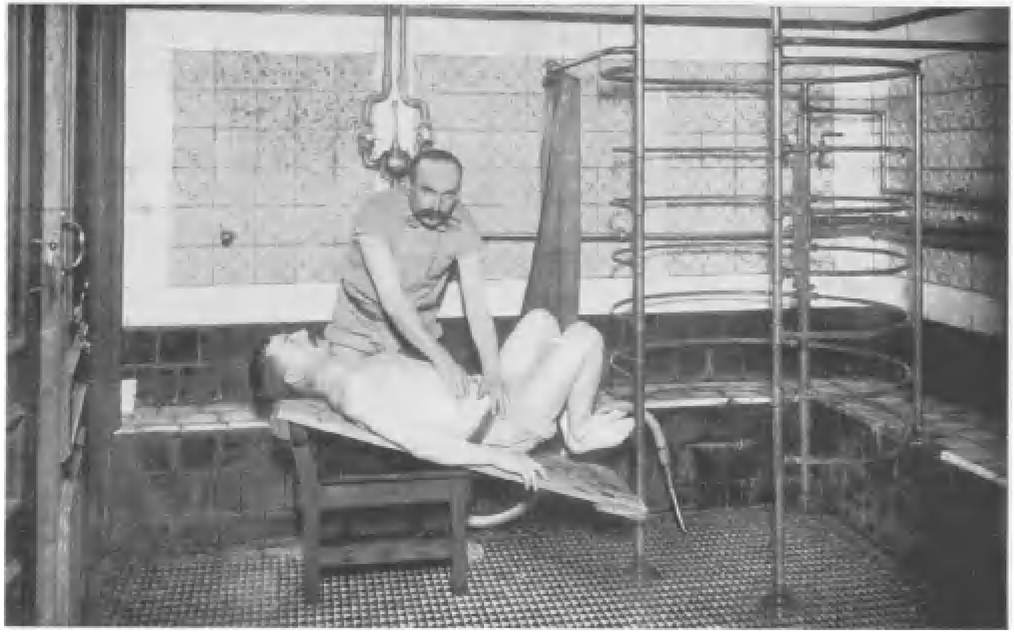
THE AIX DOUCHE.

PLATE XIV.



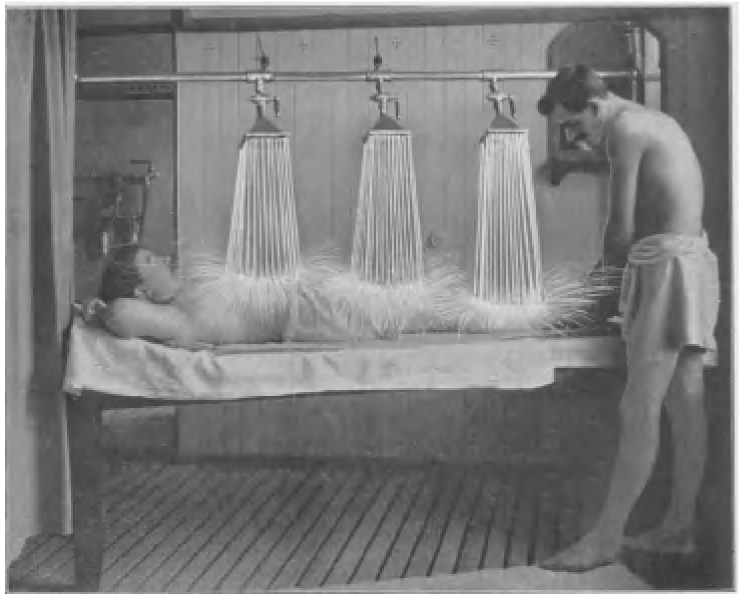
Special Douche-Massage Chair, allowing Complete Relaxation (Bath).

PLATE XV.



DOUCHE-MASSAGE OF ABDOMEN.

PLATE XVI.



THE VICHY DOUCHE, WITH THREE SPRAYS.

rheumatic arthritis, lumbago, and sciatica; arthritis deformans; in toxæmia from high living with sedentary habits; in cases of brain fag from too assiduous work; in obesity; in heart disease of peripheral origin; and in many other disorders.

The Vichy Massage Douche resembles the Aix douche very closely, with some modification of procedure. The patient lies in a recumbent position on an india-rubber air mattress, while massage is administered under a spray douche projected from a series of brackets, pierced with pin-holes, suspended over the table (*Plate XVI*). The duration of the bath is twenty minutes, and it terminates with a needle spray. A preliminary steam bath is often given and free perspiration induced before the massage is started.

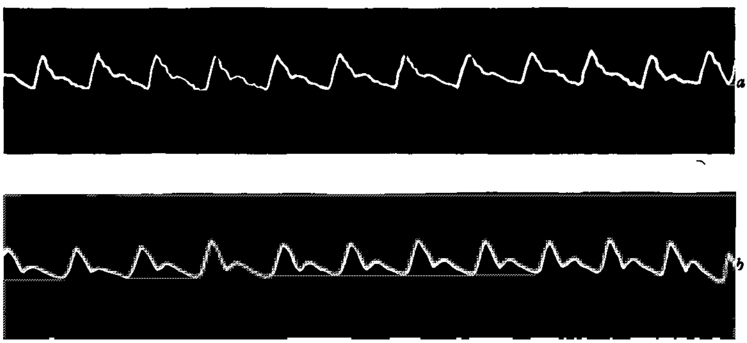


Fig. 23.—Pulse-Tracing: (*a*) Before, (*b*) After, a Vichy Douche.

CHAPTER IV.

THE TECHNIQUE OF COMPRESSES, PACKS, POULTICES, ETC.

THE WET COMPRESS.

THE wet compress (or *Umschlag* of Priessnitz) consists of a swansdown or linen fabric wrung out of water of varying temperature and applied to the surface of some part of the body. The compress is usually applied with a covering of some dry and, for choice, rather impermeable material, to prevent loss of heat by evaporation. Unless so covered, a warm compress will rapidly become cold, and any compress dry. Flannel does best as a covering, rubber fabrics being too impermeable, and as a rule preventing evaporation too completely.

The action of a cold compress is somewhat obscure. Schade, a German physician, has recently explained it from the point of view of the osmotic pressure of the tissues and tissue fluids. The osmotic pressure of a solution may be said to be *the pressure which dissolved substances exert on the molecular surface of the fluid in the endeavour to increase the latter.* This pressure may be very considerable. In health, the osmotic pressure of human blood serum is constant, and is about $7\frac{1}{2}$ atmospheres.

Variations of osmotic pressure may be expressed in another way by stating the lowering of the freezing point of the solution under examination. Blood serum has a freezing point depression of 0·56° to 0·57° C. (briefly expressed as Δ). The endeavour on the part of the body to keep this pressure at a constant level is spoken of as the "isotonic balance" of the blood and tissues.

In inflammatory conditions the osmotic pressure is changed and the isotonic balance lost. In order to understand the conditions affecting an inflamed area, we may analyze such a simple condition as a boil. In this the central pustule is at abnormally high osmotic pressure, ranging between 0·6° C. and 0·8° C., and may even rise to 1·4° C. Passing outwards, one comes to the hyperæmic zone, in which the pressure is still too high, but is increasingly lower the further we go from the central pustule. Outside this is the area of manifest œdema, which has a pressure varying from about ·75° C. close to the hyperæmic zone, to ·56° C., which is the pressure of normal tissues. The importance of this change in pressure is realized when one learns that the volume of a cell diminishes as the osmotic pressure of the fluid in which the cell is suspended is raised above that of the cell itself. Thus a red blood corpuscle loses about one-quarter of its volume when suspended in a 1·5 per cent solution of sodium chloride (Δ equals $-0·9°$ C.) compared with a cell suspended in 0·9 per cent solution of sodium chloride (Δ equals $-0·56°$ C.). Next, as is well known, the structure of a cell is materially altered by suspension in a fluid of higher osmotic pressure than the cell itself. Red cells lose their disc shape and become spherical when kept in 1·5 per cent solution of sodium chloride. Correspondingly, the function of a cell suffers when the isotonic balance is lost. This can be measured by watching the phagocytic power of leucocytes suspended in a saline solution of varying strengths. Clinically it is found that when the osmotic pressure of a part is raised, the part has undergone an injury, and an inflammatory reaction results.

Isotonic solutions may be injected into the tissues without any disturbance of a pathological nature, but pain invariably results if the solutions be hyper-isotonic. This statement does not apply, of course, to substances which are escharotic, or possess corrosive action on the tissues with which they are brought into contact.

The osmotic pressure of the tissue fluids thus plays an important part in the process of inflammation. The Priessnitz application causes a reactive hyperæmia, and thus tends to re-establish the balance of osmotic pressure. Schade considers that while the compress possesses no special action on the area of hyperæmia, i.e., the pustule and its immediate vicinity, it yet converts the local anæmia of the œdematous zone into a local hyperæmia. The result of the increased circulation through this zone is to heighten the lymph circulation centrifugally, thus getting rid of the products of inflammation rapidly or rendering them harmless by neutralization with the various substances in the lymph or serum.

Hot compresses just covering the acutely inflamed area rather increase the pain, while those reaching over the whole of the area affected allay pain rapidly ; further, *ring-shaped* fomentations just covering the area surrounding the central inflammatory area also rapidly allay pain.

The duration of a compress will depend on the effect desired. Generally speaking, cold compresses are renewed as soon as they become warm, and hot compresses as soon as they become cool. If cold compresses be left on until they become warm, they act as poultices and stimulate inflammatory changes. Compresses dry more rapidly on patients with brisk circulations and hot dry skins than in those with feeble circulation and who are in an asthenic or cachectic condition. A maximum stimulating effect may be obtained when hot and cold compresses are applied alternately to any part of the body ; the circulation in the part is increased and the local metabolism markedly stimulated.

Therapeutic Indications.

Cooling compresses are useful in all local pathological conditions of an inflammatory nature, and aid in the removal of hyperæmia or congestion, and in the relief of pain.

Warm compresses promote suppuration and increase local tissue changes and the absorption of morbid products. They have a local antispasmodic action, and often relieve the pain of neuralgia, rheumatic joint pains, etc.

THE VARIOUS COMPRESSES IN USE.

The Head Compress.—This is a well-known application, and one of great service in various congestive conditions of the brain and meninges. The compress is applied either to the top or the back of the head, and in the latter case the back of the neck is included in the application. If necessary, the whole face and scalp may be treated together. It must be borne in mind that a cold application to the forehead will cause collateral hyperæmia of the brain, while one over the jugular region will tend to cerebral anæmia. A brief hot compress will act in the same way. Headaches of a neuralgic character are often relieved by this compress. In febrile and congestive headaches cold compresses afford most relief. The head should be carefully dried after the compress has been removed (*Fig.* 24).

Fig. 24.—Head Compress.

Throat Compresses.—These are very commonly employed domestically, but are very seldom correctly applied, for the usual method is to fold a handkerchief into a narrow bandage and then wind it round the neck like a collar or muffler. So applied it rapidly becomes useless, for it is soon displaced from its original position by the patient's movements, and air is allowed to enter. The proper mode of application varies with the condition to be dealt with (*Fig.* 25). In any tracheal or laryngeal trouble, one end of the bandage should be wetted, and covered with the other, which is dry, to delay evaporation; or a wetted linen handkerchief should be applied and covered with another, preferably of silk, and larger in size than the under one.

Fig. 25.—Throat Compress.

In affections of the tonsil and pharynx the application should be made as follows :—

A piece of swansdown calico, long enough to reach from ear to ear passing underneath the chin, is folded into a 4-layer compress. A bandage of flannel 8 in. by 24 in., provided with a slit for either ear, is also made: these are fitted by actual measurement to each patient. The calico compress is now wrung out of water at 15° C., and laid on the flannel bandage which is to act as a cover. The wet compress being placed under the chin, the flannel bandage is now unrolled from the top of the head, on the right, the ear being allowed to come through the slit, and then carried underneath the chin and up the left side (*Fig.* 27). The whole compress is secured by means of safety

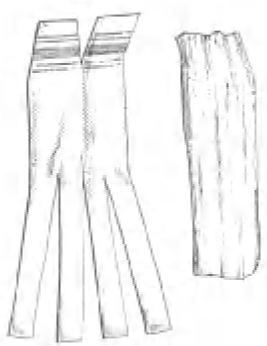


Fig. 26.—The Kellogg Compress.

Fig. 27.—Compress for Tonsils and Pharynx.

pins, care being taken that while it is sufficiently tight it is not uncomfortably so. A hot compress applied for twenty minutes, and then followed by a cool one, will do good in many throat inflammations. If suppuration has started, as for instance in Ludwig's angina, the hot compress will encourage the suppuration and tend to bring it to the surface. In early inflammatory conditions, a cold compress will often go far to subdue and check the inflammation.

The Chest Compress.—A pad of towelling or swansdown calico, 8-folds thick, is wrung out of cold water (iced if desired) and applied to the chest for twenty minutes. This is covered by a flannel cross-binder, which passes over the patient's shoulders and is finally fixed by a tape (*Fig.* 28). After the application is completed, the patient is carefully dried and rubbed with a rough towel. In pleurisy of a dry and painful character, this compress is often very soothing to the patient ; it is also helpful in pericarditis and cardiac excitement. In all cases of hæmoptysis it is a valued and serviceable application. Care must be taken, however, not to employ it in cases where there is presumably marked

Fig. 28.—Chest Compress.

fatty change in the myocardium associated with cyanosis, pulse irregularity, and restlessness on the part of the patient (Kellogg).

Cooling Trunk Compress.—A small blanket, no broader than will reach from armpit to hip, is spread across the bed, with a waterproof sheet of like size beneath. Upon these is laid a cotton sheet wrung out of cold water, 6- to 8-folds thick, of nearly the same breadth, long enough to embrace the trunk with the arms excluded, and well overlapped in front. On this the patient lies down (*Fig.* 29), and the sheet is brought round and tucked tightly underneath the flanks, each side in turn, the blanket in like manner, and the waterproof over all. A hot-water bottle to the feet and a cold cloth to the head are then applied, and the patient's lower extremities warmly covered up.

This application exercises a markedly antipyretic effect, especially if frequently renewed. In febrile conditions in

Fig. 29.—Compress for Trunk.

which drugs seem to have very little effect on the pyrexia, this application will frequently bring the temperature down several degrees in a few hours.

Most patients say they find the compress very comforting, and indeed it is a most convenient and valuable therapeutic agent. In the feverishness of children due to some gastric disturbance it is especially valuable, and the writer has found it of service in acute pneumonia.

Although the antipyretic action is enhanced by frequent renewal, in many cases it may be left on for four or five hours, or even all night, without changing. Hyperæmia is induced on the surface of the abdomen, and sleep is encouraged by the resultant cerebral anæmia.

The Abdominal Bandage (or Neptune's Girdle).—This is a piece of swansdown calico, 3 feet long by 8 to 10 inches wide. A length sufficient to go one and a half times round the patient's abdomen is immersed in water, wrung out, and wrapped round the part. The dry portion is then folded over the wet, so as to prevent undue evaporation, and may be further covered by a waterproof cloth of some sort, the whole application being secured by means of tapes.

This bandage can be worn quite well whilst the patient, if a man goes about his ordinary daily occupation; but is inconvenient for women owing to the corset. It is an application of some value in various digestive disorders, and is generally of a soothing nature, though nervous, irritable subjects often dislike it, and are kept awake at night by it.

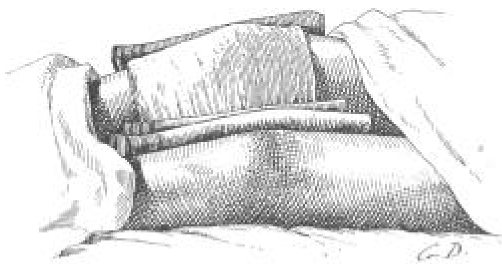


Fig. 30.—Joint Compress.

Circular Joint Compresses.—These are made of strips of swansdown, 18 inches by 6 inches, wrung out of water and applied to the joint to be treated, covered with flannel or waterproof. They are useful in various rheumatic joint affections (*Fig.* 30).

The Electro-thermal Compress (or Electric Thermophore).—This was invented by Cerruti, and has for a number of years been in use in Italy, especially in the hospitals at Turin. The apparatus is really a compress consisting of light, flexible, and incombustible pads, containing electrical heating apparatus in the form of threads of asbestos around which are wound fine coils of resistance wire (*Fig.* 31). These threads are arranged in spirals between the folds of the compress, are perfectly insulated, and are attached at one end of the pad to thicker wires which can be connected with the ordinary electric supply, so that when the current is turned on the compress is heated uniformly throughout. The amount of current passing is regulated by means of

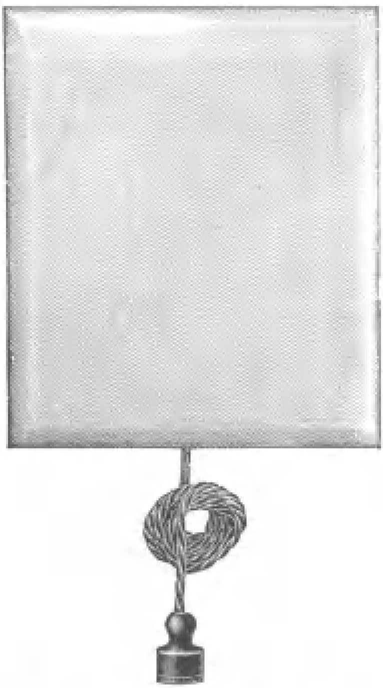


Fig. 31.—Electro-thermal Compress.

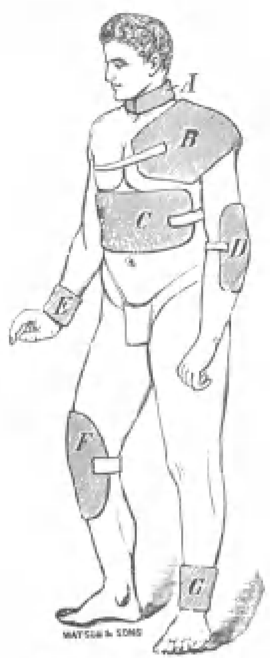


Fig. 32.—The Compresses applied.

a small rheostat, and any desired temperature up to about 150° C. can be arranged for. There is a removable outside cover for each compress, which can be periodically cleaned.

These compresses are extremely convenient and inexpensive, but of course can only be used in houses where the electric current is laid on. Placed in contact with the skin, they are an excellent medium for the application of dry heat; while by inserting a piece of damp cloth between the compress and the skin, a poultice is formed which can be maintained at any desired temperature for an indefinite length of time.

THE WET PACK.

This is applied in the following manner. A blanket $2\frac{1}{2}$ yards square is placed on a suitable couch or stretcher bed, and upon this is laid a coarse linen sheet wrung out of water at 16° to 18° C.

The patient, around whose head a cool compress has been arranged, now lies down on the sheet, which is carefully

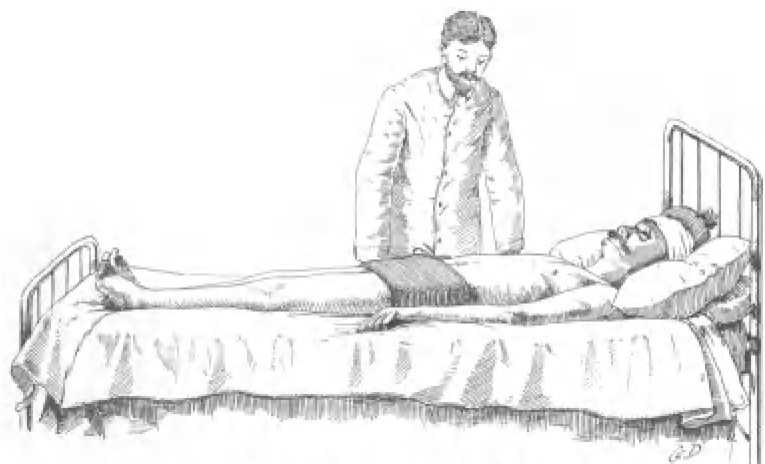


Fig. 33.—Application of Wet Pack.

and smoothly wrapped about him in the following manner: His arms are raised above his head, and one-half of the sheet is drawn across his body, its upper portion tucked alongside the trunk and the lower between the lower limbs. The arms are brought down to the side of the body (*Fig.* 33), the other half of the sheet being arranged so as to include them and its border tucked in along the opposite side beneath the arms and between the legs, in such a manner that the two skin surfaces do not come into contact. The blanket is then brought together at all points, particular care being taken to cover in the neck and shoulders (*Fig.* 34).

The blanket is usually equal to $1\frac{1}{2}$ times the circumference of the patient's trunk, and serves to keep in the heat. It is necessary to wrap it pretty firmly round the patient and to restrict movements of the limbs; at the same time we must avoid rendering him uncomfortable or giving him pain. The feet should be kept warm by means of a hot-water bottle or the previous application of friction.

Action.—The whole body-surface is at first markedly stimulated by the cold sheet, and quickened heart action and respiration result. Usually the sense of cold disappears in about a quarter of an hour, and the patient becomes

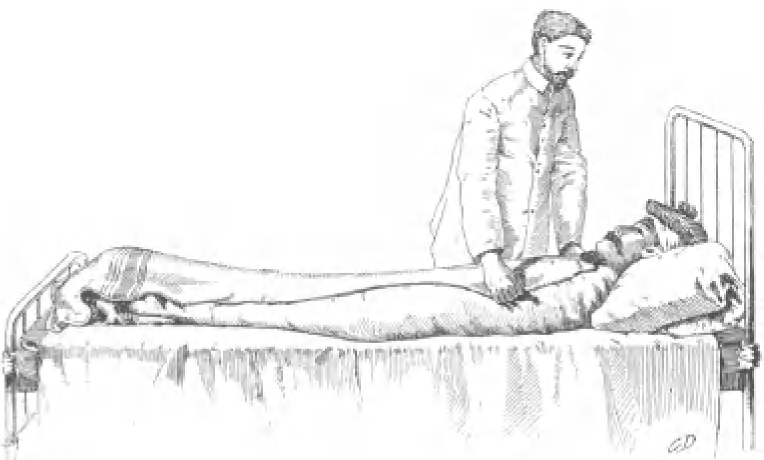


Fig. 34.—The Wet Pack complete.

warm and comfortable. The peripheral vessels dilate, the pulse slows, and the patient feels drowsy, often falling asleep. Later, perspiration may take place, depending on the duration of the pack, which will vary according to the effect we desire to produce. If the pack be changed frequently a marked antipyretic effect is obtained. The warm reaction is slower each time the pack is repeated.

THE DRY PACK.

This application is similar to the wet pack, only the wet sheet is omitted and a soft thin blanket or flannel sheet is used in its place, covered on the outside with a thick blanket.

Indeed, very often merely a single thick blanket is employed. The patient is very completely enveloped, and a hot-water bottle placed at the feet (*Fig.* 35).

Reddening of the skin is rapidly induced by the irritation of the blanket, and the body soon becomes warm. Perspiration appears with a rapidity which varies with the individual, on an average in one and a half hours, and sooner than in the wet pack. The body temperature rises, the tongue becomes dry, the pulse and respiration quicken, while the head feels somewhat full and congested. Considerable discomfort is experienced by the patient until perspiration is actually established. The onset of perspiration may be hastened if certain preliminary measures be taken. One method is to place the patient in a hot full bath (40° C.)

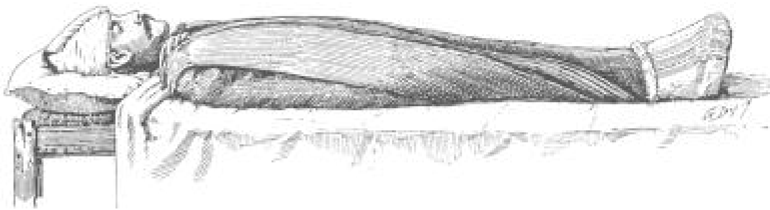


Fig. 35.—The Dry Pack.

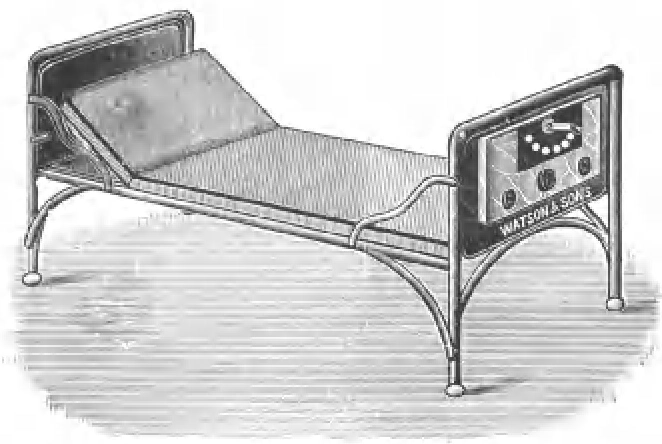


Fig. 36.—Electric Sweating Mattress.

for ten minutes before applying the pack. This is useful when the patient is suffering from chronic granular kidneys associated with high blood-pressure. Another method is to get the patient to put on very warm clothing and engage himself in active muscular exertion, such as swinging Indian clubs, for ten minutes or so, and then put him in the pack. The pack may also be made more active and efficient if the patient lies on an electric sweating mattress (*Fig.* 36), in which heat is generated by the resistance of thin conducting wires.

While perspiration is going on, cold water should be freely drunk, and on the conclusion of the pack the patient should be well lathered down and given a cold spray douche.

Needless to say, such a method of inducing diaphoresis is much more clumsy and tedious than the hot-air or electric-light bath; but blankets are often available where these latter luxuries are not to be had.

Therapeutic Indications.

Metabolism is generally stimulated by these packs, but if often repeated they are very depressing and enervating, and are contra-indicated if the patient has a weak heart. They are indicated in any acute or chronic toxæmia in which the establishment of diaphoresis is desirable.

In febrile conditions, the antipyretic effect of the wet pack may be of great service. Too prolonged application or too often repeated packs will cause some cardiac depression, and care is therefore needed in this respect. Provided there be no marked cardiac asthenia, however, in some cases of hyperpyrexia as many as a dozen packs may be given. In diphtheria this pack is of especial use, combined, of course, with the usual antitoxin treatment.

Other conditions benefited in a varying degree are: Neuralgia, chorea, exophthalmic goitre, muscular and articular rheumatism, and rheumatoid arthritis.

For patients who are unusually nervous in disposition, and resent the complete wrapping up and restriction of movement, partial packs may be employed which, while less powerful, are efficient for soothing and hypnotic purposes.

FOMENTATIONS AND POULTICES.

Fomentations and poultices are simply local baths to the skin. If there be an inflammatory condition of skin or structures covered by it, these applications are a convenient and efficacious means of employing warmth and moisture in the treatment, relieving the vessels, increasing the collateral circulation, and so relieving the local circulation and pain. Thus applied at the commencement of inflammation, they often summarily check it, abort threatening abscesses, and prevent the formation of pus. Acne indurata and herpes labialis may be much restricted by the application of fomentations. Discrimination in their employment is needful, for conditions such as impetigo contagiosa are fostered and made worse by such applications.

Again, if an abscess has actually formed, the repeated application of hot fomentations serves to " bring it to a head," as the vulgar phrase goes, helps the expulsion of the pus without the aid of the surgeon's knife (though this may be often a shorter and more æsthetic cure), and prevents the diffusion of the inflammation.

To be efficacious, a poultice or fomentation *must* be hot —indeed, as hot as can be borne—and must be frequently changed, at least every two hours.

If the object of the poultice be to hasten an abscess bursting, it should be large and ample ; but when the abscess has burst, a small poultice or fomentation about the size of the aperture should be used, or the surrounding skin will become sodden and irritated from the repeated application.

Apart from the soothing local effect of fomentations on inflamed tissues, they have a similar action on deep-seated and more or less remote parts (*vide supra*). Thus large hot poultices are of great service in pleurisy, pneumonia, bronchitis, pericarditis, and peritonitis. In dealing with pneumonia, caution is necessary not to cause additional respiratory embarrassment by using poultices, especially for children. A jacket of cotton-wool or gamgee sprinkled with turpentine or camphor liniment may be preferable in such cases. The jacket poultice for children has fallen somewhat into desuetude.

In peritonitis, too, a poultice should not be thick and heavy, or the pain may be made worse. Poultices are useful in acute rheumatism, sciatica, pleurodynia, and in various rheumatic pains, and acute lumbago. In this last condition the poultice should be large, thick and very hot ; it should be changed about every thirty minutes, and may be kept up for three hours if necessary.

In changing poultices, the fresh one should be ready in hand while the cooling one is removed, so as to avoid chilling the skin.

Fomentations are usually composed of several thicknesses of flannel wrung out of boiling water. They are less weighty than poultices, and less messy and septic. The water is wrung out of the flannel by means of a wringer made of stout huckaback towelling attached to two sticks (portions of a broom handle do well). The flannel, after immersion in boiling water, is placed in the wringer, which is then firmly twisted round the flannel until the water is squeezed out. The operator who manipulates the sticks thus avoids scalding his hands, though the water may be very hot. The heating may also be conveniently done by steam, and this is of course always available in a properly equipped bathing establishment. Having been exposed to the steam, the fomentation is run through a roller to remove any excess of moisture. Until actually applied to the patient, the fomentation is kept tightly rolled up in a towel, by grasping the loose ends of which a final squeeze can be given to extract moisture. The proper temperature of the application is gauged by the back of the attendant's hand.

These pads are made in two sizes, one 11 by 22 inches, and a larger 22 inches square. They are about half an inch thick and quilted. When applied they only contain water which is actually absorbed by the material ; they should be covered at once by some mackintosh material, and frequently changed, as they cool rapidly. When finally removed, the skin of the patient should be wiped dry and covered with a layer of flannel or cotton-wool, ot prevent a chill being taken.

Such hot fomentations are most useful in various colics—renal, biliary, or gastro-intestinal.

A hot pad may be alternated with a cold pad in certain conditions, as follows: The hot pad is applied for five minutes, and then a piece of soft calico towelling wrung out of cold water is laid over the part, being kept on for five minutes or more, when the hot pad is once more applied to the surface. Such applications are useful in gastric and gastro-intestinal catarrh.

Fomentations may also be medicated in various ways, the most common being the application of 20 to 30 drops of turpentine oil, constituting "the turpentine stupe."

Poultices are made of various substances, bread, linseed-meal, oatmeal or starch. Each has its peculiar advantages. The linseed and oatmeal poultices possess very similar properties. They are very compact, slightly porous, and retain their heat and moisture well. Linseed is somewhat irritating to certain skins. Bread poultices are more porous, cool more quickly, and dry more easily. Starch poultices are very soothing, and retain heat for a considerable time.

For making poultices the water should be boiling, and all the materials ready to hand. A sufficient amount of boiling water should be poured into a heated bowl, and the linseed meal, etc., sprinkled in, the mixture being quickly stirred until the mass is of a doughy consistence. This is then rapidly spread on warm linen, the edges of which are so turned in as to prevent any of the poultice escaping. Quickness is essential if the poultice is to be hot. If the water be added to the *meal*, a lumpy, uncomfortable mass will result, not an evenly consistent, soothing poultice.

Bread poultices may be made by cutting up stale bread into thick slices, pouring boiling water over them and soaking for a few minutes; or the mixture may be simmered in a saucepan for a short time. The bread is then strained and beaten up into a paste, and spread. The poultice is more porous if the first method is adopted.

Starch poultices.—A little *cold* water is added to any form of starch, and a pulp made; sufficient boiling water is then added and the poultice spread.

Bran poultices are often convenient on account of their lightness. The bran is placed in a flannel bag, and boiling water poured on it.

Mustard Applications.—In making up the mustard pads, a large tablespoonful of mustard is allowed for each pint of boiling water, or a breakfastcupful of mustard bran to the same amount. The cloth is wrung out of this after a minute has been occupied in stirring up the mixture and another minute for settling. For less sensitive skins, a paste is made of mustard (and for this the mustard bran is quite strong enough) and spread on the face of a hot cloth with a thin fold of muslin laid over it, and this is so expeditiously applied as to ensure a hot application. Table mustard and linseed or oatmeal in equal proportions are equivalent in strength to a like bulk of mustard bran.

Mustard cloth.—A piece of calico or towelling, fourfold, wrung lightly out of hot mustard and water, is applied as hot as it can be borne to the part indicated, and kept in close contact for twenty minutes at the most. If felt too acutely, it may be removed earlier. The effect of the above may be accentuated if it is preceded by a hot fomentation for five minutes. This is what is commonly done for—

The Liver pack.—A small blanket is laid across the couch or bed, with waterproof material beneath. The patient lies down on this, and a hot fomentation, large enough to cover the whole hypochondrium, is applied for five minutes, and then replaced by a mustard cloth. The mustard cloth is usually retained for fifteen minutes. When patients are intolerant of mustard, the hot pad alone is used.

Mustard plaster.—The following is recommended by Whitla as a rapid and convenient method of preparing an ordinary mustard plaster.

The required quantity of mustard is put into a large cup (about a tablespoonful of mustard makes a large sinapism) and as much cold water is poured on as will produce a soft uniform cream, not quite so fluid as to pour out readily. A sheet of paper is procured of such thickness as will readily permit the fluid part of the cream to soak through, without becoming too easily torn. Old newspaper is the best for this purpose, and it should be laid upon a table or smooth surface, the mustard cream turned out of the cup, and roughly smeared or spread over its centre. The circumferential or clean parts of the paper are folded over this, making the required shape and size of the sinapism, which is lifted off the table and the surface which was undermost applied to the patient's skin.

When the materials are at hand, less than a minute is enough to perform this little operation. The plaster can be best carried to the bedside on a plate. The mustard itself does not actually come into contact with the patient's skin, but only the fluid which soaks through the paper between the skin and the cream.

The sinapism should be kept in contact with the skin by means of a bandage or pad of flannel. It is difficult to lay down any absolute time during which the plaster should remain on, for it will vary very much in individual cases. After being applied for a few minutes, however, the edge of the plaster should be raised and the skin inspected. If it remains scarlet for a few minutes, the application should be removed, but if the redness disappears, the application should be continued. The twenty minutes above specified

Fig. 37.—Ice Bag.

in regard to mustard cloth are only approximate, and represent the maximum. To push endurance to the point of distress is a mistake, converting what should be a benefit into an injury. The patient must be told that when the limit of reasonable endurance has been reached, he must do like Tom Sawyer, and "holler 'Nuff!'" It must be further borne in mind that mustard applications are hurtful in the extreme when the skin over the part concerned is inflamed, or indeed shows any form of irritation. In such circumstances a plain hot pad without mustard must suffice.

The Ice Bag.—Of this there are various forms. That we are most familiar with is the small ice bag which we see in the wards of any hospital (*Fig.* 37). It is a small bag of rubber, provided with a metal cap and filled with broken ice. The ice helmet is a modification of this; and there is also the well-known Chapman's spinal ice bag (*Fig.* 38). Various appliances are now made of Leiter's tubing, whereby ice-cold water may be allowed to flow in immediate proximity to any inflamed region, and the cooling effect of such an appliance is considerably greater than an ice bag.

Such appliances are of great use in spinal injuries and congestions, acute myelitis, and spinal or cerebral meningitis. Opinions differ somewhat as to the value of an ice bag in pleurisy. Affleck considers it a most valuable method of treatment and very soothing to the patient, while Kellogg considers it is contra-indicated. The latter, however, speaks highly of the ice collar in diphtheria, when applied for fifteen or twenty minutes in place of a fomentation. The effect is to decrease the hyperæmia of the affected area reflexly, and also by contraction of the carotids.

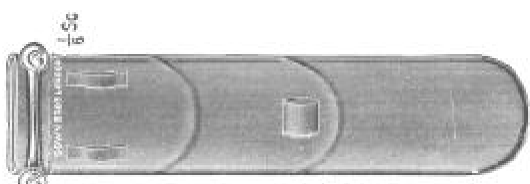


Fig. 38.—Chapman's Spinal Ice Bag.

Chapman made a variety of claims for his spinal ice bag which have been more or less substantiated. He found it had a sedative influence on the spinal cord, but also that he could to some extent increase or diminish the circulation in any part of the trunk, by varying the part of the spine to which he applied the bag. If he wished to influence the head, he applied the bag to the neck and shoulders; if the chest and arms, he applied it to the upper part of the back; and to the lumbar region for the pelvis and legs. In this way he could influence the occurrence of menstruation, and he states that after a brief application to the lower dorsal region he has seen the feet become very rapidly warm. He also found it useful in sea-sickness and the vomiting of pregnancy. By filling the bag with hot water, on the other hand, he could induce contraction in the vessels which were dilated by the application of cold, and was in this manner able to arrest menorrhagia, epistaxis, and other hæmorrhages.

CHAPTER V.

THE NAUHEIM BATHS.

THESE baths have been known for about half a century, but more recently Beneke, of Marburg, advised their use in the treatment of various forms of cardiac disability. They are composed of water charged either naturally or artificially, in varying degree, with carbonic acid gas, and containing small quantities of saline matter, such as chloride and sulphate of soda. The specific gravity averages about 1005. At Nauheim the springs used for this purpose contain chloride of sodium, chloride of calcium, and a varying amount of CO_2. The "Neuer Sprudel" contains only approximately 1 cc. per litre of the gas, while the "Grosser Sprudel" contains over 3 cc. per litre. The course of baths is always commenced with the springs weak in carbonic acid gas; indeed, at the start the waters are allowed to give off the whole of their gas, while some "mutter-lauge," rich in calcium chloride and bromine, is added to them. Later a spring, the water of which is richer in CO_2, is used, and this is gradually increased until strong carbonaceous waters, flowing continuously in and out of the bath, are employed (Sprudel Strombad).

The action varies with the temperature and degree of carbonation of the water employed. Small bubbles of the gas adhere to the skin of the patient, which is powerfully stimulated thereby, and becomes reddened. There is a sensation of heat and prickling and some degree of hyperæsthesia. The cutaneous vessels, "peripheral heart," become surcharged with blood to the relief of chronically overloaded and halting ventricles.

One of the advantages of this bath is that it can be given practically anywhere by means of artificially prepared water. There are several good preparations on the market for this purpose—among the best known being Sandow's,* the "Croyden,"† recommended by Bezly Thorne, and the "Zana" preparations of Zucker‡ (consisting of bicarbonate of soda and formic acid in solution).

The Sandow preparations are put up in boxes containing four packets of bicarbonate of soda, and eight tablets of acid sulphate of soda. Eight parts of the former exactly neutralize twelve parts of the latter, but the alkali should always be in excess. Thirty-two ounces bicarbonate of soda, with twenty-two ounces of acid sulphate, will make a good bath of forty gallons, and will generate about 250 cc. of gas per litre of water. A whole packet of Sandow should be added to forty gallons of water containing about 10 lb. of chloride of sodium and 10 oz. of chloride of calcium, to make a *strong* bath.

At the commencement of treatment, however, where no effervescence is desired, the bath can be made up with 4 lb. of chloride of sodium, and 6 oz. of chloride of calcium. Later, half a box of Sandow may be added to this, and later again a whole box used with the stronger brine. The material for the brine can be easily obtained from the Salt Union at Nantwich.

The temperature of the water varies from 36° C. to 30° C., beginning at the higher temperature and being gradually lowered.

Carbonic acid gas is best obtained in large institutions and hospitals by means of the special apparatus of the Fischer-Kiefer Co., of Zurich (*Plate XVII*). This produces a more even carbonation of the water than is possible with powders, but is of course too elaborate and expensive a method for private houses. An enterprising medical man known to the writer obtained his CO_2 by means of the plant of an aerated water manufacturer whose premises adjoined his own!

Technique of the Bath.—The patient should recline at an angle of about 45°, with his entire body up to the head and

* Buchner, 149, Houndsditch, London, E.C.
† Croyden & Co., 55, Wigmore Street, W.
‡ The Hygienic Co., Southwark Bridge Road, S.E.

PLATE XVII.

THE FISCHER-KIEFER CO_2 GENERATOR FOR NAUHEIM BATH.

neck immersed in water (*Fig.* 39). The bathroom should be well ventilated, and the patient should breathe regularly, abstaining from conversation.

Some sense of oppression is commonly felt at first, but will soon pass off if the patient takes two or three deep inspirations, " which facilitate the passage through the pulmonary circuit of the blood which is being driven through the right heart from the splanchnic and other venous reservoirs." The patient must leave the bath at the exact time prescribed, and be at once enveloped in a warm bath towel, and carefully rubbed dry by the bath

Fig. 39.—Patient in the Nauheim Bath.

attendant. He should then lie down on a couch in an adjoining apartment, and rest for at least an hour before dressing.

The duration of the bath and the strength of the constituents must vary with each individual and the stage of treatment. In many cases, careful observation on the part of the physician himself is desirable.

The baths are usually taken in a course of twelve, and rarely should more than three be taken in each week. On the days on which there is no bath the patient is put through the Schott-Nauheim Exercises.

THE EFFECT OF THE BATHS AND EXERCISES ON THE CIRCULATORY ORGANS.

In all conditions dependent on arteriosclerotic changes and atheroma, such as commencing aneurysm, congestion of the abdominal viscera, and imperfect emptying of the heart, if the tissue changes have not passed beyond the reach of repair, frequently relief and sometimes cure may be afforded by the suitable use of the Schott-Nauheim system. It has indeed been proved beyond reasonable doubt that early conditions of arterial degeneration can be greatly ameliorated by this method of treatment, and to a much greater degree than can be effected by any known drug or combination of drugs. By this treatment the heart is stimulated to more complete systole, and residual blood is expelled, while the peripheral resistance in the circulation is diminished. Benefit is always derived where it is to the advantage of the patient to restore healthy substance and proportionate working capacity to the myocardium.

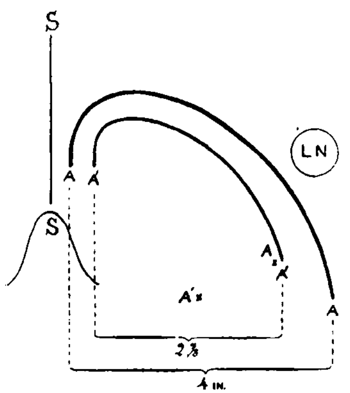


Fig. 40.—Diagram of Cardiac Dullness as affected by Nauheim Baths.

The beneficial action is only limited by the degree of obstruction in the nutrient arteries and the degeneration of their coats. If these changes are far advanced, then increased force in the cardiac systole will only accelerate the degeneration and hasten the end. While reparative processes take place with readiness in the coronaries and the myocardium, organic changes in the valves from chronic endocarditis are beyond the range of any line of treatment.

It may be said that in valvular lesions the well-being and duration of life of the patient depend on the measure of compensatory hypertrophy and the absence of myocardial degeneration. This is probably more true of aortic regurgitation than of any other lesion.

In short, the Nauheim treatment is of the highest efficacy in establishing compensation in valvular disease of whatever nature, and restoring the myocardium to a healthy condition.

In cases of cardiac dilatation, the diminution of the area of cardiac dullness is very striking. Indeed, Kellogg states that after one bath he has found the superficial dullness one inch less in its transverse diameter in cases of marked dilatation and loss of compensation.

It is well to keep a record of such cases by a simple diagram, such as *Fig.* 40.

The Schott brothers have also emphasized the value of the baths in this respect, having found a progressive and

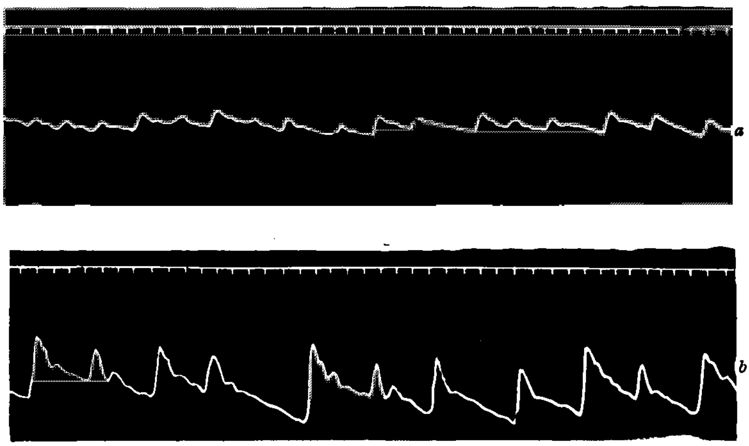


Fig. 41.—Pulse-Tracing: (*a*) Before, (*b*) After a Four-week course of Nauheim Baths.

appreciable reduction in the area of cardiac dullness after a short course of these baths (*Fig.* 41).

THE SCHOTT-NAUHEIM EXERCISES.

Technique.—The body should be held upright and joints kept straight. The resistance applied should not be sufficient to cause any shortness of breath or tremor in the patient's limbs.

The resistance may be applied by the patient himself putting into action the opposing muscles to those which effect the movement, or by an attendant, commonly called "the operator." Each movement should be performed slowly and evenly, at a uniform rate, and not repeated twice in the same limb or group of muscles. The patient's breathing should not be accelerated, and any duskiness or pallor of the cheeks, yawning, dilatation of the alæ nasi, or drawing in of the corners of the mouth, must be taken as a signal for the immediate suspension of the movements. In order to prevent the patient closing the glottis and holding his breath, he should be told to keep counting in a whisper.

The Exercises.

1. The arms are to be raised slowly outwards from the side until they are on a level with the shoulder. After a pause they should be slowly lowered.
2. The body should be inclined sideways as much as possible towards the right, and then to the left.
3. One leg should be extended as far as possible sideways from the body, the patient steadying himself by holding on to a chair. The leg is then dropped back. The same movements are repeated by the other leg.
4. The arms are raised in front of the body to a level with the shoulder, and then put down.
5. The hands are rested on the hips, and the body is bent forwards as far as possible, and then raised to the upright position.
6. One leg is raised with the knee straight, forwards as far as possible, then brought back. This movement is repeated with the other leg.
7. With the hands on the hips, the body is twisted round as far as possible to the right, and then again to the left.
8. With the hands resting on a chair, and the back stiff and straight, each leg is raised as far as possible backwards, first one and then the other.
9. The arms are extended and the fists supinated. The arms are then extended outwards, next inwards, at the height of the body.
10. Each knee is first raised as far as possible to the body, and then the leg extended.
11. This movement is the same as No. 9, but with the fists pronated.
12. Each leg is bent backwards from the knee, and then straigthened.
13. Each arm is bent and straightened from the elbow.
14. The arms are brought from the sides forwards and upwards, then downwards and back as far as they will go, the elbows and the hands being straight.

15. The arms are put at a level with the shoulder, and then bent from the elbows inwards and again extended.
16. With the arms in front at the level of the shoulder, and the hands stretched, the arms are opened out sideways and then brought together.
17. The arms are bent from the elbow outwards and extended.

Bezly Thorne enumerates the following conditions as suitable for Nauheim treatment :—

Palpitation, with and without hyperpiesis.
The strained heart of athletes.
Cardiac dilatation, with " air-hunger " symptoms.
Petit mal (of the cardiac type).
Cerebral neurasthenia.
Tachycardia and bradycardia, exophthalmic goitre.
Cheyne-Stokes breathing dependent on arteriosclerosis.

Summary of Action.—The primary effect in most cases is to reduce the pulse-rate by 4 to 6 beats per minute, while the pulsations are rendered more vigorous owing to the improved coronary flow. The cutaneous vessels become dilated and hyperæmic, while the internal vessels are contracted. The output of urine and CO_2 are both increased. There is a more complete contraction of the right ventricle, and increased vascular tonus throughout the whole circulatory system. There is a marked improvement in the general health and nutrition of the patient.

The opinions of some of the leaders in medicine on the subject of these baths are of interest. Sir Douglas Powell says : " The employment of carefully graduated and observed exercises of Schott may be regarded as especially adapted for the treatment of the flabby, irritable, 'stuffy' hearts—cases of fatty infiltration and impaired metabolism—which are met with in people of venous plethora.

" In cases of chlorosis with dilated heart, after a preliminary week or two of complete rest, the Schott treatment is of value when combined with a chalybeate and a dry bracing climate.

" In the first commencing failure of heart in chronic valve disease, the treatment may be employed, combined with a more or less complete cessation from other forms of exercises, and similarly after such cases have been restored up to a certain point by digitalis treatment.

"Further, certain cases from the symptoms of which we recognize the presence of atheromatous changes in the coronary vessels, the treatment may be cautiously tried in combination with much rest. The treatment is undoubtedly an aid to our therapeutics."

Broadbent's opinion was as follows: "In cases of cardiac dilatation from loss of tone of the heart after influenza or some depressing disease, it may be of great service, and effect a cure where drugs and other treatment have failed.

"In many cases of functional and neurotic heart disease, which are commonly difficult to deal with, it may also give satisfactory results.

"In valvular disease, it is of course unnecessary when compensation has been established and no symptoms are present; when compensation has completely broken down it is not advisable to rest in bed, and suitable treatment by other means may be more efficacious.

"In cases of mitral disease, more especially mitral stenosis, when compensation is just maintained with difficulty, when the degree of stenosis is such that increased contractile power of the right ventricle induced by digitalis would be useless or harmful, it may be of great service. In aortic disease it is not advisable, owing to the risks of syncopal attacks, though when compensation is breaking down it may sometimes yield good results. In adherent pericardium, with threatened compensatory failure, it may be of service."

Professor Lindsay says: "I must confess I read with some incredulity the reports of rapid diminution of cardiac dilatation under this treatment, and I entertain no doubt that increased expansion of the lungs is the main factor in the alteration of the percussion area of the heart which has been described." While admitting slight experience of the method, Lindsay considers "the advantages consist in the methods employed being thoroughly systematized, controlled, and regulated."

Strumpell writes: "The employment of baths in heart disease deserves special consideration. Numerous experiences go to prove that they are well borne, not only by patients with heart disease, but that they exercise peculiar and beneficial and invigorating influence on the action of the heart."

In view of the above there seems to be no room for scepticism or reasonable doubt that the use of Nauheim baths and exercises in many cardiac and associated conditions is in the clearest manner indicated.

Contra-Indications.

In cases with albuminuria due to chronic Bright's disease (large white kidney), it is better not to prescribe these baths.

They are also unsuitable when the patient is suffering from eczema, from angina pectoris associated with cardiac asthma, or from marked œdema or peripheral neuritis.

CHAPTER VI.

PEAT, FANGO, AND OTHER MEDICATED BATHS.

THESE are semi-solid baths of varying density and temperature; with them may be included the "hot sand" bath and the hot seaweed bath. They are used chiefly for their thermic and mechanical effects, but also to some extent for their chemical action.

Peat is a form of turf soil consisting of dried and decomposed vegetable matter which has undergone certain chemical changes induced by constant intimate contact with mineral matter percolating through it for thousands of years. Apart from dried grass fibre, root and bituminous substances, it contains silica, phosphate and sulphate of iron, sodium chloride, and sulphuretted hydrogen, as well as sulphuric and carbonic acid. After undergoing complete disintegration by exposure to the weather, the peat—by admixture with hot water—is made into a soft mush or mud, of the consistence of fine porridge, practically free from grit. The amount and nature of the chemical salts present in the peat from any district will of course depend on the nature of the springs in the district and the amount and quality of saline matter they contain. Sulphates, carbonates, and chlorides can be added to the hot water prior to mixing it with the peat.

The peat baths at Marienbad are ferruginous in character, and those at Driburg sulphurous.

Action.—A peat bath exerts a considerable mechanical effect, resembling that of massage, through compression and friction. The capacity of peat for retaining heat is much greater than water, and these baths can be employed at much higher temperatures than water baths. The motor and sensory cutaneous nerves are markedly stimulated.

Fango Di Battaglia.—Fango is the volcanic mineral deposit from the hot springs of Battaglia, near Padua. It has been used for centuries by the Italians for the relief and cure of painful affections, such as sciatica, lumbago, gout, rheumatism, etc.

Its value being recognized by visitors to Battaglia, it was imported to some of the Continental bathing places, and its properties were tested under skilled and scientific observation. The results were so satisfactory that it has been gradually adopted at the principal health resorts, which now owe a great part of their success to the results of fango treatment. At Baden-Baden, Kissingen, etc, its use has greatly increased. The use of fango dates from very early times. Under the Roman Empire the applications of this material at the Eugean Thermæ were noted for their excellent effects.*

In appearance fango is a soft greyish-brown plastic substance of the consistence of butter, and equally soft to the touch. It is odourless, and, after the application is finished, can be quickly and completely removed from the skin by means of a douche of warm water, leaving the skin surface absolutely clean.

Chemical Analysis.—Fango is rich in iron, argillaceous earth, magnesia, lime, and alkalies, united with phosphoric and sulphuric acids.

	In 100 parts.
Combustible and volatile matter	10·98
Soluble in Acids	41·36
Insoluble	58·64

The portion soluble in acids is composed of :—

Carbonic Acid	9·34
Sulphuric Acid	6·65
Silica	7·86
Oxide of Iron	9·81
Phosphates	1·83
Carbonate of Lime	6·05
Magnesia	1·40
Potassium, Sodium } as Sulphates	0·94

In addition there are traces of the rarer minerals, such as thorium, helium, and radium.

* Fango baths were first introduced into this country at the bathing establishment connected with the Royal Hotel, Matlock Bath.

In order to bring the fango to a proper temperature for application to the body, it is heated in a large water-jacketed or steam-jacketed pan. The temperature at which it is applied is a most important point, and it is essential that the heat should be easily controlled. The apparatus in general use is a large tinned copper pan with a lid. The pan is surrounded by a water chamber, and the latter is heated by a number of large gas Bunsen burners. The heating takes place but slowly, but the cooling is equally slow, and when once a large mass of fango is raised to proper temperature, it takes some hours to cool. The application is, indeed, a large sterilized mineral poultice enveloping the affected part (*Plate XVIII*).

Temperature and Duration of Application.—It was at first thought important to obtain as high a temperature as possible in the fango treatment, but this was an erroneous idea. The following rules should be observed in a general way :—

To begin with, a low temperature should be used, and gradually raised by a degree or so at a time. A low temperature for fango is 45° C ; the highest temperature endurable is 56°–58° C., at which signs of burning show themselves. Generally speaking a temperature of 54°–55° C. is sufficient.

The higher temperatures are only useful in the treatment of deep-lying abdominal or thoracic viscera. For all kinds of neuralgias, low temperatures (45° C.) are advisable. With old or weak patients, the temperature should never exceed 49° C., and the packs be given only on alternate days. Packing should not take longer than thirty-five to forty-five minutes.

For washing off the fango, a warm douche or spray is recommended. General baths are not desirable. Neurasthenics, and those suffering from some other nervous complaints, usually require a cold douche after the warm one, followed by a rubbing down.

Reaction.—The patient should be warned at the commencement that a reaction takes place (and sometimes even repeats itself). During the time of this reaction, which usually appears after a few applications, the affected part is frequently much more painful and sensitive. After a few

PLATE XVIII.

FANGO TREATMENT.

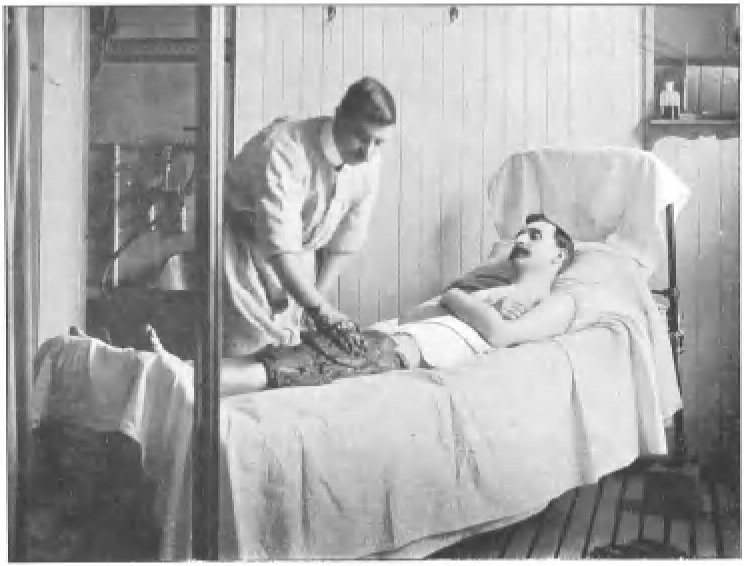


Fig. A.—APPLICATION OF THE FANGO.

Fig. B.—PACKED-UP.

more applications the pain subsides again, and usually a steady improvement sets in.

Fango treatment can be employed from infancy to old age, and with every constitution, even with such as suffer from severe heart complaints. Cases with high fever, advanced phthisis, or women who are *enceinte*, should not be treated with fango.

A very important point in fango as well as in every other thermal treatment, is that the physician should keep a sharp eye on the patient, especially at the beginning, and see him after every third and fifth packing; and also that he adapts his prescriptions to the individual case.

The Action of Fango.—The action of fango must be considered in a threefold aspect: the chemical, the mechanical, and the thermal. The chemical effect has not yet been made sufficiently clear, and there are great differences of opinion concerning it. The mechanical effect consists in the pressure exercised by the layers of fango, which act like a gentle massage. The cause of the thermal action is of course to be found in the high temperature to which fango has to be brought; a balancing of the heat of the body and the heat of the fango takes place, and the body remains always under the same warming layer.

The physiological effect of fango applications on the blood-pressure, the distribution of the blood, and on the heart may be shortly expressed as follows: According to many observations the frequency of the pulse is diminished at the beginning of the application, becomes greater after about ten minutes (an increase of 6 to 8 per minute), then diminishes again by 2 to 3 per minute, and after this remains stationary until the end of the application. The application is immediately followed by an increased tonus of the blood-vessels, this being the consequence of the irritation of the vaso-constrictors; the skin becomes pale; the blood-pressure is heightened for a short time; then a hyperæmia of the cuticle takes place through paralysis of the constrictors, and with it a reduction of the heart action in consequence of diminished resistance. According to Baelz this paralysis is not annulled by cold, and patients could leave the bathing-house undressed, even in winter, without catching cold.

The reflex action of the sensory and temperature nerves on the heart is kept up, a douching with cold water is at once followed by a decrease of the number of pulse strokes, and by a strengthening of the heart action, without diminution of the redness of the skin. Baelz noticed also that the blood of anæmic patients is greatly improved after a fango application. The temperature of the body is heightened during the application, particularly during the first quarter of an hour (1° to 1·5° C. or more). According to Maggiora and Levy, this is not so much the result of a lessening of the radiation of heat as of a direct heating of the blood through the far hotter fango. In the beginning of the application a diminished frequency of respiration is observable, which increases after about ten minutes by four or five breaths, without being followed later on by oppression or deeper breathing.

A fango application does not relax the muscles, and very little fatigue is subsequently felt. An increased secretion of nitrogen can be proved either in the perspiration or in the urine. Gout especially produces an increased secretion of uric acid. The action of fango on the nerves differs according to the temperature employed : it either promotes, hinders, or altogether stops their action. The physiological facts justify its employment in the following ways : Fango is, *First*, the best cataplasm known. Its density, its even consistency, its low specific heat, the fact of its being a non-conductor of heat, and the mild counter-irritation it produces on the cuticle permit it to act for a long time on a considerable area of the body, even when brought to a high temperature, without substantially disturbing either the pulse, the blood-pressure, or the heart action, without producing congestions and oppressions, or leaving behind (like other kinds of baths) a great feeling of relaxation and fatigue. *Secondly*, fango is an excellent diaphoretic.

Through its action on the distribution of the blood in the organism, fango has a diverting effect, while in the cuticle it produces hyperæmia. In both cases the effect is an intensive, passive one, with diminished tonus of the vascular system, of long-continued duration. We are therefore able not only to effect a momentary lessening of congestion in cases of hyperæmia of the inner organs as well as of the mucous membranes of the respiratory and intestinal tracts, and in hyperæmia of the brain and its membranes, but the effect endures, and by a methodical continuation of the treatment the vessels of the affected parts will by degrees resume their normal tonicity and fullness.

On the other hand, fango applications produce an increased supply of blood of a higher temperature, with consequent perspiration, in rheumatic affections of the joints and of the nerves, and in this manner they promote the resorption of all sorts of effusion, and particularly of perimetritic exudate as well as gouty deposits, etc.

Combined with a suitable diet, fango treatment is of great advantage in affections of the intestinal tract, especially in chronic catarrh of the bowels.

Rheumatism, Subacute or Chronic, will always be one of the chief indications for fango treatment. The results obtained are completely successful. Cases usually come under treatment after having suffered some time. The reaction may take two or three days, and according to its intensity the doctor will continue or discontinue the pack for two or three days, or else lower the temperature. After a thorough improvement has taken place it is advisable to give five to ten more packs, so as to prevent a relapse.

Chronic Articular Rheumatism (in all its stages, up to arthritis deformans).—The greatest field for fango treatment is offered by this complaint. The packs are first applied at 115° F., the temperature being increased by about one degree daily, till 128° to 130° F. is reached. In this complaint the temperature should be increased in spite of the reaction, which takes place usually after the second until the sixth packing, and lasts from two to five days. Only with a very acute reaction should the temperature be lowered. In the general course of treatment, reactions often take place later on. These are usually rather intense, but do not last more than a day or so, and generally announce a new amelioration.

If the joint becomes swollen by fluid effusion, skilful massage may be required. Often rather large synovial effusions, occurring during the first few packs, go down after a little time by merely continuing the packs. As a rule, use massage in cases where it appears to be called for (e.g., in contractions and thick old effusions) only after the reaction, and call the attention of the patient to the fact that an increase of pain may at first result from the massage.

Rheumatoid Arthritis.—Massage is generally given from the beginning, except where the joints are very painful. An improvement almost invariably takes place, the intense pains are alleviated, and for a time they may disappear entirely. The treatment should be of longer duration, and repeated at intervals of six months at least.

Muscular Rheumatism.—The fango is applied first at 47° C., and gradually raised as high as bearable. Reaction is rapid and brief, and recovery usually quickly follows.

In old and chronic cases, such as lumbago, the reaction is delayed, occasionally not appearing till after fifteen or twenty packs; but the case then makes satisfactory progress, and the lumbago is often banished for years. Occasionally patients complain that the pains wander from the back to the thigh or chest, etc. The application should follow up the pains, which gradually diminish, disappearing last at the place where they began.

Old injuries: high temperatures can nearly always be prescribed from the first.

Neuritis.—In all applications to painful nerves, low or moderate temperatures must be employed, beginning at first as low as 40° to 43·3° C., and for ten minutes or so only. Each case must be judged by itself, for there are few in which excellent results are not obtained if sufficient care be taken. Occasionally there are inveterate cases of sciatica that show no signs of improvement, even after prolonged applications.

In these cases, if no reaction has taken place after a few packings, the reaction must be enforced. This is done by applying two or three packs at 54·5° C. When the reaction occurs, lower the temperature to 46° C., and let it remain at this. As soon as the pain lessens, the packs should be applied every other day, and later twice a week.

Alcoholic neuritis (multiple) may be successfully treated with fango.

Abdominal or Pelvic Neuroses.—High temperatures are most useful here. The whole abdominal, lumbar, and sacral regions are treated. This is mostly of service in gynæcological patients.

Tabes Dorsalis.—For the shooting pains, four or five packs, applied every second day, often produce a very satisfactory result. The pains diminish, and often disappear entirely.

In chronic bronchial catarrh, pleuritic effusion, abdominal diseases, gallstone colic, and pelvic disorders, the highest temperatures must be used.

Gout.—In acute gout, fango is especially useful ; it allays the pain and reduces the duration of the attack. After three or four days improvement sets in, and by the seventh day an excellent result is nearly always produced, whilst otherwise the patient would have had to stay in bed or on an easy chair for three or four weeks. In forty cases of acute gout, we had only one where the effect was not so prompt.

SAND BATHS.

The body, or a portion of it, is immersed in sand heated to a temperature of from 42·4° to 54·4° C. Profuse perspiration results, with reddening of the skin upon which the sand cakes.

The body temperature rises 3° or 4°, owing to delayed heat loss. These baths are used at Harrogate, and at Lavey, in Switzerland.

The sand was formerly warmed by exposure to the sun, but is now usually heated in special ovens. Fine hard sea or river sand is used. The heated sand is laid for a depth of six to twelve inches on the bottom of the tub, and the patient lies down in this. His head is raised on a pillow, and the body carefully covered with warm blankets.

The temperature of the sand to begin with is from 45° to 50° C., and may be maintained by means of hot pipes in the floor of the tub. Perspiration rapidly occurs, and is freely absorbed by the sand, so that the patient experiences no discomfort. Pulse and respiration are quickened.

Duration, one to one and a half hours. The patient is treated as after the steam cabinet or Turkish bath.

INDICATIONS.—These baths are specially indicated, in preference to vapour or water baths, where a powerful skin stimulation with increase in body heat is desired. They are of service in various joint affections of a gouty or rheumatic nature, in neuralgia, peripheral neuritis, and in chronic inflammatory affections of the uterus.

They should not be given to patients who are suffering from cardiac disease of an organic nature, phthisis pulmonalis, or to pregnant women.

BRINE BATHS (Sool-Bader).

These baths are prepared from water containing sodium chloride, or by adding saline to ordinary water. Powders may be used which are prepared from suitable mineral waters by concentration.

The salts are chiefly chlorides of sodium, magnesia, and calcium. From 15 to 20 lbs. are necessary to make a full bath to contain 3 per cent. The bath water should contain not less than 1·5 per cent of saline matter, and the amount may be increased up to 5 or 6 per cent. The usual temperature of the bath is 35° C.

The action of these baths depends chiefly on the irritative effect of the saline matter on the patient's skin, which is rendered somewhat hyperæsthetic. Production of CO_2 is increased and the blood-pressure rises. The baths possess a somewhat diuretic action, and the urea and chlorides are excited and increased. The effect is greatest if the saline percentage of the bath be low. With the increased metabolism the patient's appetite improves.

INDICATIONS.—These baths are of value in the treatment of various chronic inflammatory disorders of the pelvis in the female, such as perimetritis and parametritis, in chronic joint rheumatism, and neuritis.

MEDICATED BATHS.

Vegetable, animal, or mineral matter are added to the water in these baths in order to modify their action in various ways. Among the substances employed are dried plants, such as camomile, thyme, spearmint, lavender, oil of cade, etc. An alcoholic extract of these is added to the bath water.

Midgeley's, Manchester, prepare excellent powders for "medicating" baths, in great variety.

A common form of bath employed is the pine bath, prepared from pine needles, or young shoots of firs or pine trees, or an alcoholic extract.*

Bran baths have a soothing effect on various irritative skin conditions, and mustard baths, prepared from mustard flour or mustard bran, are useful as derivatives in various internal inflammations and congestions.

A combination of mustard and bran is often used. A tablespoonful of mustard flour to a teacupful of bran in each gallon of hot water.

* Langbein's Coniferol tablets, obtainable from the Hygienic Resorts Bureau, Chancery Lane, W.

SECTION II.—*Heat and Light in the Treatment of Disease.*

CHAPTER VII.

THERMOTHERAPY.

GENERAL PRINCIPLES.

THE use of heat, in one form or other, in therapeutics, dates back to the dim and distant ages of remotest antiquity; even animals, when ill, instinctively have recourse to the radiant heat of the sun. Doubtless the first idea of the use of heat as a curative agent arose from the beneficial effects experienced from submitting the body to the influence of the solar rays.

The therapeutical applications of heat are innumerable, and, with the progress of science, have gradually extended their range from the linseed poultices of former times to the modern and elegant appliances for treatment by means of moist or dry heat; from the old Roman sweating-houses to the luxurious and well-appointed Turkish baths of the present day.

Although originally practised by enthusiasts on more or less empiric lines—in common with many other forms of treatment which have subsequently received the warm approval of medical men and scientists—the use of heat in its various forms has during the last century been the subject of study by numerous medical men throughout the world.

In 1840, Guyot issued his "Traité de l'Incubation." It is the first serious study on hot air and the employment of high temperatures for the alleviation of pain, especially with reference to affections of the bones.

In 1844, Chautard, perceiving the value attaching to luminous radiant heat, strongly recommended its adoption in the treatment of rheumatism. Then came Fodéré, of Strasburg, and Marchand, of Bordeaux, who studied the action of sand baths, heated by solar rays, a form of treatment, known as *arenation*, which is practised in some places at the present day, e.g., Battle Creek, Michigan (*Plate XXIV*).

Coming to more recent times, the works on hot-air and vapour baths, and on the various applications of heat, are so numerous that their bare enumeration would fill several pages.

HEAT MAY BE EMPLOYED IN THREE DIFFERENT FORMS :—

1. *Moist heat ;* 2. *Dry heat ;* 3. *Luminous radiant heat.*

1. **Moist Heat.**—Without going into the question of ordinary baths, poultices, fomentations, etc., we will now consider what takes place in vapour baths, of which the temperature varies from 24° C. to 55° C. The enclosure within which such baths are given consists of a closed chamber into which is allowed to flow either pure water vapour or vapour charged with medicinal substances. The patient usually bears without inconvenience a temperature of from 24° C. to 35° C., but beyond this latter temperature and up to, say, 44° C., the respiration and circulation are very noticeably accelerated, and such untoward events as vertigo, loss of consciousness, congestion, hæmorrhage, etc., are to be feared. These are due to the hot vapour, which renders respiration laborious and painful, and also to the obstruction offered to the evaporation of the moisture given off from the body in an atmosphere already supersaturated with moisture. In order to get rid of the first of these difficulties, there has been introduced the box bath, which consists of an enclosure within which only the body is enveloped in vapour, the head being outside the box, thus permitting the lungs to receive air from without. In spite of this, when one enters a room in which such box baths are being given, the high temperature is generally very noticeable, as are also the humidity and disagreeable odour of the atmosphere which one breathes. It is practically impossible to remedy the difficulty of evaporation of the perspiration.

2. **Dry Heat.**—Among the applications of dry heat in which air does not play the part of the conducting medium, and in which the temperature does not get beyond 49° C.

to 55° C., are bran, salt, or hot sand compresses, dry fomentations, etc.

The hot-air bath represents the more general application of dry heat; the temperature varies from 40° C. to 74° C. and may even reach 112° C., the maximum temperature bearable for any length of time; but it is not prudent to submit patients to this latter temperature.

In 1893 Tallerman demonstrated the possibility of attaining with dry heat temperatures unknown until then. His apparatus consists of a metal cylinder heated by numerous gas jets. The cylinder is closed at one end, with the exception of one small opening where a ventilator is fixed. At the other end is fixed a movable screen of special cloth, with an opening in the centre through which the affected limb is passed. The apparatus thus consists of a closed space with a means of securing ventilation. Considerable experience in English and American hospitals demonstrates that a temperature of 148° C. can be borne without inconvenience, and gives good therapeutic results in some cases. The apparatus is to all intents and purposes *a gas oven*, and products of combustion are distinctly perceptible.

3. **Luminous Radiant Heat.**—This is either natural or artificial; natural in sun baths; artificial in the Dowsing baths. The latter system of baths possesses many and considerable advantages over all other systems, and permits of a temperature of upwards of 260° C. being attained, and maintained with safety.

In order to fully appreciate the medical value of luminous radiant heat, it is necessary to explain here certain of its physical properties which are but little understood at the present day.

SOME PHYSICAL FACTS IN REGARD TO LUMINOUS RADIANT HEAT.

Luminous radiant heat—of which the sun represents the best possible example—is the conjunction of radiant heat with light and certain chemical rays. All combustion with flame creates luminous radiant heat, but it is not always necessary to use combustion, in the chemical sense of the word, to obtain this mode of transformation of energy. Electricity can transform itself directly, *in vacuo*, into luminous radiant heat. This is the case with the Dowsing lamp, which emits simultaneously heat rays and light rays (*See Fig.* 42).

Radiant heat, light rays, and chemical rays are three types of radiant energy ; from the physical point of view there is no essential difference between them, and their laws of propagation are identical.

Radiant heat is that which, emanating from a heated body, passes through other bodies, described as diathermanous, as light passes through diaphanous bodies.

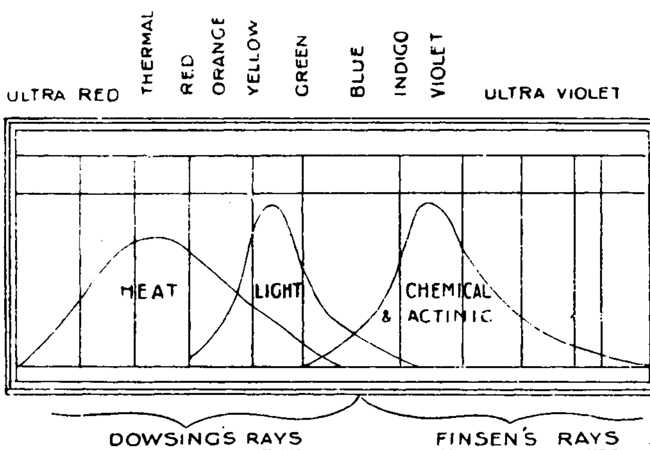


Fig. 42.

A part of the sun's heat travels through the atmosphere as light, without being absorbed in it ; the fire from the hearth warms us at a distance without the heat which it emits being absorbed by the air which separates it from us. This is what is known as *radiation.*

Radiation consists in the vibrations of ether produced by the impulse of molecular movements of a radiant body. Luminous rays are perceptible to us by the eyes, and heat rays by the skin and flesh, but the invisible rays of heat, the luminous rays of light, and the chemical rays are each represented by ether vibrations, only distinguishable by difference in length of wave. Tyndall demonstrated this in his studies on the spectrum ; in fact, when we observe the obscure region of the spectrum, we see that the heat rays become more and more intense in proportion to the proximity of the luminous rays ; at the same time the heat waves acquire a greater amplitude, causing greater energy of vibration, the energy of vibration being proportional to the square of the amplitude. Thus, to obtain high temperatures, a source of luminous heat is preferable to all others.

In spite of the identity in origin of obscure and luminous heat, it is not less true that luminous heat possesses properties peculiar to itself.

Practically, the transmission of obscure heat is effected by convection, and consequently indicates the raising of the temperature of the surrounding atmosphere ; for example, to raise by, say, thirty degrees, the temperature of a body separated some distance from a source of obscure heat, it is absolutely necessary that the atmosphere of the intervening space be also raised by thirty degrees.

Luminous radiant heat will effect its purpose without raising the temperature of the surrounding atmosphere ; its rays, like the rays of the sun, do not by convection carry the heat from point to point, but merely energy in the shape of vibrations, which energy is transformed, or converted, into effective heat in encountering obstructing bodies.

Luminous radiant heat travels through space. It may be diffused as light, and reflected and directed by means of suitably arranged reflectors. This may be readily demonstrated by arranging opposite each other, some little distance apart, two large spherical or parabolic mirrors of burnished copper in such a manner that their axes are coincident, and placing a piece of live coal, or other lighted substance, in front of the one, and a piece of tinder in front of the other, when it will be found that the tinder almost immediately bursts into flame.

Luminous rays and chemical rays play an important part in luminous radiant heat, and it may be useful at this point to mention some features of special interest. Under certain conditions, light becomes converted into heat. A striking example of this is shown in connection with a conservatory. If, when the sun is shining brightly, all ventilation is stopped for a few hours, the heat within the conservatory becomes intolerable. The heat rays alone are not responsible for this increase in temperature, for, as is well known, heat rays only penetrate through glass to the extent of 33 per cent, a percentage quite insufficient to account for the rapid rise in temperature within the conservatory. The explanation is to be found in the fact that the luminous rays, which pass through glass practically without diminution, coming into contact with the plants and other objects within the conservatory, are absorbed in such subjects, and thus converted into effective heat. Tyndall has demonstrated the same thing by the following ingenious experiment. He passed a beam of electric light through water, to absorb the heat rays, and then, by passing the resultant rays through a lens of ice, he set fire to some black paper and ignited gun-cotton on the other side, showing that it was not the heat rays which brought about that result, but the light rays. In other words, the wave lengths were altered, they were lowered in refrangibility, and converted into heat.

Certain substances, amongst others platinocyanide of barium, have the property of absorbing rays of a certain wave length and of emitting rays, more or less luminous, of a different wave length. This interesting phenomenon constitutes fluorescences, of which the radioscope represents the most important application.

Thus we see that luminous radiant heat is formed by the blending together of heat rays, luminous rays, and chemical rays; but it is possible to eliminate either one or other, and to have separately either heat rays, light rays, or chemical rays.

In order to separate heat rays from luminous rays, we utilize the fundamental difference between their action on the bodies they meet. Amongst such bodies, some completely stop the passage of radiant heat and, for this reason, are called athermanous; others, which permit the passage of radiant heat, are called diathermanous. Diathermanous bodies are not necessarily transparent, nor are athermanous ones necessarily opaque. An alum solution allows the light to pass through, but completely stops the passage of heat. Iodine, on the other hand, in solution of bisulphide of carbon, allows the invisible heat rays to pass, but effectively obstructs the light rays. These facts are easily demonstrated. Water will boil by light which has passed through iodine and is concentrated in a glass tube containing water. If the iodine is replaced by an alum solution, the boiling ceases instantly.

Summarizing briefly, it may be stated that :—

1. Luminous radiant heat is made up of different radiations or vibrations, which can be separated one from the other.
2. It can be directed on to a body without raising the temperature of the surrounding atmosphere.
3. It can penetrate glass without diminution of potency.
4. It can be reflected by means of reflectors.
5. It can be so diffused by means of special appliances, that very high temperatures may be attained by the air enclosed in a given space.

The Physiological Action of luminous radiant heat, which is composed of heat, light, and chemical rays, each possessing specific and important properties, is determined by the combined action of all such rays upon the body. This, from the therapeutic point of view, is of much interest, as it is such a combination of rays which in practice is most often brought into requisition.

One remarkable feature at once attracts attention. The human body can bear, with luminous radiant heat, much higher temperatures than have hitherto proved possible by any other application of heat. The complete or whole body bath can be used without danger at a temperature of upwards of 205° C.; this bath is usually given with a temperature ranging approximately from 149° to 205° C., while with the local bath a temperature of upwards of 260° C. may be attained.

At first sight it would naturally be thought that such high temperatures must necessarily be productive of considerable risk to the human organism. In hot-air (Turkish) baths, the temperature rarely rises beyond 79° C. Cutaneous perspiration and respiration are the only means at the disposal of the body for maintaining its temperature under such conditions. This remains equally true when using the Dowsing system, with this very important difference, that the action of the skin and lungs can be raised to the highest possible pitch, because the respiration of the patient is not affected, the air inhaled being of the normal temperature. Cutaneous perspiration is an example of the well-known fact that water cannot be converted into vapour without absorbing and rendering latent a considerable amount of heat. The quantity of water, in the form of vapour, exhaled by the human body has been estimated at 32 ounces per diem. The heat absorbed and rendered latent by such evaporation is, according to the most careful calculations, equal to that which would raise the same weight of water from 0° to 625° C.

Cutaneous perspiration can thus be considered a most powerful agent in regulating the temperature of the human body, and observation demonstrates that it becomes more active, and therefore absorbs more heat, as the temperature around it is raised. But in order to attain this result, it is essential that the air in contact with the skin be kept free from moisture, the presence of which tends to the reduction of the perspiration, and in fact stops it entirely when the atmosphere becomes supersaturated. To ensure the requisite dryness of air, it is therefore essential that some more or less perfect system of ventilation should be obtained. It is for this reason that the ordinary hot-air bath, having no appreciable ventilation, may become a source of no little danger to the patient.

The evaporation which takes place in the pulmonary cavities constitutes a further means which the body possesses for maintaining its proper temperature in a superheated atmosphere. Its intensity is in inverse ratio to the moist condition of the air.

To undergo high temperatures, it is essential that the temperature of the body should remain normal. To accomplish this, the heat which is given off must be almost entirely converted into another form of energy, viz., the latent heat of vapour.

The Dowsing appliances, utilizing luminous radiant heat by direct radiation without heating the surrounding atmosphere, do not increase the temperature of a room, and in no way affect the breathing of the patient ; and by diffusing the heat in a confined space, automatically ventilated, the same results follow. The constant renewal of the air in contact with the body of the patient securing freedom from saturation, enables temperatures, hitherto unknown, to be obtained by the use of luminous radiant heat.

Remarkable potency and uniformity are characteristics of the physiological action of these high temperatures, which have been closely studied by, amongst others, Hedley and Douglas Kerr, of Bath. The results obtained by them, which are very similar to those given by Chrétien, of the Salpetrière Hospital, may briefly be stated as follows :—

Very marked redness of the skin, due to the dilatation of the subcutaneous blood-vessels ; more or less profuse perspiration ; more or less rapid acceleration of the pulse ; speedy, sometimes immediate, alleviation of pain ; temporary increase of the temperature of the body ; increase of the solid matter of the urine, particularly of the urea and uric acid, and greater elimination of carbonic acid by the lungs.

The redness of the skin is not uniform, assuming a red-marbled appearance caused by a dilatation of the blood-vessels forming the capillary network in the cellular spaces of the corium. The cutaneous perspiration differs in patients, but is always more profuse in this than in ordinary hot-air baths. The perspiration increases with the heightening of the temperature and spreads all over the surface of the body, even in local applications, when the area under treatment may be very limited.

The acceleration of the pulse, although variable, is less pronounced than is the case in hot-air baths, and results from the dilatation of the peripheral blood-vessels, which facilitate the action of the heart and permit of more complete and stronger contractions. An hour after a luminous radiant-heat bath, the pulse becomes slower but stronger than before, especially in cases of patients suffering from weak hearts.

The sedative action of the luminous radiant-heat treatment is very marked. In cases of acute gout, its action is

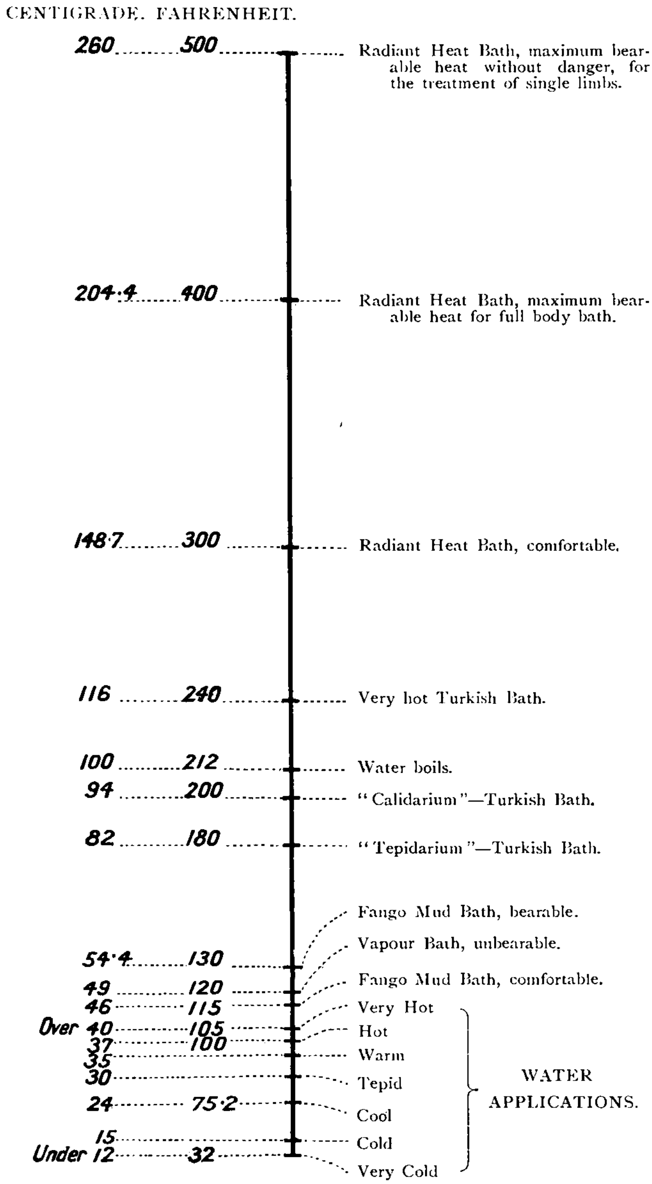


Fig. 43.—Chart Showing Thermometric Equivalents.

practically immediate, freedom from pain being experienced almost, if not quite, from the first application of the rays to the body; in cases of sprains, contusions, articular or muscular rheumatism, and neuralgia, no inconsiderable diminution of pain is experienced from the first, with an increasing feeling of relief after each succeeding application.

In a Dowsing bath having a temperature of about 218° C. and a duration of from thirty to forty minutes, the temperature of the body, taken under the tongue, shows a gradual increase of from six- to eight-tenths of a degree; rarely more than a degree. Within about twenty minutes after the bath the temperature returns to, and remains, normal.

In a Turkish bath, on the other hand, a stay of only ten minutes, with a temperature of about 107° C., is sufficient to raise the temperature of the body, taken under the tongue, more than a degree (Dobson). Twenty to thirty minutes after leaving the bath the temperature has not only fallen to the initial point, but has actually gone below it (Hoppe).

The increase in elimination of the solid matters in the urine, particularly of the urea and uric acid, seems to be mainly brought about by the increase in the temperature of the body, by the more rapid flow of the blood through the expanded blood-vessels, and by the profuse perspiration which is induced. A remarkable feature is that, during a course of the Dowsing baths, it is generally found that there is a greater volume of urine discharged than usual.

There is always a very considerable elimination of carbonic acid from the lungs, resulting in a general stimulation of the digestive organs. There is sometimes a slight acceleration in respiration, but usually it remains normal.

The combination of luminous rays, chemical rays, and heat rays gives to luminous radiant heat properties not possessed by obscure heat. Two experiments made by Bain, of Harrogate, show very important results. In the first experiment, the hind leg of a dog—anæsthetized with ether—was placed in a non-luminous hot-air case. In the second experiment, with the leg under the same conditions, the Dowsing apparatus was used, and the leg exposed to luminous radiant heat. The results obtained in each case were as follows :—

	Obscure or Non-Luminous Heat.	Luminous Heat.
Temperature of the Air in Case ..	150° C.	120° C
Elevation of the Temperature of the Body	·5°	·1°
Elevation of the Temperature of the Limb	1·8°	4·2°

From the physiological point of view, it is not possible to form conclusions applicable to human beings, owing to the difference in the cutaneous functions, but it is nevertheless clear that luminous heat at 120° C. brings about a rise of temperature, both local and general, greater than is produced by non-luminous heat at 150° C., showing that luminous radiant heat possesses greater penetrative power than non-luminous.

Analysis of the various results obtained under the influence of luminous radiant heat enables us clearly to trace its curative effect in various diseases, and its remarkably sedative influence in the alleviation of pain. Hedley has given a very good explanation of this. He takes, as an example, one of the various forms of rheumatic or gouty arthritis, for which the Dowsing baths are specially recommended. Such an example, however, is complicated by conditions peculiar to itself, and it is perhaps simpler to consider the case of, say, a recent sprain, which will illustrate much more clearly what takes place.

As an immediate consequence of such an injury, the distention of the ligaments, the more or less pronounced strain, and the laceration of the fibrous tissue, cause an extravasation of blood in the tissues, and often in the joint itself. A more or less extensive swelling rapidly sets in, followed by signs of local inflammation. The pain is intense, and on the slightest movement becomes excruciating. At the same time, both the larger and smaller blood-vessels become dilated, with, consequently, a larger flow of blood through them than is usual. The dilatation of the capillaries fed by the smaller blood-vessels in question is only proportionately less pronounced, and is brought about primarily by the flow of blood being greater than they can normally contain. The normal difference of pressure between the blood of the capillaries and the lymph contained in the lymphatic spaces increases considerably, and brings about the diffusion of a certain amount of lymph. It is even possible that the capillary circulation may be stopped by congestion brought about by the adhesion of red and white corpuscles; in this case the increased activity of the circulation is followed by stagnation, but the outflow of the cellular elements being very active, their disintegration will rapidly produce coagulation of the lymph surrounding the seat of injury.

The surrounding tissues, which are comparatively much less hurt, become swollen, because the lymphatics are unable to absorb the products of the vascular exudations, and are distended by the lymph, which does not coagulate, since it is no longer in contact with elements in course of disintegration. The painful symptoms result mostly from the pressure produced by an exudation which has no outlet in a joint protected by ligaments and fibrous tissue which cannot expand. The lymphatic system, by extra activity of its absorptive functions, endeavours to counteract this abnormal pressure, but the compensation is not sufficient, and more or less swelling is the rule.

What is the action of luminous radiant heat in such cases? Shortly after submitting the limb to the influence of luminous radiant heat, the skin becomes red, and profuse perspiration sets in. The redness of the skin is due to the dilatation of the cutaneous blood-vessels, whilst the perspiration results from: (1) The dilatation of the blood-vessels, particularly of those capillaries which are in intimate relation to the perspiring and sebaceous glands and follicles; (2) The direct stimulation of the cellular elements and glands by the various radiations.

Therapeutic Indications.

All affections which are benefited by hot-air baths, whether local or general, are very successfully treated by luminous radiant heat. Owing to the perfection in ventilation attained by the Dowsing apparatus, it is possible, without risk, to submit patients to temperatures varying from 150° to 232° C. in the complete—or whole-body—bath, while with the appliance for local baths, a temperature of upwards of 260° C. may safely be given.

The physiological action, proved by numerous actual tests, enables the results which may be anticipated in the treatment of various affections to be set out with a very considerable degree of certainty. They are as under :—

Gout.—A single bath is often sufficient to cause a very considerable alleviation of pain in cases of acute gout. The sedative effect usually begins to be felt at a temperature of about 171° C. and continues for several hours after the bath, which usually lasts for from thirty to forty-five minutes. When the pain returns, it is always less severe. Douglas Kerr usually prescribed a Dowsing complete bath in the morning, and a local application at mid-day. The duration of the severest attacks is then reduced to a few days.

Immediately after the commencement of the treatment it is noticeable that the urine becomes more abundant, and richer in urea, urates, and uric acid.

In cases of subacute or chronic gout, not only is there alleviation of pain, but often the deformities of the joints, so characteristic of this affection, become less pronounced, and even disappear entirely, while the improvement in the functions of elimination has a rapid and favourable influence on the general health of the patient.

Rheumatism.—In a case of polyarthritic febrile rheumatism, where salicylates and antipyrin did not seem to give very appreciable results, a Dowsing bath of 150° C., lasting on an average about twenty minutes, was given daily. There was an almost immediate alleviation of pain, the swelling decreased, the temperature was lowered, and the volume of urine augmented. The illness lasted for a period of twelve days, but the pain was very considerably diminished from the time of the first application of the luminous radiant heat, and convalescence resulted without any complications. It is, of course, not possible to draw conclusions from any single observation, but the results in this case were such as to justify recourse to similar treatment under like conditions.

In the different forms of rheumatism—chronic, articular, muscular, blennorrhagic, and senile arthritis—the sedative action of the luminous radiant heat in the alleviation of pain is very marked, while the inability to move the affected limb gradually disappears.

Bruises, Sprains, etc.—In the treatment of these affections, luminous radiant heat has proved of signal service, especially for football players, by whom it has been extensively and most successfully used.

Phlebitis.—In cases of phlebitis, even where the œdematous swelling is at a chronic stage, radiant heat treatment is excellent. After a single bath there is a marked reduction in the size of the part affected, while continued applications result in the normal condition being restored.

Rheumatoid Arthritis.—According to Kerr, at the initial stage, even at the time when the attacks are most acute, there is a rapid improvement in the flexibility of the joints and in the general condition of the patient, who not infrequently gains in weight during the course of treatment. At a more advanced period, when the joints have become deformed and there is a cessation of pain, the application of luminous radiant heat is of itself ineffectual, but if the adhesions are broken, either gradually or suddenly, and a Riss bath taken immediately thereafter, the result is a considerable diminution of the deformity, and, after subsequent baths, some recovery of the flexibility of the joints.

Sciatica.—In sciatica the results are often at variance with one another. All experience a considerable amount of relief during the bath ; some are quickly cured, while others, on the contrary, have a recurrence of sharp and acute pain. These differences are probably to be accounted for by insufficient diagnosis ; for instance, it is known that, whatever be the form of treatment, the same results are not obtained in cases of neuralgic as in those of neuritic sciatica.

Nephritis.—The utility of the radiant-heat bath in cases of nephritis consists in the profuse perspiration which it induces, thus relieving the work of the kidneys.

General Affections, such as obesity, anæmia, general debility, and predisposition to rheumatic affections, are all beneficially influenced by the action of luminous radiant heat on the functions of nutrition, respiration, and perspiration. It has also been shown that the luminous rays increase the number of the red corpuscles in the blood and their power of oxygenation.

SUMMARY.

The physiological action of the radiant-heat bath may be briefly summarized thus :—

1. Very marked redness of the skin.
2. Very abundant perspiration and the elimination of considerable quantities of carbonic acid by the lungs.
3. Acceleration of the pulse and increase of temperature —these two phenomena are less marked in proportion than in the Turkish bath.
4. Increase of the volume of solid materials of the urine, especially of the urea and uric acid.
5. Greater activity of the functions of general nutrition, and the elimination of organic oxidation products.
6. Penetrating power of the heat rays much greater than that of obscure heat.
7. Marked excitation of the skin by the chemical rays, which possess pronounced bactericidal properties.
8. Special action of the luminous rays on the red corpuscles of the blood, augmenting their number and thus increasing their power of oxygenation.

The Dowsing Radiant-Heat Baths.—In 1896, H. J. Dowsing, an electrical engineer, invented an apparatus which transformed electricity *in vacuo* into radiant heat.

Special electric lamps constituted the source of luminous radiant heat. The electric lamp is formed of a filament contained *in vacuo*, within specially prepared glass bulbs, or tubes of various shapes, according to requirements. They are equally suitable for either continuous or alternating currents, and for any voltage. Instead of, as in ordinary lamps used for lighting purposes, producing light without appreciable heat, powerful heat rays as well as light rays are emitted. The heat rays are of such intensity that a thermometer placed between two lamps provided with reflectors, and separated by a distance of some sixteen inches, registers almost immediately about 204° C. The electric current, before reaching the lamps, passes through a variable resistance, which serves as a regulator, by means of which any desired temperature may be obtained.

The lamps are fixed in highly burnished reflectors of suitable formation, and are easily adjustable to any position necessary to direct the luminous radiant-heat rays either on any desired part, or on the whole, of the body (*See Fig.* 44 *and Plate XIX*). The curve of the surface of reflection must be such that the heat rays emanating from the lamps are prevented from striking against the glass;

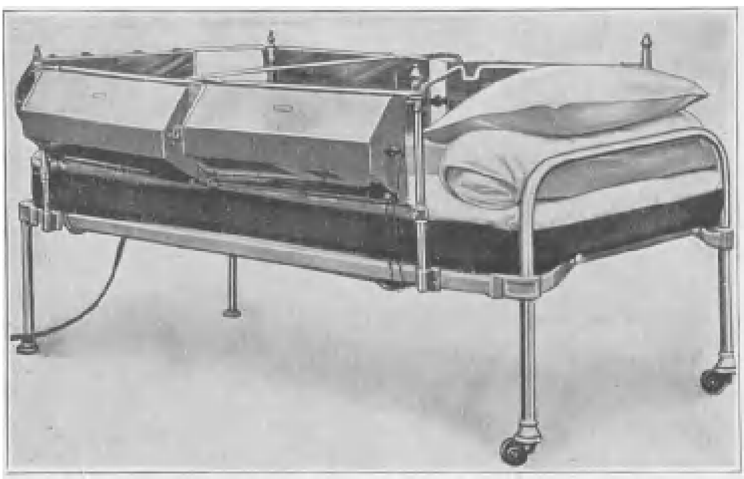


Fig. 44.—Dowsing Luminous-heat Apparatus.

otherwise, owing to the very high temperature obtained, the lamp might be injured.

The appliances thus permit of the application of luminous radiant heat as already mentioned :—

(*a*) By direct radiation without heating the surrounding air.

(*b*) By diffusion in an enclosed space, automatically ventilated, thus heating the air within such enclosed space.

(*c*) By the utilization of certain determined radiations to the exclusion of others.

Appliances for Direct Radiation without Heating the Surrounding Atmosphere.—One or more Dowsing lamps are mounted with reflectors, which, by the diversity of their forms, permit of the limitation of their radiation activity to certain parts of the body, to more or less extended portions, or to the whole of the body.

The reflectors, mounted on a vertical and movable stand, can be fixed at different heights. One can thus easily direct the luminous radiant-heat rays on any part of the body of a patient, sitting, standing, or reclining (*Fig.* 45). There being nothing in the nature of an enclosure, and the temperature of the room being in no way raised, the patient breathes

Fig. 45.—Direct Radiator applied to Back of the Neck.

the normal atmosphere—a point of no inconsiderable advantage. This method of treatment is comparable to a sun bath, with the added convenience that, by means of a rheostat attached to the appliance, the intensity of the heat can be increased or decreased as may be required or desired.

The Leucodescent Therapeutic Lamp.—This is one of the best and most powerful appliances for the administration of radiant heat at present available. It consists of a high electric-power lamp (300 to 500 c.p.) placed within a cylindro-conical metal hood. This hood is lined with a highly polished nickel-plated surface—*the reflector*. The top of this dome-like hood is formed by a corrugated aluminium plate, which is called *the condenser*. This does not become tarnished, because aluminium is not affected by ordinary corrosive substances.

The nickel-plated reflector, however, especially the conical portion, which is of such great importance in crossing and recrossing the millions of light rays, must be kept bright. This is absolutely essential if the full power of the lamp is to be maintained, and is easily effected by the regular application of a little plate powder on a chamois leather. The incandescent lamp is kept in its position by means of two binding posts connected by suitable wires with the main.

Attached to one side of the hood is a wooden handle for manipulating the apparatus. By means of this the lamp may be readily swung to and fro, as it is carefully balanced by a special mechanism. On the side opposite the handle is a circular window in the hood through which the operator may view the surface under treatment. The rays obtained from this lamp are to all intents and purposes intensified sunlight, combining all the physical properties of light and heat.

Appliances for Diffusion of Luminous Radiant Heat in an Enclosed Space.—The lamps, fitted with special reflectors, are fixed in an enclosed space, varying in size and arrangement, according as the treatment is required for only a part, or for the whole, of the body (*Fig.* 46). It must not be understood by the term "enclosed space" as here used that the circulation of the outer air is completely suppressed. Perfect ventilation is necessary, and is secured, in order to eliminate as much as possible, and as soon as formed, the perspiration from the body brought about by the very high temperature to which the patient is subjected; the automatic ventilation provided in the Dowsing apparatus is amply sufficient to keep the patient's skin perfectly dry.

There are also appliances for administering the heat by direct radiation without raising the temperature of the atmosphere surrounding the body.

The complete body bath consists of a bed fitted with asbestos-lined mattress and blanket, and having five reflectors, each containing two Dowsing lamps, with rheostat for regulating the current. The reflectors are fixed on metal rods, easily movable, supported by standards resting on the floor or fixed to the sides of the bedstead. The patient, being undressed, lays himself upon the mattress, and is covered with the asbestos-lined blanket, and the head only being exposed, the patient breathes the normal atmosphere of the room. The current is then turned on, and by means of the rheostat, the air within the enclosed space is brought up to the requisite temperature. The local baths for the various limbs are, of course, on a smaller scale, and are made of special shapes for treating deformed limbs, etc. The apparatus for the leg or foot

Fig. 46.—Local Radiant-heat Cabinet.

can be placed on a stand of suitable height, while that for the upper limbs is fixed on a stand which can be adjusted in any direction.

In all local baths, when using the asbestos-lined blanket, the luminous radiant heat acts, not only by radiation, but also by superheating the air in the enclosed space; otherwise the radiation is direct, without in any way affecting the temperature of the surrounding atmosphere.

For all local applications other than of the limbs, the apparatus or appliance consists of a lamp and reflector attached to a movable stand, the arrangement of which is such that, by means of swivels and ball-and-socket joints, the reflectors may be moved and the rays readily directed on any part of the body.

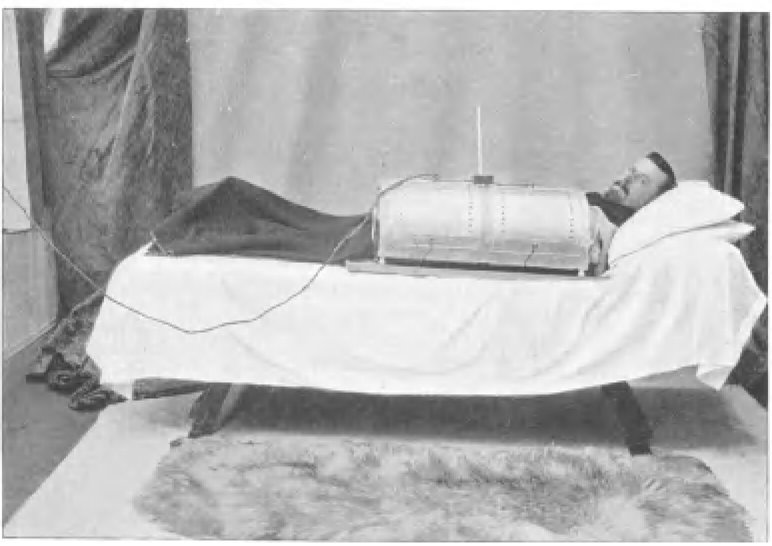
Appliances for the Utilization of Certain Determined Radiations to the Exclusion of Others.—For this purpose a contrivance in the nature of a highly burnished metallic cone is used, within which is placed a Dowsing lamp so arranged that the rays are concentrated at the apex, where screens of various colours can be fixed to allow the modified rays to pass. A red glass screen stops the chemical rays, and an alum solution cuts off the heat rays. A solution of sulphate of copper held between two crystal glass plates will allow chemical rays only to pass. This is a feature in therapeutics which is still in its infancy, and it is well worth the attention of medical men. The remarkable results obtained by the late N. R. Finsen, of Copenhagen, tend to show that much may yet be expected from it.

The Greville Electro-thermic Generators.—These apparatus are usually made of aluminium, and are designed for treatment of the whole body (with the exclusion of the head), or any region in particular (*Plate XX*) ; indeed, one of the main features of the system is the ease with which heat may be applied to any portion of the body affected. The heat is produced by the flow of electricity through sections of naked wire made of a non-oxidizable metal or compound of metals. The wires (arranged like harp strings) are wound upon porcelain insulators attached to the back of the generator, while the front or inner side is of perforated sheet aluminium. A temperature of 200°-250° C. is easily obtainable, and is under absolute control. The electric current may be taken from the ordinary lighting mains or from accumulators.

In this system the rays convected from the naked wires are of heat-giving properties only. In fact, the main difference between the Greville and the Dowsing radiant-heat baths is that in the former the invisible rays beyond the red in the spectrum are alone used, while in the latter the light rays are used. These ultra-red rays have been found to contain the maximum amount of heat, and no injurious chemical rays are permitted to enter the generator.

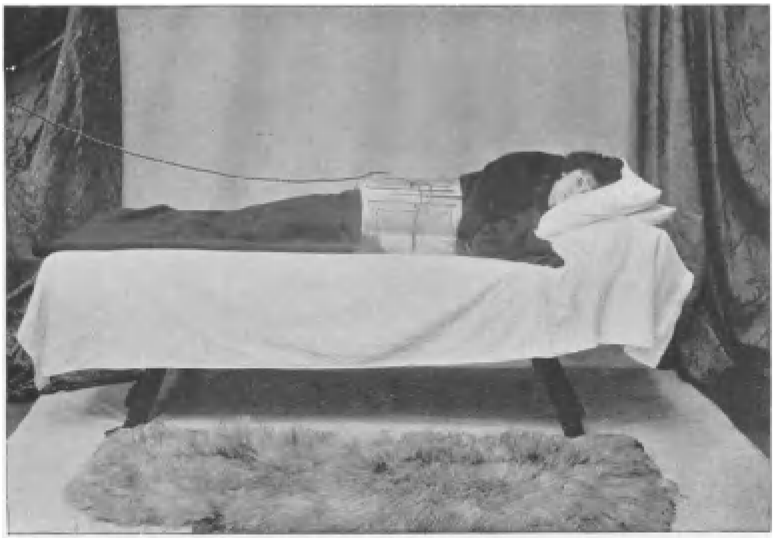
PLATE XIX.

Shoulder and Foot Treatment by Greville Generator.



Greville Generator for One Arm in use.

PLATE XX.



Greville Generator for Hip in use.

Greville Generator for Whole Body in use.

CHAPTER VIII.

HOT-AIR, STEAM, AND TURKISH BATHS.

THE HOT-AIR CABINET BATH.

THE essential difference between this and the Turkish bath is that the head is excluded from contact with the hot air, so that the whole body is exposed to dry superheated air, while the patient breathes in a comparatively

Fig. 47.—Hot-air Cabinet, heated by Electrical resistance wires.

cool atmosphere. Many portable and inexpensive forms of the bath are sold, made of waterproof cloth stretched on a wooden or metal frame, and these are often perfectly efficacious. There are also more elaborate wooden cabinets constructed, lined with zinc or cork (*Fig.* 47).

Electricity is the most suitable means to heat the air, because the temperature is easily under control, and can be increased up to about 150° C. (the exact amount can be read off on a thermometer). The air is quite dry, and not vitiated by any vapours of burning gas or oil, and the patient breathes air of ordinary temperature.

The heat is generated by the electric current passing through suitable resistance wires, which are wound over porcelain frames so that the air has free access. A smaller or greater number of these electric stoves can be switched on to regulate the temperature.

The cabinets are made either for the whole body or only for an arm or leg. Other sources of heat employed are small gas stoves, spirit lamps, steam coils, or paraffin stoves. Some of these are not free from risk, and more than one patient has been severely burnt. The electric method or the steam coil is certainly the best. If a lamp or stove be used, it must be lighted before the patient enters the bath. The bath may be administered to a patient in bed, by using a special frame and covering, under which a tin pipe is led to conduct the hot air. This is a common hospital device.

The temperature of the bath should vary from 65° C. to 120° C., and the duration may be from six minutes to one hour, according to circumstances. The maximum beneficial effects can be obtained in the generality of cases in thirty to forty minutes.

Before entering the bath, the patient should remove all his clothing, and wrap up in a blanket or large Turkey bath sheet while waiting. Before and during the bath, water, hot or cold, should be freely drunk. The head should be enveloped in a cool, damp cloth.

On leaving the bath, the patient is given a spray or rain douche, and if necessary a vigorous reaction insured by friction. In rheumatic cases it is sometimes well to prolong the perspiration in a gentle form by enveloping the patient with warm blankets, and merely finish off with a cool sponging.

Therapeutic Indications.

Hot air is of great value in the treatment of obesity, uric acid diathesis, fatty glycosurics, neurasthenia, or indeed any auto-intoxication. Many organic forms of chronic nervous disease, as locomotor ataxia, are materially benefited by the use of hot-air baths, even though we admit that *cure* is out of the question. Various anæmias also are helped, care being taken not to employ too high a temperature or unduly prolong the bath.

All morbid conditions dependent on congestion of the various internal organs are improved by judicious employment of this bath. In actual hyperpiesis particular care is necessary in prescribing it, however, and the head should be invariably kept cool by means of an ice bag or towel wrung out of ice-cold water.

THE STEAM CABINET BATH.

This is identical with the Russian vapour bath, except that, instead of being shut in a room into which the steam is introduced, the patient sits in a cabinet with his head excluded (*Fig.* 48).

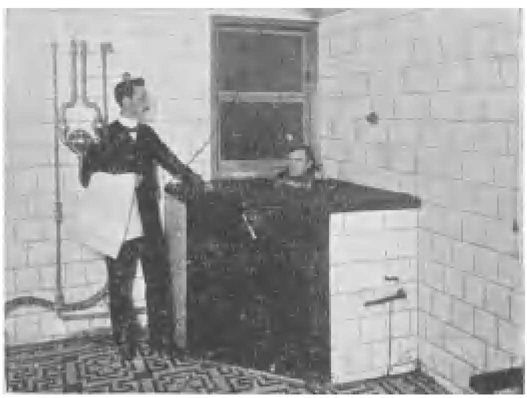


Fig. 48.—The Steam Cabinet.

The cabinet, usually made of wood, should be practically steam-tight. The steam may be generated in the cabinet itself or, which is better, conveyed from an outside source.

The patient may be vertical or horizontal, and sits or lies on a latticed wooden seat, under which run pipes with small perforations by means of which the steam enters. The temperature of the bath rises in direct proportion to the rapidity with which the steam enters. The temperature desirable is from 50° to 55° C. The patient can tolerate higher temperatures after a series of baths. No sensation of burning is experienced when once free diaphoresis has been established. As in all such procedures, the head of the patient must be enveloped in a damp towel. Diaphoresis is hastened and increased if water be freely drunk.

On leaving the cabinet, the patient should have a spray or rain bath, beginning with water at 30° C. and cooling down to 15° or 12° C.

Duration of the Bath.—On the average from fifteen to thirty minutes. Brief exposures of two to five minutes are employed as a preliminary to a Turkish bath or cold stimulating applications. Baths of over thirty minutes' duration should not be employed except in the case of very robust patients.

Physiological Effects.—After a short application the cutaneous vessels become dilated and the body surface warm. In five or six minutes perspiration begins, and the skin reddens. The body temperature rises, respiration and pulse are accelerated, and metabolism is increased. The white blood corpuscles are almost always increased, but the red diminish, unless a relative increase takes place owing to inspiration of blood from much fluid loss. There is loss of body-weight, varying with the duration of exposure, and often amounting to several pounds.

Therapeutic Indications.

Brief baths are employed in anæmia and neurasthenia, while more prolonged baths are of service in various constitutional dyscrasia, in rheumatic affections, uric acid diathesis, chronic renal disease, and in various skin affections, such as psoriasis. In common colds, chills, and febrile affections, the diaphoresis induced is also useful.

Generally speaking, febrile diseases are a counter-indication, as are also organic nervous diseases (if we exclude some of the parasyphilides at an early stage, and chronic arterial degeneration).

PLATE XXI.

THE CALIDARIUM. TURKISH BATH.

PLATE XXII.

The Cooling Room. Turkish Bath.

THE TURKISH BATH.

The Turkish bath is a very ancient procedure, and dates from the time of the Roman Empire. To-day, in various parts of Italy, in Rome and elsewhere, the ruins of such baths, used in the time of Nero, may be seen. In Jerusalem a bath of this nature, built at the time of Herod is still used regularly, after nearly two thousand years have elapsed. Practically every nation and country has some peculiar form of a "sweating bath," some of which are extremely dirty and unpleasant. Probably the Turkish bath is the most elaborate and luxurious type of this variety of bath. In the modern form it consists of a series of rooms comprising at least the following compartments :—

1. The *Tepidarium*—a room heated to a temperature of 44° to 54° C.

2. The *Calidarium*—a room heated to a temperature of 65° to 93° C. In some cases there is an annexe to this apartment heated up to 120° to 150° C., but in smaller suites this is usually dispensed with (*Plate XXI*).

3. The *Shampoo Room*, which is furnished with marble slab, douche apparatus, etc., and attached to this room is frequently found a plunge or swimming bath at a temperature of 12° to 15° C. for the more vigorous patients to use as a final measure in cooling.

4. The *Cooling and Dressing Room*, with suitable couches for patients to rest on from forty minutes to one hour after a bath (*Plate XXII*).

The rooms are heated by means of a furnace, or indirectly by a steam heater. Ample provision must be made for ventilation, for inefficiency in this respect will cause much oppression and headache to those using the bath. The outlet for foul air should be near the bottom of the room, communicating with a ventilating shaft. If heated by hot air, the opening for its admission is best placed at a point two or three feet above the level of the floor.

Technique.—The patient, having removed all his clothing with the exception of the loin cloth demanded by modesty, drinks a glass of water and lies down on a couch in the tepidarium. A moist cloth is often placed around the head.

The time which elapses before the onset of perspiration varies greatly in different subjects, but, on an average, some moisture appears on the skin in from 10 to 15 minutes, and very soon the patient is perspiring profusely. When perspiration is slow, the activity of the skin is increased by the brisk application of friction gloves.

Two or three minutes spent in the Russian bath or steam-box prior to entering the Turkish, soften the skin and facilitate a good sweat. The feet may further be placed in a hot foot-bath and hot water freely imbibed. Such patients as do not perspire even with these adjuvants usually experience a good deal of oppression and discomfort; the skin becomes very dry and hot, and they should be removed from the bath, or they may become seriously upset. These cases, however, are the exception.

Perspiration having been properly established, the calidarium or second room may be entered, and profuse perspiration allowed for about ten minutes. Many people are unable to stand the intense heat of the third room even for a few minutes, but hardened veterans enjoy it.

A suitable amount of diaphoresis having taken place, the patient enters the shampoo room and lies down on the slab. He is briskly massaged from head to foot, much superficial epidermis, already loosened by the perspiration, being thus removed. Lathering follows, hot soapsuds being ladled on to the skin and well rubbed in with a loofah, preferably brought by the patient, so as to avoid the possibility of infection. The shampooing is a most comforting process, and is continued until the skin feels smooth and polished. A douche or spray douche, from 25° C. down to 15° C., or even lower, is now applied. This has a tonic effect, and also serves to completely remove the soapsuds. The plunge bath may be taken or omitted, according to circumstances, and then the patient, wrapped in a warm sheet, lies down in the cooling room until the pulse is normal and the skin thoroughly dry. A cup of coffee at this stage is beneficial and refreshing in many cases.

Where the object is reduction of weight, a daily Turkish bath up to one hour in duration may be employed, but for the average person three a week are amply sufficient, and with feeble patients these must be of brief duration.

Physiological Action.—The sweat-glands are powerfully stimulated, and the amount of secretion may rise from the normal $1\frac{1}{2}$ oz. per hour to several pounds per hour. A loss of 2 lbs. in weight is quite common after a full Turkish bath. Unless the patient drink water freely, the blood volume will be considerably reduced in these circumstances, and cardiac enfeeblement result. Blood is withdrawn from liver, spleen, and all the internal organs, and the absorption of fluid from the intestines which takes place leads to subsequent constipation in some cases.

By the inhalation of the hot air, the pulmonary mucous membrane is excited to secretion to some extent, rapid volatilization occurring. The respiration is mainly thoracic.

The cardiac beats quicken and the mean blood-pressure rises soon after the bath is entered, and some fullness in the head and discomfort may be experienced, lessened by the foot-bath mentioned above. The mean blood-pressure falls and the pulse slows with the onset of perspiration. The rise in body-temperature is so slight as to be negligible in the majority of cases. In very obese persons this may not be the case, however, as the heat loss in such cases is not proportionate to the heat gain. Kellogg points out that such patients have much smaller skin surface in proportion to their weight than spare individuals.

Therapeutic Indications.

These are practically the same as the hot-air bath, but the Turkish bath cannot be employed for many cases for which the hot-air bath is quite advisable. It is contra-indicated, e.g., in arteriosclerotic conditions, cardiac asthma and dilatation, exophthalmic goitre, in patients with unusually high blood-pressure, and in advanced renal disease.

CHAPTER IX.

PHOTOTHERAPY.

IT has been shown that sunlight is made up of various kinds of rays, and the existence of the following have been clearly demonstrated: (1) Heat rays; (2) Light rays; (3) Chemical or actinic rays.

The heat rays, although invisible, make a powerful impression on the cutaneous nerves. They are found in the red portion of the spectrum; while the light rays are in the yellow portion, and the chemical rays in the violet and ultra-violet portions. Chemical rays are invisible, but act on the skin. By various devices any of these elements in a sunlight ray may be picked out or eliminated.

The electric arc light and sunlight are very similar, the former containing more actinic or chemical rays in beams of equal luminosity. The incandescent light contains a large portion of heat rays. The effects of exposure to light are due chiefly to the action of the chemical and thermal rays. The powerful effect of light on plant life is shown by the manner in which plants, leaves, or flower-stalks bend towards the origin of the light in their growth. Light rays are powerful for good or ill, however, and as is well known, concentrated sunlight will scorch and destroy plant life.

On animal life the action of the chemical rays is well demonstrated in sun-burn in man, and the darkening of the white coat of animals long exposed to sunlight. The pigment in the skin of races resident in tropical zones is largely a protective measure.

Action of Light on Metabolic Processes.—The output of CO_2 is increased in all animals when exposed to light; all tissue changes are more rapid, and if food be withheld more weight is lost in daylight than in the dark. The metabolic processes of prisoners confined in solitary, darkened cells, fed on a scanty supply of bread and water, are sluggish in the extreme, with resultant mental depression and sense of humiliation. This also has much to do with the occurrence of cretinism in the deep, sunless valleys of Switzerland.

Tissue oxidation is unquestionably increased by sunlight in all living creatures, and in the human species this is due to reflexes set up by the stimulation by light rays of the nerve endings in the skin.

Exposure to powerful sunlight causes headache and vertigo, due to too powerful stimulation of the optic nerve; similar results are seen after prolonged exposure of the naked trunk. Black races are protected against the actinic or chemical rays by the pigment in their skin, which is impenetrable to these rays, and a white man can acquire temporary immunity similarly by the application of some black water-paint.

Sunstroke is of course due to over-exposure of the central nervous system, head or neck being insufficiently covered, to strong sunlight. In Europeans, a very brief exposure suffices, but in the native races some immunity is acquired by the nervous system becoming so far habituated to the special stimulus. In India it is not uncommon, even at noon, to see natives stretched on the ground asleep, absolutely unprotected against a scorching sun.

The functions of the skin are all stimulated by such exposure to the sun's rays, irrespective, to some extent, of the temperature of the surrounding air. Profuse perspiration is induced by the action of the chemical and the heat rays, the latter being most concerned. Toxic substances in the blood may be thus got rid of, but further light has a most powerful germicidal influence, rapidly killing parasites, fungi, and several of the more virulent types of bacteria.

Therapeutic Application of Light.—(1) Sunlight; (2) Electric light: (*a*) arc, (*b*) incandescent. It has been clearly demonstrated that the nature of these forms of light is the same, irrespective of the source, although the latter is of importance in considering the questions of convenience in practical application and the therapeutic results.

Sunlight contains all these types of rays in abundance; of electric lights, the arc resembles it most. The incandescent light contains about 90 per cent of heat rays, the balance being made up of small proportions of luminous and chemical rays. In this country the use of this bath is largely restricted to the indoor form, owing to the low temperatures prevailing at most seasons of the year.

The only sanatorium in Great Britain with an open-air sun bath is Peebles Hydropathic (*Plate XXIII*). Here, in suitable weather, the more vigorous types of patients lie out on couches, clad in a waist towel only, for half an hour or more. They may walk about, indulge in the health-giving skipping so warmly advocated by Dr. F. T. Bond, of Gloucester, or use light dumb-bells, and so increase oxidation to as high a degree as possible; at the same time keeping comfortably warm. Instead of couches, a sand-bed or bank is very useful, and is employed at Battle Creek Sanatorium (*Plate XXIV*). The sand is always warmer owing to the prolonged exposure to the sun. In private houses a flat roof free from observation from higher altitudes may be utilized, and in many places small roofless huts of suitable size and altitude.

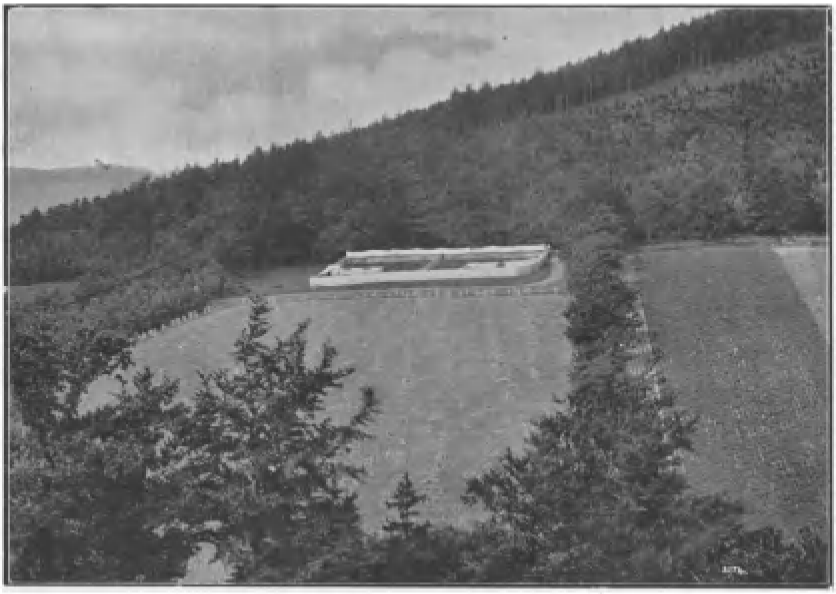
The Indoor Sun Bath.—The indoor sun bath is often more convenient in this country, and can be easily arranged, given a suitable south exposure and sufficient degree of sunlight (*Plate XXIII*).

Since the valuable ultra-violet rays are absorbed by glass, it is necessary that the windows in the room used open on a hinge, *à la Française*. Apart from the head, which should be suitably protected by a moist towel or wrapping of some sort, the greater the surface exposed to the sunlight the better. But this will depend on different circumstances, such as the degrees of warmth and sunlight, and the strength of the patient.

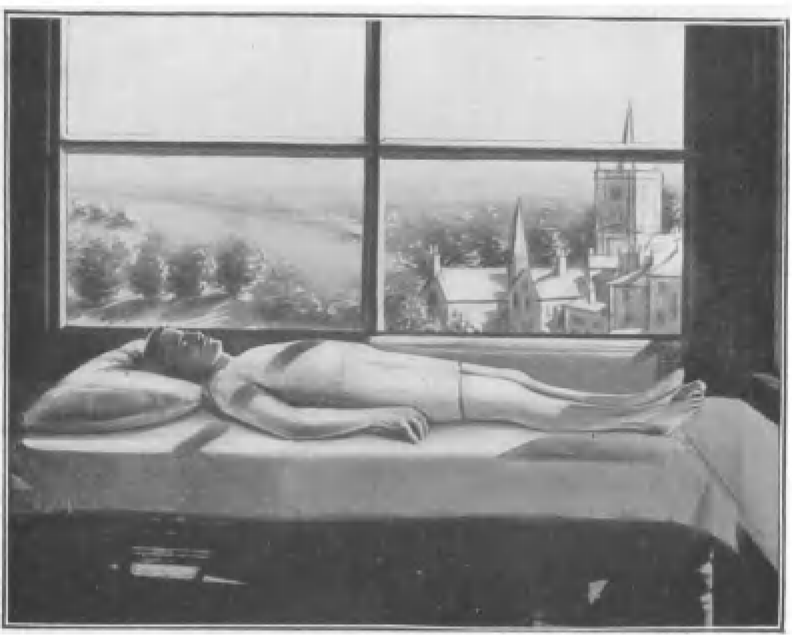
When localized applications are desired for any special affection, the parts of the body not exposed should be merely covered with a white sheet or blanket.

The duration of the bath varies greatly. It will depend on the season of the year, the climate in which it is employed, and the prevailing weather conditions. At the start three minutes are often sufficient for a feeble patient. Caution is always needful, for too long exposure will cause headache,

PLATE XXIII.



Open-Air Sun Bath (Peebles).



Indoor Sun Bath.

PLATE XXIV.

THE SAND BATH AT BATTLE CREEK.

lassitude, and depression if the sun be hot, and possibly a severe chill or even pneumonia if the air be cold.

Individuals with dark hair and complexion are less sensitive to the influence of sunlight than fair, blue-eyed people, and for the former the exposure may often be allowed for half an hour or more without harm resulting. Custom counts for a great deal, too, and after the training and toning up afforded by a series of baths, exposure for two or three hours daily can often be tolerated and enjoyed. The skin usually darkens considerably, from increase in pigment.

In northern temperate latitudes, the intensity of the sun's rays is greatest from mid-June to mid-September, and the intensity always increases with the altitude.

After-treatment.—At the conclusion of the bath, the patient should be taken in hand by an attendant and given either a wet-sheet rub or a cooling spray or douche, or in the case of robust and vigorous patients, a plunge and short swim is a beneficial termination.

Temperature of the Patient.—The patient's temperature should be taken immediately before, during, and after the sun bath. The temperature usually rises from ·5 to 1° C.

In individuals who perspire freely the temperature usually rises but slightly, but in persons with dry skins, such as chronic dyspeptics, diabetics, and those suffering from extensive scleroderma, a higher temperature is soon shown.

Physiological Effects.—The reaction induced by a sun bath represents the effect of the combined influence of the thermic, luminous, and chemical elements of the sun's rays.

The heat rays elevate the body temperature just as the hot air or steam do in the hot-air or vapour bath cabinet, either by causing an accumulation of heat or preventing its escape by radiation and evaporation. All the organs of the body are stimulated, and the metabolic activity is increased. There is increased oxidation of proteid substances, increased consumption of carbohydrates and fats, and increased output of CO_2 correspondingly. The cutaneous vessels are dilated, the sweat glands rendered more active, and the actual amount of sweat may rise from the normal average of 1½ oz. per hour to 2 or 3 lb., particularly if the patient is taking exercise (*vide supra*).

The blood is markedly diverted from the internal organs to the skin surface, and these viscera thus rendered anæmic *pro tem.*; the patient is often rendered very drowsy by the cerebral anæmia. Finsen has further shown that the chemical rays are equally active as regards the nervous system, and have a markedly tonic influence.

Therapeutic Indications.

It will be seen at once that all cases in which defective metabolism participates in the cause of morbid conditions are, *cæteris paribus*, a fair mark for sun baths. Among the most common of these are dyspepsia, diabetes, obesity, and that congeries of symptoms included under the phrase "uric acid diathesis," with which possibly uric acid has very little to do. In anæmic conditions, the hæmopoietic centres are stimulated, toxins are eliminated, and an accompanying and often resulting neurasthenia is relieved. In some forms of renal disease, hepatic congestion, and early cirrhosis, benefit is frequently derived. In tuberculous conditions a noticeable improvement is also seen, when the climate permits of the sun bath forming part of the open-air régime now so universally employed.

Even skin diseases such as eczema and psoriasis are found to benefit; but it will be obvious that in such cases there will be objections to "mixed bathing"!

Caution.—Care must be taken not to unduly expose cardiac cases, and special precautions to keep the head cool are necessary in patients suffering from insomnia.

THE ELECTRIC-LIGHT BATH.

Electric light is possessed of properties identical with those of the sun's rays. Both the arc and the incandescent lights may be employed for this bath: in the former the luminous rays predominate, in the latter heat rays.

In the forms of electric-light baths used in the United States in the early eighties, a single reflector was placed at the back of the bath to focus the rays on the patient.

Physiological Effects.—As a result of a series of experiments carried out by him, Siemens arrived at the following conclusions:—

1. Electric light has the effect of producing chlorophyll in the leaves of plants and promoting growth, and of favouring protoplasmic activity.

2. The action of the artificial light is identical with that of daylight.

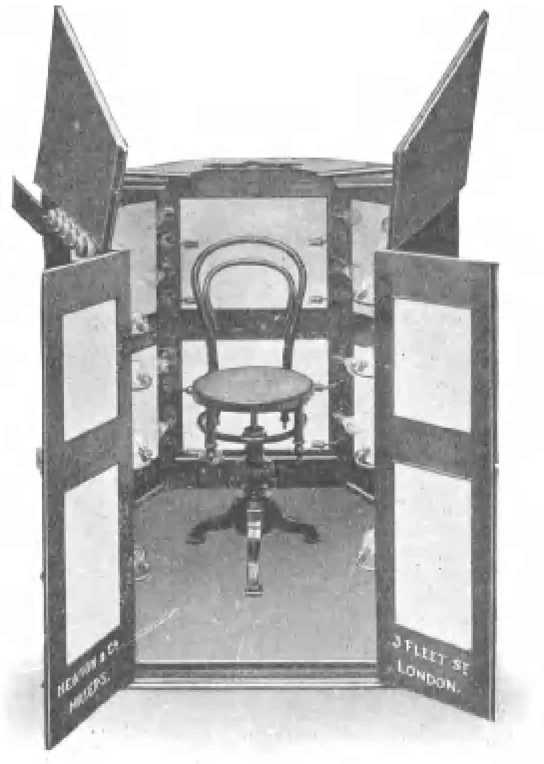


Fig. 49.—Vertical Electric-light Cabinet.

3. Under the influence of electric light, plants were able to sustain increased stove-heat without collapsing, showing the influence of light as a vital stimulant. These observations were confirmed by Sarat, Prillieux, and others.

It has been found that bacteria are killed in a few minutes by exposure to the concentrated rays of a 6000 candle-power lamp.

On the skin, the application of electric light has the same effect as sunlight, producing free perspiration, pigmentation and erythema.

The Incandescent Electric-light Bath.—This is the most convenient and commonly used form. The most elementary type consists of a frame on which are supported a metal reflector and a large number (20 to 30) of lamps. The patient is laid or seated opposite to this, and one surface of the body is exposed; later, he is turned round and receives the application of the light on the opposite side.

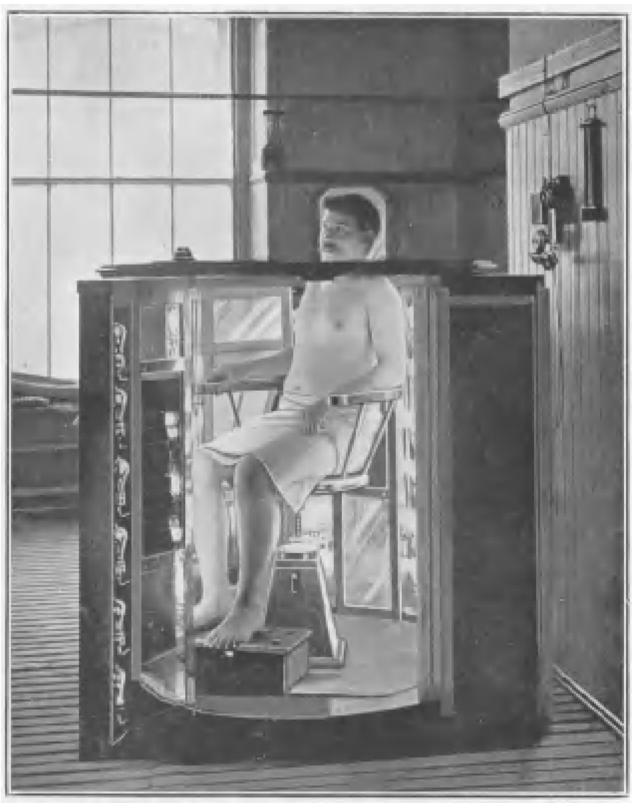
The Cabinet form (vertical) of bath, as devised by Winternitz, is now commonly used (*See Fig.* 49 *and Plate XXV*). The patient sits in the cabinet with his head excluded, while the naked surface of his body is exposed to the action of from 20 to 40 lights for a period of from fifteen to forty minutes; for a merely tonic effect three to ten minutes will suffice. If it is desired to make the skin act freely, so as to have an eliminative or diaphoretic action, the patient is allowed to perspire freely for half an hour or more.

A disadvantage of the vertical form of cabinet is that the patient has to sit in a somewhat constrained upright position. This is rendered unnecessarily uncomfortable by the tendency of the makers to put the hole for the patient's head absolutely in the centre of the bath, whereas it would be better if nearer the posterior wall, with the whole cabinet sloped somewhat backwards. For patients who are delicate and who have any tendency to faint, the horizontal cabinet (*Fig.* 50) is to be preferred, and it is at all times more comfortable.

Precautions.—The feet of the patient should be warm—if necessary by the use of a warm foot-bath—and head cool; a damp towel may be wrapped around it turban fashion. This should be freshly immersed in cold water and re-applied as often as it becomes warm.

The temperature of the bath may range from 65° C to 150° or even 200° C. The heat is applied to the body by means of the radiant energy of the incandescent lamps, and not by the air, through which the light passes without heating it to any great extent. It follows, therefore, that the actual temperature of the air surrounding the

PLATE XXV.



THE ELECTRIC-LIGHT BATH.

patient is of very little moment. The less moisture there is present in the air contained in the cabinet the higher will the temperature tolerable to the patient be. Good ventilation of the bath is therefore essential in order that the moisture arising from the patient's body be carried off. The intensity of the bath is regulated by means of switches for increasing or lessening the number of lights, or by a rheostat.

After-treatment.—The patient, on completion of the application, is lathered down with soap-suds and douched or sprayed with warm water, gradually brought down to cold, and then wrapped in a warm sheet and allowed to cool off and rest on a couch.

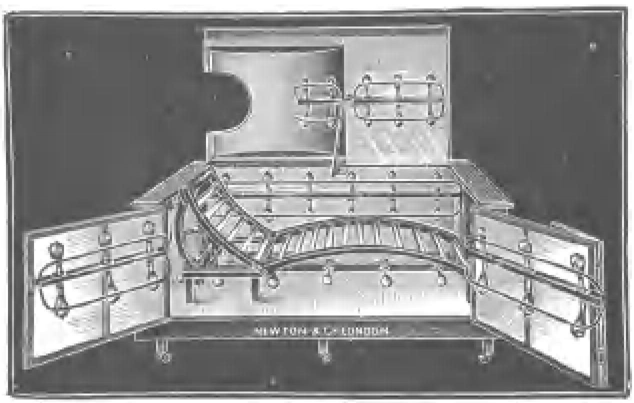


Fig. 50—Horizontal Electric-light Bath.

Physiological Action :—

1. The electric-light bath is most valuable as a heating agent. By a prolonged application the skin of the patient is reddened, the superficial vessels dilated, just as in an ordinary vapour bath, for the dilatation and relaxation of these superficial vessels is maintained for a considerable period of time, and heat production and elimination are markedly induced. In this way the output of CO_2 is greatly increased, which demonstrates the powerful influence of the bath on the metabolism of the body.

2. The electric-light bath induces free *general perspiration* more rapidly than any other known procedure. The sweat

appears within five minutes of the patient entering the bath, irrespective of the actual air temperature in the cabinet. The time required to induce diaphoresis in an ordinary Turkish bath is very much longer; indeed some persons never perspire at all.

3. The body temperature rises rapidly in the electric-light bath—four to five degrees in twenty minutes.

4. The increased elimination of CO_2 is very marked, and evidences the active oxidation and tissue changes induced by this procedure.

Kellogg estimates the increase as nearly 50 per cent. Comparatively, in a Russian or Turkish bath the increase is only found to be 10 to 11 per cent. The respiration of the patient, while considerably quickened, is free and unembarrassed. None of the oppression and distress met with in the Turkish or Russian bath is induced.

5. The blood-pressure, after a primary rise, is lowered. The red cells are increased by about 15 per cent. The pulse rate is somewhat quickened.

Therapeutic Effects :—

1. *Revulsive effect.*—By the rapidly induced and prolonged dilatation of the cutaneous blood-vessels, the blood is diverted to the surface of the body, and passive venous congestion converted into an active arterial hyperæmia. The longer the bath is continued, the more intense does this effect become.

2. *Sudorific effect.*—Perspiration is induced more quickly and vigorously than by any other known agent, with a minimum of inconvenience and discomfort to the patient. Copious water-drinking during the bath encourages the perspiration and keeps the blood-volume constant. As above mentioned, the head should be wrapped in cold cloths, especially if the bath is prolonged.

3. For promoting the absorption of morbid exudates, such as pleural effusion, ascites, or joint effusions, the electric-light bath is admirably adapted.

4. *Tonic effect.*—A brief application—five to eight minutes—has a bracing and tonic effect. The after-application of a warm to cold spray and a dry rub enhances the stimulating effect.

Therapeutic Indications.

The condition of disordered metabolism which goes under the name of " uric-acid diathesis " is much benefited by a series of electric-light baths.

By the increased oxidation and improved metabolism the nitrogenous by-products and toxic substances are gradually eliminated, with proportional benefit to the patient. The application should be made two or three times weekly, and should be combined with suitable diet, free water-drinking, and plenty of exercise. Allied conditions which similarly benefit are rheumatism, gout, diabetes, and some forms of neurasthenia.

Fat glycosurics are most benefited. The skin is rendered more active as an organ of elimination, and the free diaphoresis and increased oxidation reduces the amount of sugar in the urine. The blood is rendered more alkaline, and the tendency to " acid-intoxication," so well known in this disease, correspondingly diminished.

Obesity.—In the treatment of this condition the electric light is a most potent and valuable agent. As stated above, the increase of tissue consumption during the bath amounts to from 45 to 50 per cent, and as three-fourths of the energy of the body is consumed in heat production, the value of this is very obvious. An increase such as this, kept up for from thirty to forty minutes several times every week, naturally results in a considerable weight reduction. The heat elimination and tissue consumption is greatly increased when the temperature of the air surrounding the patient is lower than the body temperature.

Neuralgia, including sciatica, myalgia, and the various vague pains associated with auto-intoxication, are all benefited markedly. Conditions such as plumbism and arsenical poisoning and neuritis are improved, a daily application being sometimes necessary. In a minor degree, anæmic conditions are benefited and the recuperative powers of the body helped to re-establish the normal hæmopoetic processes.

Renal Disease.—Few measures afford such marked relief to acute and subacute renal disease as the electric-light bath. Prompt relief is afforded to the congested and inflamed organs by so large a proportion of the blood in the body being diverted to the skin. The application should be longer than usual, the patient being refreshed from time to time by a rub with a friction glove wrung out of cold water. The usual precautions as to cool head and warm feet are especially necessary, and great care must be also taken to avoid a chill, which would counteract all the good effects of the bath. In acute cases the bath may be repeated several times in the twenty-four hours, and a condition of continuous diaphoresis maintained.

In chronic "granular" kidney, special care is needed in prescribing and administering, owing to the risk of apoplexy. In cardiac dropsy and hypertrophy unusual care is also necessary, and high temperatures must be avoided. The bath should be brief in duration, and an ice-bag or cooling application be placed on the patient's head. There are many other conditions for which treatment by means of the electric-light bath are of value which need not be here entered into.

In conclusion, one may say with truth that the therapeutic and hygienic value of the electric-light bath can scarcely be over-estimated. It is a most admirable and effectual method of bringing into activity and maintaining in operation the natural forces by means of which all eliminative processes are achieved.

THE ROENTGEN X RAYS.

These were discovered by Roentgen in 1895, following on the work of Crookes and Lenard. The essential apparatus for their production is a highly exhausted vacuum tube, of which there are now many types, through which an electric current of high potential is made to pass.

When the exhaustion reaches a degree of about $\frac{1}{10,000}$ of an atmosphere, sparks do not pass between the terminals, but the tube is filled with a glow of light caused by what are known as cathodal rays. By the impact of these on the anode, or anti-cathode as it is usually called, the X rays are produced. These travel at the same rate as light rays, but cannot be polarized.

They are capable of traversing many substances, such as muscle and skin, which are opaque to ordinary light rays, and they manifest their presence by their effect on fluorescent bodies or photographic plates. To these properties is due the value of the rays as an aid to diagnosis. They also possess a physiological action on the tissues which may be exceedingly harmful as well as beneficial.

Radiotherapy is confined almost exclusively to dermatology, and for full details as to its use, works on radiotherapy and dermatology must be consulted. Apart from diagnosis, their use in general medicine is not great at the present time. Their value in diagnosis, however, has recently been greatly enhanced by the introduction of instantaneous X-ray photography by Dr. Groedel, of Nauheim, which has been popularized in Great Britain by Mr. Schall. By means of such photos the diagnosis of aneurysms and various pulmonary conditions is rendered much more accurate.

THE FINSEN LIGHT.

It is impossible to deal with the subject of phototherapy without mentioning the apparatus introduced by the late Prof. N. R. Finsen, of Copenhagen. It was first applied by the inventor to the cure of lupus, by focussing sunlight through water lenses pressed on the skin to render it anæmic and thus allow complete penetration by the rays. Sunlight being less rich in the ultra-violet rays than the electric arc light, and also being very inconstant in supply, Finsen devised very large arc lamps for the treatment, the light being focussed on the diseased surface by telescopes through quartz lenses cooled by a stream of water. Quartz allows of free passage to the ultra-violet rays. Later a smaller and more portable form of lamp was invented—the Finsen-Reyn.

This treatment is only of use in dermatology, and even in that class of work has lately been largely displaced in this country by the Uviol vapour lamp and radiotherapy.

SECTION III.—*Massage, Etc., in the Treatment of Disease.*

CHAPTER X.

MASSOTHERAPY.

MASSAGE, or massotherapy, consists in the treatment of various forms of disease by systematic manipulations. The derivation of the word is from the Arabic *Mass'h*—to press softly; the Sanscrit root being *makch*. There is a Greek word, μασσω, meaning to handle or knead.

Massage is a very ancient form of treatment. In Chinese manuscripts allusions to it will be found dating back to a period as remote as three thousand years before the Christian era, and there are oral traditions of even greater antiquity. The manuscript, *Kong Fao*, the date of which is 3000 B.C., contains detailed accounts of the various manipulations. The practice seems to have been common to Celestials, Persians, Greeks, and Romans. Much information in regard to the early history of massage is found among the writings of Celsus, Galen, Hippocrates, Oribasius, and other ancient writers.

Hippocrates says: "A physician must be experienced in many things, but assuredly also in rubbing, for things which have the same name have not always the same effect: for rubbing can bind a joint that is too loose, and loosen a joint that is too tight. Rubbing can bind, can loosen, can make flesh, and can make parts to waste. Hard rubbing binds, and soft loosens."

The Romans frequently employed massage after their bath, just as we employ the "shampoo" after the Turkish bath at the present day; and after the circus fights it was employed to restore sprained and stiffened joints to their normal flexibility and suppleness. Homer tells how women rubbed and anointed veterans after the toil and stress of battle.

A few years ago massage was so vaunted and exploited for commercial reasons that medical men were inclined to regard it with considerable scepticism and suspicion. It has, however, stood the test of time, and we know at the present day that it is a reliable and powerful therapeutic agent. The advertising "rubber" professes that it will cure almost any ill that flesh is heir to, from obesity to consumption; on the contrary, its sphere of action is in most hands comparatively limited. Carried out under the direction of a trained and scientific physician, it may, however, yield brilliant results in numerous conditions obdurate to the action of drugs.

Some medical men have a very limited and unfortunate conception of the process. They call it "rubbing," and think that any able-bodied and active man or woman can master the technique in a few lessons and proceed to "rub" with good results. This is far from the truth. Considerable training and aptitude are needed, and at least an elementary knowledge of anatomy is essential. In the Ling School, in Stockholm, the course of training, which also includes medical gymnastics, occupies a period of five years.

It must be admitted that women are more skilful and successful at massage than men, especially in "rest cures" —their touch is more delicate, their hands softer and more flexible. There are, however, unquestionable objections to the application of general massage by a member of one sex to the other. Indeed, it is in connection with this very question that massage fell, some time ago, into such disrepute.

To the blind, above all, is granted the "*tactus eruditus*," and in Japan massage is regarded as peculiarly their province. With this idea they have been trained from time immemorial, and until recently none but the blind were so engaged. Of late years, however, people possessed of their sight have entered the arena, and the competition has become very keen in spite of the low rate of remuneration.

To acquire a good knowledge of massage, pupils, having gone through a course of good general education, spend from three to five years in the schools for the blind. When found to be an efficient masseur, the blind student either takes a post in one of the schools as teacher, or starts on his own account as a private masseur. In Yokohama, with a population of half a million, there are no less than 1000 men and women engaged in the practice of massage, of whom 900 are blind ; 400 of these belong to a guild, and 600 are working on their own account.

GENERAL RULES.

The part to be treated should be placed in a posture of complete repose, with the muscles quite flaccid. It is impossible to apply massage to muscles in a state of active contraction.

The entire limb should be in the same plane, or with the distal portion somewhat higher than the proximal, and the manipulations are always carried out in a *centripetal* direction, commencing at the most distal point and moving towards the trunk.

General massage is conveniently carried out with the patient lying on a bed, or on a couch of twenty-seven to thirty inches in height.

While petrissage and tapotement can be quite well performed with the patient's clothes on, it is best to remove all clothing and have the patient warmly covered with blankets, except the actual part under treatment.

To avoid skin irritation some oil or vaseline is sometimes used ; a purified petroleum oil, such as "Dee oil," is best ; but unless the skin be unusually dry and hard, they can all be dispensed with ; and if any lubricant be used, boracic acid will often suffice. The better the masseur, the less adventitious aid of this nature will he require.

The duration of the sèance will of course depend on the nature of the case ; the tendency is to give too long a time. For any joint, limb, or special region, ten to fifteen minutes is ample. When general massage is required, a period of thirty to forty minutes will be necessary ; and in Weir Mitchell cases, up to one hour twice daily.

While the methods of different operators will vary somewhat, the following manœuvres are universally employed :

Effleurage, or Stroking, is a gentle stroking or rolling of the skin, gradually increased to moderately firm friction, always in a centripetal direction (*Fig.* 51). In dealing with small areas the palmar surface of the masseur's fingers are employed; while over large surfaces the whole surface of the palm of the hand is applied to the skin. Sometimes the ulnar edge of the hand is employed in preference.

Each stroke commences from the most distal point on the extremity under treatment. In the upstroke the pressure applied is somewhat firm, while in the down-stroke, which should be absolutely continuous, less pressure is

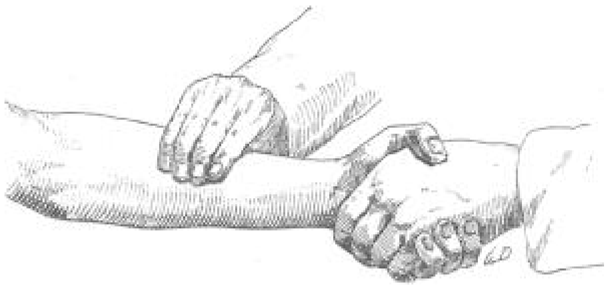


Fig. 51.—Effleurage carried out with the Finger-tips.

exercised. From start to finish of each movement the hand of the operator does not leave the patient's skin. The rapidity of the stroke varies with the effect which it is desired to produce. Rapid, brisk strokes of about one hundred per minute are stimulating, while slower and firmer strokes of seventy to the minute, or less, are soothing in effect.

Petrissage, or Kneading.—This is one of the most valuable manipulations, as well as one of the most difficult to carry out properly (*Fig.* 52). The skin and muscles are

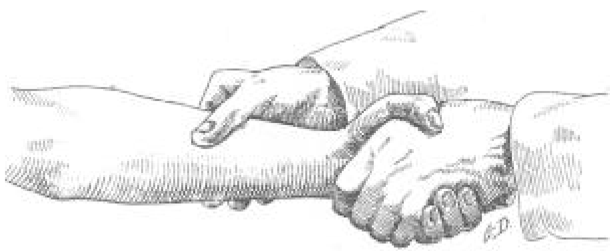


Fig. 52.—Petrissage with a single Finger or Thumb, to remove Inflammatory Exudates.

grasped and kneaded, seriatim, from the peripheral parts to the centre of the trunk, the hold being alternately tightened and loosened.

It is of the utmost importance that neither the skin nor the hairs are dragged on, for this is very painful at the time, and often causes a crop of boils to form later, which will for the time being necessitate the entire suspension of the massage. In dealing with the larger groups of muscles, such as the quadriceps extensor groups, it is well to use both hands simultaneously (*Fig.* 53). It is sometimes possible in this way to deal with the muscles on either side of a limb at the same time, and roll the muscles against the bone. This special manœuvre is known as "fulling," from its similarity to the movements of the fuller in linen bleaching.

Fig. 53.—Petrissage of the Fore-arm with both Thumbs.

Fig. 54.—Tapotement with the Dorsal surface of the Hand.

Tapotement, or Tapping.—This consists in a series of blows struck in quick succession, either with the fingers, the edge of the hand, or the whole hand (*Figs.* 54, 55). The blow should be staccato in character, coming from the wrist, rapidly delivered with a certain rhythm. To produce a superficial effect the fingers only are used, while if we wish to act on the muscles and deeper-lying structures, a series of chopping strokes are given with the ulnar edge of the hand along the whole length of the muscle in its transverse axis. Bearing in mind that the object is to produce a slight mechanical stimulus and not a painful impression, care must be taken that when the whole hand is used, what is intended to be a sharp blow or stroke does not degenerate into a smack.

Fig. 55.—"Hacking"—a variety of Tapotement.

No pain or bruising should be produced. When the ulnar surface of the hand is used (*Fig.* 55), the fingers should not touch the patient's skin, and the blow must come from the elbow joint. To successfully carry out this manipulation some delicacy of touch is requisite, and also considerable manual strength.

Friction Massage.—This consists in rubbing small circles from the peripheral parts centripetally, using the whole hand, the thenar eminences, or the finger tips, according to circumstances. It is of especial use in treating joints and any region where kneading is impracticable.

Vibration.—This is in some respects a combination of the two preceding manipulations (*Fig.* 56), a vibratory or shaking movement being added to them. It is probably of all the different massage manipulations the most difficult to acquire, and it is the only one which can be with advantage carried out by mechanical means (see **Mechanical Vibration**).

Fig. 56.—Petrissage of the Arm Muscles with Vibratory movement.

GENERAL MASSAGE.

While it is immaterial whether we begin with a foot or with the upper extremity, it is well as a matter of routine to follow a regular order; for instance, legs, arms, chest, abdomen, and back.

The patient, except for the last-named region, lies in the supine position throughout, with only so much of his body exposed as is actually under manipulation.

Massage of one extremity is much like another, so that what is said of the lower extremity will in large measure apply to the arms. If the hair of the patient's skin be long, it may save much pain and trouble to shave the leg close, or at any rate crop it with scissors.

If the left extremity is to be manipulated, the masseur will stand at the patient's right. At the commencement each toe is flexed and extended two or three times; then the ankle, knee, and hip joint, etc. The patient's left foot is taken in the masseur's left hand, while with the right hand on the dorsal surface he strokes towards the ankle. The sole of the foot is then kneaded with the fingers, and then the skin around the malleoli and tendo Achillis with the thumb and fingers.

In treating the leg, the patient lies upon his right side, while the masseur is seated. Resting the patient's heel on his knee or thigh (*Fig.* 57), a few steady strokes are made upwards from the level of the ankles.

The muscles of the calf are then thoroughly kneaded, and then the muscles on the anterior aspect of the leg are similarly dealt with. If the leg is large and fleshy, the more

Fig. 57.—Effleurage performed with the entire Palm of the Hand rapidly moved towards the Knee.

superficial layers of muscles are pressed and kneaded against the deeper layers ("fulling"); a little light effleurage then quickly concludes the treatment of this region.

After stretching the skin around the knee and applying a little friction, the thigh is dealt with. Effleurage is first applied to the whole thigh and hip. Petrissage is then applied to the large groups of muscles—quadriceps cruris and adductors—both hands being used at the same time. The movements must pass from below upwards. Effleurage is used at the finish as usual. The patient lying on his right side, effleurage is then carried out around the head of the hip joint; with the operator's right hand, the short muscles around the trochanter are then carefully kneaded.

In dealing with the upper extremity, the hand is manipulated in much the same manner as the foot; the thenar and hypothenar eminences are thoroughly kneaded and finished with effleurage, which is continued up the forearm; the wrist, elbow, and shoulder joint are then freely flexed, extended and circumrotated.

Holding the patient's left hand in his right, the operator thoroughly kneads the muscles of the forearm on its anterior and posterior aspects. Similar treatment is then carried out on the upper arm, finishing with the shoulder joint.

Fig. 58.—Rotation of the Forearm muscles.

The Chest.—The pectorals are treated with kneading movements and tapotement (sometimes) and effleurage carried out over the rest of the surface of the chest, the posterior surface remaining over until the back is treated.

The Back.—The patient having been comfortably arranged in the prone position, friction and kneading is applied to the back of the neck. Effleurage follows along the whole back, somewhat rapid and vigorous in character. Thumb and finger kneading is applied to the erector spinæ and deep muscles of the back, and following this the muscles of the hips and buttocks are thoroughly kneaded. Rapid effleurage of the whole surface of the back is now performed, with very quick stroking of the skin over the spine, which becomes reddened.

Massage of the Stomach.—The object of gastric massage is twofold, viz., to increase the motility or contractile power of that organ in atonic conditions, and at the same time increase the quantity and quality of the secretion. Massage, properly carried out, will always increase the acidity of the gastric juice, except when the absence of hydrochloric acid is due to malignant disease. The gastric tenderness often present in hyperchlorhydria will often

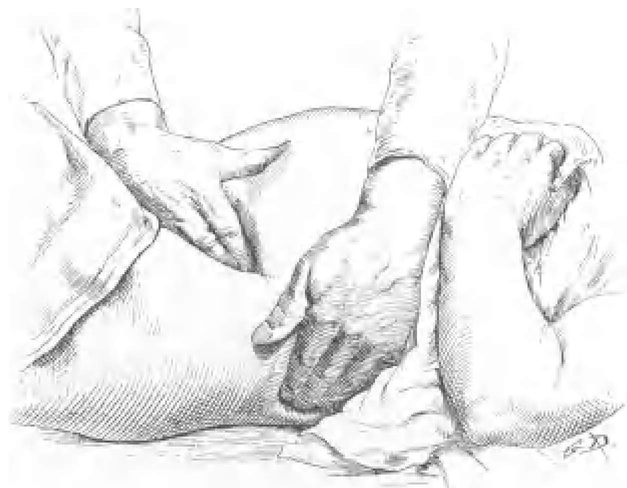


Fig. 59.—Massage of the Stomach.

prevent the performance of gastric massage, and this is well, seeing the condition would for the most part be aggravated by such manipulation. In all cases of diminished acidity, however, massage is helpful.

To reach the comparatively limited area of the stomach wall that is accessible to touch, in the first place the patient must be thoroughly relaxed, and deep manipulations be used (*Fig.* 59). Any rigidity of the abdominal muscles will make the manipulation impossible. If relaxation cannot be obtained with the patient in the usual supine position, with raised head and drawn-up knees, he should be asked to turn on his right side, and the masseur work from behind him.

Deep kneading and shaking, followed occasionally by vibration and slapping, are the movements most commonly employed. The séance usually lasts ten minutes, and the treatment is well given about half an hour after food.

In cases of atony and defective motility, when it is desired to aid the removal of the gastric contents through the pylorus, after preliminary effleurage and kneading, the masseur should stroke firmly from left to right across the stomach with the whole surface of the right hand, getting the thenar eminence well in under the left ribs, and then

Fig. 60.—Massage of the Abdomen.

slowly moving across in a somewhat downward direction. It is possible in a few minutes to get rid of a large amount of food débris through the pylorus by means of this movement if efficiently carried out.

Massage of the stomach is too often superficial, and the defectively trained masseur soon reveals himself by rubbing in the wrong direction.

Massage of the Abdomen.—Before commencing, the patient should always see that the bladder is empty, and if possible an action of the bowels should be obtained.

In order to get the muscles completely relaxed, the patient's head and shoulders are elevated, his knees flexed, and a request made that he breathe deeply and regularly. The greatest difficulty is met with in getting the proper degree of relaxation in nervous individuals, particularly women. A little patience, and chatty conversation to distract the patient's mind, will generally overcome this difficulty after a few minutes.

In commencing, the masseur puts both his hands underneath the patient (*Fig.* 60) until they meet in the lumbar region, and then draws the hands forwards, compressing the patient's flanks, and at the same time lifting somewhat until the hands again meet in the mid line of the abdomen.

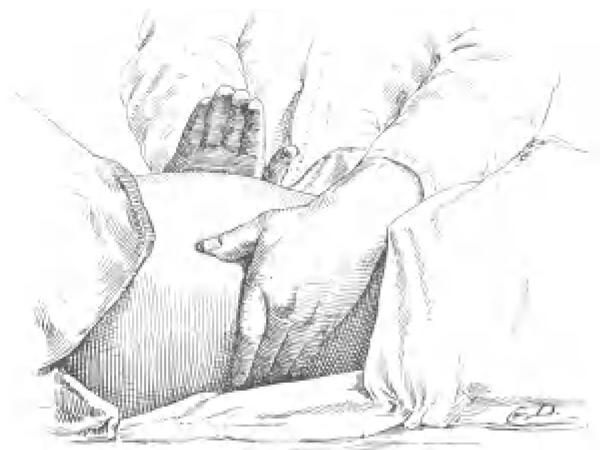


Fig. 61.—Massage of the Abdomen—(following the course of the Colon).

Deep kneading is begun in the right iliac space with both hands, and the entire abdomen is thoroughly kneaded several times, from the right to the left side. The left iliac space is treated in the same way, and the colon is followed throughout its entire course (*Fig.* 61) and treated with digital kneading. More general and heavier manipulation may be carried out with the thenar eminence and fist in patients who are tolerant of such manipulation. The concluding movement is light pressure of the abdomen with the whole of the operator's hand, to which he then imparts a vibratory movement.

A very poor substitute for good abdominal massage is the shot bag—a stout canvas bag containing small shot—

which is moved about the abdomen, over the course of the colon, etc., by the patient himself. A similar appliance is Sahli's iron ball. Such massage is of course elementary in the extreme ; but in cases of constipation, where the genuine article is not available, either from expense or other reason, these manipulations are sometimes of service.

The General Effects of Massage.—After the conclusion of each séance the patient should be warmly covered up and allowed to rest for upwards of half an hour.

A sense of drowsiness is often experienced, and the patient may fall asleep. In a few days he will find his appetite improving, his sleep to be sounder, and his general condition improved. The skin becomes softer, more elastic and glossy, and fresher in colour. The veins are more distinct, and there is finally improved tactile sensation, although the immediate effect of massage is to somewhat deaden sensation. Von Mosengeil demonstrated by injecting solutions of Indian ink into rabbits' joints that the rapidity of absorption was much increased by massage. He applied massage to one side and not to the other, and found that on the treated side the lymphatic glands in the vicinity of the joint were soon full of particles of Indian ink.

The muscular tone is more rapidly restored after fatigue by massage than by mere resting, and the muscles respond more readily to electrical stimuli. Waste and fatigue products are removed from the muscle tissue, and new nourishment introduced, and the patient soon puts on weight owing to the increased nitrogenous metabolism.

The force of the cardiac systole is increased by massage of the limbs, and the blood pressure raised. On the other hand, abdominal massage tends to some degree of vascular hypotonicity and generally lowered blood-pressure. The respirations are increased in both depth and frequency. The red blood corpuscles are notably increased, both in the healthy person and in the anæmic, after a course of massage ; there is not, however, a proportionate increase in the amount of hæmoglobin. Both the peristalsis of the stomach and its secretory power are markedly stimulated by local massage. Intestinal peristalsis is also increased, while the activity of the liver is similarly affected.

The temperature of the whole body is temporarily raised about 1° C., but rapidly returns to the normal.

THERAPEUTIC INDICATIONS.

Dyspepsia and Constipation are frequently markedly relieved by judicious massage. In the former condition it is of special importance to see that the massage is not out of proportion to the amount of food which the patient is taking—*and assimilating*. If caution be not observed, weight loss is easily increased. As the appetite improves, more food is consumed, and with improved assimilation the duration of massage can be slowly increased.

In constipation the massage should be applied in the early morning before the patient dresses, so as to induce a healthy action of the bowels at the usual time. Both the abdominal muscles and the intestinal wall should be influenced. Beginning in the region of the cæcum, the operator should work up the right side of the abdomen, along the transverse colon, just above the level of the umbilicus, and down the left side. (See *Fig*. 61).

After superficial movements have been performed, the pressure should be increased, and the hands given a rotatory motion and made to follow the line of the colon.

The abdomen should be so treated for about fifteen minutes daily, and the treatments kept up for a month or six weeks, according to results. The movements can later be imitated by the patient himself by means of the "shot-bag," though, of course, this is much inferior to manual treatment.

Insomnia is commonly greatly benefited by general and abdominal massage, which should, however, be applied late in the day.

Joint Affections.—Various sprains and synovial inflammatory conditions are much improved by massage. The most striking results are seen in cases where the joint has become stiff and useless from disuse, and the muscles atrophied. In these cases initial breaking down under an anæsthetic is often required. Chronic rheumatoid arthritis, while somewhat helped, is less yielding to the application of massage than gout or gonorrhœal rheumatism.

In these conditions active treatment, for ten to fifteen minutes twice daily, should be kept up, combined with various hydrotherapeutic applications.

Generally speaking, acute inflammatory joint conditions are best left alone by the masseur. At the same time, in acute cases gentle manipulation may be begun very early after the injury.

Nervous Affections and Myalgia.—In obstinate sciatica local massage may be of great service; an initial "dry stretching" is often indicated, then kneading of the muscles and skin stroking.

Other forms of neuritis are equally benefited. Rheumatic and gouty myalgia, lumbago, etc., frequently yield in a few days to this mode of treatment. In regard to the muscles, it must also be borne in mind that when a patient has been compelled to keep his bed for some weeks, owing to a fracture or some illness, convalescence and ability to walk are much helped by applying massage to the limbs a week or ten days prior to getting up.

Other conditions in which massage is indicated are anæmia, obesity, drug habit, chorea, and neurasthenia.

Local manipulation of the uterus, etc., in subinvolution and similar conditions, is essentially objectionable, nay, disgusting, when performed by physician or masseur; hardly less so when carried out by a masseuse.

Conditions Not Benefited by Massage.

The indiscriminate use of massage is to be strongly condemned, for there are numerous conditions for which it is perfectly useless, and not a few when it is absolutely hurtful and even dangerous. Instances of the latter are, in general massage, venous thrombosis, and in abdominal massage, severe gastric ulcer.

In febrile conditions the temperature is further raised; in acute renal disease or pulmonary tuberculosis it may induce a hæmorrhage. It may, however, be employed in phthisis during a quiescent period. Abdominal massage should never be employed when the patient is menstruating or pregnant.

Common sense will negative the use of massage where there is any considerable solution of continuity in the skin of the patient, be the immediate cause a burn, an ulcer, or a cut. In any dermatitis, of course, harm will be done and the condition be aggravated by massage.

VIBRATION BY MECHANICAL MEANS.

The performance of vibration by the hand must of necessity be more or less limited as to time and rapidity of motion. The hand and fingers soon grow weary, though in this, as with the ergograph, practice enables a much greater amount of work to be carried out.

Fig. 62—The "Ruk" Vibrator, being applied by Patient himself.

Mechanical vibration is an admirable adjuvant to ordinary massage, and is one of the most important passive movements used in medical gymnastics. There is no dcubt that a machine-driven instrument can produce effects unattainable by means of the human hand. The effect may be made stimulating or soothing as desired, while the circulation in any part can be improved, and the absorption of any morbid effusion be hastened. Twenty-five or thirty years ago, Bourneville introduced mechanical vibration as a method of treatment in nervous diseases, particularly for neuralgias, and it was used with consider-

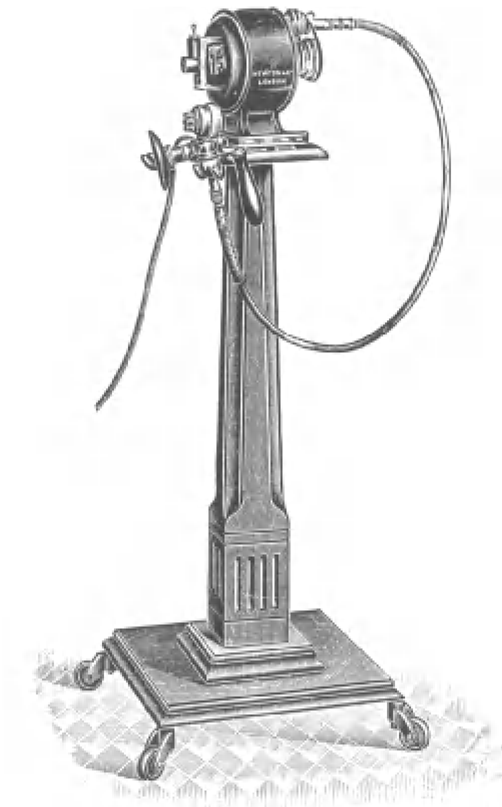


Fig. 63—The "Barker" Vibrator.

able success at the Salpêtrière and other hospitals. In the early eighties, Dr. Mortimer Granville produced a vibrator, worked by a magnetic battery. An apparatus driven by hand, such as the Liedbeck or the Veedee, may in these days of electricity be practically put out of court. Almost every electrician has some form of vibrator—

often not expensive—in his catalogue, which can be attached to a motor, and worked in any house where the electric current is laid on. Such an apparatus can often be worked by the patient unassisted, and the motion is not of the jerky character which is almost inevitably associated with a vibrator worked by hand. One of the best of these apparatus is the " Ruk " (*Fig.* 62), made by Schall; it is comparatively inexpensive, and merely requires to be connected to the nearest lampholder or wall plug. It gives regular strokes in rapid succession as soon as the switch is closed, and the intensity of the strokes can be suited to every patient.

Another apparatus (on which the *Lancet* has reported favourably) is the "Barker" vibrator (*Fig.* 63). This is one of the very best on the market, and is extremely comfortable to the patient. There is no jerking or jarring movement, the machine is practically noiseless, the vibrations are even in character, and the effect on the patient is similar to that produced by a rapidly alternating current. With each machine are supplied a large number of "applicators" adapted to almost every region of the body.

CHAPTER XI.

THE REST CURE.

THERE are three essential factors in the rest cure. These consist in :—

1. Absolute rest in bed.
2. Isolation from friends, letters, etc.
3. Abundant feeding.
4. Massage and electricity.

Weir Mitchell, of Philadelphia, was the first physician who systematically employed these methods in combination; and the late Sir W. S. Playfair introduced the treatment into this country, and used it extensively with great success.

The class of patient in whom the most striking results are obtained are neurotic individuals of either sex, who have become emaciated. Some such cases have broken down from sheer overstrain, where initially there was not a big supply of nerve energy to draw upon. Others have gradually brought themselves into a condition of ill-health and complete nervous exhaustion from cultivating "diet" fads or leading idle, useless, unwholesome, if not vicious, lives.

Some may evidence the condition known as "anorexia nervosa," and either refuse food, take very little, or, worse, vomit what they do take immediately the meal is finished. Vomiting may alternate with diarrhœa. The emaciation is often slow in such cases, but the ultimate condition of the patient is practically skin and bone; in other words, at the commencement of the "cure," such patients are frequently in a condition of the most profound emaciation.

The following weights are instances :—

Female,	æt. 22;	5ft. 8in.;	weight, 82lb.
Male,	æt. 24;	5ft. 6in.;	weight, 7st. 1lb.
Male,	æt. 23;	6ft. 2in.;	weight, 8st. 3lb.

Such patients are usually markedly anæmic, listless, apathetic, depressed if not tearful; the skin is loose and dry, and mind and body are enfeebled to the last degree.

While they occasionally resent the confinement, and protest at the frequent feeding for the first day or two, they soon become accustomed to the routine, especially if provided with a cheerful and tactful nurse. Any insubordination, if firmly dealt with at the start, usually ceases very speedily, and reasoning with a patient may often do much to this end.

1. **Rest.**—In regard to this factor, it cannot be too forcibly insisted that the rest must be complete. For from four to eight weeks, or even longer in severe and slowly progressing cases, the patient must be kept in bed, without intermission, night and day, only leaving it morning and evening to be placed on another bed or couch while the first bed is being made.

In severe cases a bed-pan must be used. Food must be cut up or suitably prepared, and neither reading, writing, nor sewing must be allowed.

The *ennui* resulting from this severe régime is not so great as one might expect. If good progress is being made the patient dozes or sleeps a great deal during the day, and two hours' massage, some galvanism, and frequent meals go far to fill up the waking time.

Any relaxation of the rules will depend entirely on the progress made; but in a case of moderate severity, which is doing well, some light reading, such as the daily papers, *Punch*, or pictorials, may be allowed at the end of the third week, and, later, sewing or an unexciting novel. Gradually a little sitting up in the afternoon may be also permitted. This period is gradually lengthened, and at the end of the sixth week change to another room, or a walk on a verandah, may be allowed.

A large airy room, well lighted, with a south exposure, is best for such cases. A night and day nurse may be required, but generally speaking it is best to have the same nurse sleeping in the patient's room or a dressing-room, and a special masseuse visiting twice daily, and temporarily relieving the nurse.

Too much importance cannot be laid on the choice of the nurse. Great judgment is needed in this particular, and the success or failure of the " cure " will largely depend on the nurse's temperament and capacity. She must be possessed of a high degree of patience, and her sympathy must be tempered with discretion.

2. **Isolation.**—This is essential, and must for the first four weeks be absolute. To attempt to carry out this treatment in the patient's own home is worse than useless. The place matters little apart from this, and provided the immediate environment of the patient is cheerful and peaceful, a good nursing home or hydropathic sanatorium is equally suitable. No letters must be written or received, and no person permitted to enter the patient's room except the physician, nurse, masseuse, and the maid who cleans it and attends to the fire.

3. **Feeding.**—As regards diet, the line adopted is an ample supply of appetizing, easily digested food at regular but frequent intervals. Where the patient is very low down, and digestion much enfeebled, a start has often to be made with milk or peptonized milk. To some patients this is distasteful in the extreme, while others are completely upset by it, acquire a dirty tongue, and lose weight.

The addition of barley- or lime-water sometimes helps matters, but to those who have " the indigestion of fluids " described by Fothergill—in other words, a degree of gastric myasthenia—a more solid diet is better suited. A beginning can be made with chicken purée, creamed fish, plasmon cream, and rusks, and the patient gradually worked up to a full diet. All drugs are best avoided, particularly digestive enzymes, etc. ; at the most some mild aperient medicine may be required at first, as $\frac{1}{6}$ gr. calomel, nightly, while milk is taken.

The following is a typical diet for such a patient :—

7.30 a.m. *Café au lait*, and bread and butter.
8.30 a.m. Tea or cocoa, with cream or milk ; 2 fried sole fillets ; toast and butter ; jam or marmalade, *ad lib.*
10.0 a.m. A glass of milk and rusk.
12.0 noon. A *whole* cup of beef-tea.
1.15 p.m. A large helping of chicken or pheasant, vegetables, and milk pudding.

3.0 p.m.	A cup of Benger's food—½ pint.
4.30 p.m.	Tea, biscuits and bread and butter, and a boiled egg.
6.0 p.m.	A cup of beef-tea.
7.30 p.m.	A large plate of meat, vegetables, and pudding as at lunch.
10.0 p.m.	A glass of hot milk and a biscuit.

The nurse must see that the meals are served regularly, and should keep a careful record of how much the patient takes.

The patient is usually weighed once a week, or sometimes oftener; but care must be taken in many cases to keep the weight a secret, as some patients are unduly depressed if there is a loss of weight or the gain is slow; while in female patients, if the gain be rapid, say 6 lb. in one week, they may refuse to eat so much in case they get *too stout!* This is by no means unusual.

The food is gradually diminished during the last week.

Hale-White and Spriggs have carefully investigated the metabolism of a patient during the rest cure. The food supplied during an eight weeks' course, and the urine and fæces, were carefully weighed and measured. At the commencement the patient's weight was 6 st. 4 lb., and the gain in weight was 30 lb. The physiological heat value of a day's food was found to be 5,300 calories. The daily average intake of fat was 268·69 gm., and 96·5 per cent was absorbed. The absorption of nitrogen was found to be very complete during the course, only 661 gm. being unabsorbed. It was found, however, that after making due allowance for nitrogen in urine, sweat, and catamenia, there was still 10 per cent unaccounted for; the explanation being either that these were more concentrated at the end of the treatment, or that the nitrogen was laid up in the form of some compound more nitrogenous than proteid.

4. **Massage.**—The object of the massage is, of course, to take the place of normal physical exercise, improve the circulation, and hasten the removal of waste products from the tissues. The whole body is treated, with the exception of head and face.

Beginning the first day with ten minutes morning and evening, the amount is rapidly increased up to an hour twice daily at the end of the first week, and is maintained at that until the patient begins to move about a little, when it is gradually decreased until exercise is taken freely. The immediate effect of massage is drowsiness and some degree of hunger, so that it is well to follow the massage time with a light meal, and then allow an hour for sleep. During menstruation the massage is continued, the abdomen being omitted. Some physicians combine faradism with the massage, but it does little good beyond filling in the time. Central galvanism, however, may be helpful in some cases. The limbs and trunk should be sponged daily—seriatim—with cold or tepid water, and dried with a rough towel.

The results of this somewhat remarkable treatment are equally remarkable, and the improvement in physical health and gain in weight often perfectly astonishing. A very usual increase in weight during a six weeks' course is 1½ to 2 st. Hale-White records a gain of as much as 9 lb. 12 oz. in one week, and Graham Brown of 9 lb.— the latter with milk alone. These are exceptional, and one should be perfectly satisfied with a steady gain of from 3 to 5 lb. per week.

As in the results of gastro-enterostomy for dyspeptic conditions, the thinner the patients are at the start the more striking is the gain in weight. Indeed, the patients who benefit most in every way are the absolutely emaciated worn-out neurasthenics. Fat, hysterical types, in whom the *mental* element predominates, do not improve to the same extent; indeed the gain in weight may become a mere added encumbrance. Any organic gastric trouble, such as an ulcer which bleeds, or enteritis, is a bar to success; but gastralgia and neuralgias of many regions disappear like magic in the vast majority of cases.

Romberg defined "pain" as "the prayer of a nerve for healthy blood"; if a superabundant supply of healthy blood is forthcoming, the pain goes.

If the patient has drug habits, the usual difficulties have to be contended with; but provided the habit is broken off they do well.

While some weeks may pass before the patient is inclined or able to take a great deal of exercise, still, in the large majority of cases, at the end of the course, the patient is in excellent health. Relapses do occur, but much will depend on the after environment of the patient. A short sea-voyage or a few weeks in Switzerland are excellent sequels to the period of incarceration.

The cost of such a course of treatment in a London nursing home is exceedingly heavy—from £150 to £250—more if especially good rooms are engaged. In most well-organized sanatoria and hydropathic establishments, £8 8s. to £10 10s. per week will cover the cost.

A *modified course* is often successful in mild cases, but the one rule that can never be modified is that in regard to isolation from friends, for no degree of success can be hoped for if the patient is not removed from the usual environment, which often constitutes a large proportion of the *causus morbi*.

SECTION IV.—*Electricity in the Treatment of Disease.*

CHAPTER XII.

GALVANISM AND FARADISM.

HISTORICAL SUMMARY.

ELECTROTHERAPEUTICS date back to a legendary age. Centuries ago, it is said, the women of Africa bathed their sick children in waters frequented by the electric eel or torpedo (*Malapterurus electricus*).

Earlier still, the Romans employed electricity in the elementary forms then available, for the treatment of disease. During the reign of Tiberius electricity was employed by Scribonius Largus in the treatment of gout.

Professsor Crookes humorously attributes the death of Tullus Hostilius, who, according to Roman mythology, was struck dead by one of Jove's thunderbolts, to accidental contact with "a live wire!"

Pliny and Dioscorides both refer to the remedial powers of electricity.

The history of electrotherapeutics may be divided into four eras: (1) The era of Franklinization; (2) The era of Galvanization; (3) The era of Faradization; (4) The era of Radiology, High-Frequency, and Sinusoidal treatment.

1. *The Era of Franklinization.*—One of the prominent advocates of, and writers on, franklinic electricity as a therapeutic agent was John Wesley, the divine. At a time when the medical faculty were inclined to despise electricity and underrate its value (as unhappily many members of the profession still are), Wesley claimed that electricity was indicated in a wide range of disorders; and with the list of

ailments which he drew up as suitable for electrical treatment, the modern physician who has studied electricity will find no grave fault. Independently of Franklin, Wesley also suggested the use of lightning conductors.

2. *The Era of Galvanization.*—This was commenced by Galvani's classical experiment on the frog in 1786. After his results were made public, Volta was attracted to the field of electrical experiment, and constructed his pile, which from the year 1800 onwards was largely employed in medical work, and marked a distinct advance in technique.

Unfortunately, most of the work at this period was done by laymen, who knew little or nothing of physiology or medicine. "Chemists, physicists, priests, paupers, monks, and mountebanks were the leading authorities on electrotherapeutics in the eighteenth century."

Many years elapsed before electrotherapy attained sufficient precision to command the attention of men of science.

3. *The Era of Faradization.*—Michael Faraday's discovery of the principle of electrical induction in 1831 may be said to have changed the whole course of electrotherapeutics. In the following year the first practical machine on this principle was made by Pixii, and used by Neef of Frankfort in the treatment of disease. From this time faradic electricity became extensively employed throughout Europe. Until 1895 galvanism, faradism, and perhaps to a less extent static electricity, were the forms employed in medicine. The apparatus required was not very elaborate, and the amount of work done in a large general hospital was often scarcely sufficient to justify the existence of a special electrical department.

4. *The X-ray Period.*—The discovery of X rays by Professor Roentgen in 1895 undoubtedly gave an enormous impetus to electrical work, and led to the establishment of a radiographic and electrical department in all large hospitals. The field for the electrotherapeutist expanded, and electrical treatment to some extent was taken out of the hands of the "medical electrician," or electrical quack.

Soon after this remarkable results were obtained by d'Arsonval, Elihu Thomson, and Tesla, by the use of "high-frequency" currents, which rushed into fashion, became discredited, and, latterly, are again obtaining a place in electrotherapy. Sinusoidal currents have of late been much used, chiefly through the advocacy of Herschell and Morton.

During the past century, associated with all that is best in the application of electricity to the treatment of disease are the names of Faraday, Duchenne, Meyer, Edelmann, von Ziemssen, Kelvin, Becquerel, Rockwell, and Milne Murray.

GENERAL USE OF ELECTRICITY IN MEDICINE.

Erb has defined electrotherapeutics as consisting in placing the human body—or a portion of it—in the external circuit of an electric current; in other words, in submitting it to a current of variable strength and duration, brought to it through the electrodes, with or without interruptions or changes.

While the indiscriminate use of electricity is to be strongly condemned, as foolish if not actually dangerous, its value in the treatment of many forms of disease is unquestionable. Too great care cannot be exercised in the judicious selection of cases suitable for treatment, and equal consideration must be devoted to the type of electricity used, the means of application, and the strength of the current advisable. For some cases galvanism may be useless, for others faradic electricity may be highly injurious. Much harm has been done to electrotherapy, and its progress in the treatment of disease been greatly checked, by the prejudice aroused against it owing to its having fallen so much into the hands of unscrupulous charlatans who have run it as a "cure all," and, by means of electropathic belts and other figments, imposed on the credulous public and made harvest out of their gullibility. Properly applied, in its various forms, electricity has the following therapeutic effects :—

1. It stimulates all the body tissues, and is of especial value in this respect as regards muscles, nerves, and secretory glands.

2. It promotes nutritive processes and improves the patient's general health.

3. It increases metabolic processes.

PLATE XXVI.

THE D'ARSONVAL-GAIFFE INSTALLATION FOR HIGH-FREQUENCY. STATIC ELECTRICITY, AND X RAYS.

4. While in the main stimulating, it may often relieve morbid irritability.

5. It is of immense value in diagnosis of various nerve lesions, as a means of ascertaining the existence of what is known as " the reaction of degeneration," the myasthenic reaction, etc., and—by radiography—in many morbid conditions.

It is not proposed to deal in this short section with the details of all the various batteries, etc., employed in electrical work, or with the elementary theory of the science. For the description and explanation of the various chemical, physical, and physiological effects produced by the application of electricity, the reader is referred to one of the many excellent text-books on the subject, such as those of Lewis Jones and Wilfred Harris, or the large work of Beard and Rockwell.

Space only permits the writer to deal somewhat briefly with the employment of electrotherapy, used as it should be, as an adjuvant of its sister-methods of natural therapy, viz., diet, massage, and hydriatric measures.

SOURCES OF ELECTRICITY FOR MEDICAL PURPOSES.

For galvanization and faradization the electrical energy may be derived from batteries made up of a larger or smaller number of units (cells), or it may be, and now commonly is, obtained from a dynamo (the main). As a wall plug is not always available or conveniently situated, it is frequently more convenient to use a small portable galvanic or faradic battery.

For the production of static electricity, we commonly use the machines of Holtz or Wimshurst, the latter being most favoured. The recently introduced Gaiffe-d'Arsonval apparatus, whereby static electricity is obtained by means of a transformer from the main, is very convenient (*Plate XXVI*).

THE GALVANIC OR CONTINUOUS CURRENT.

Choice of the Cell for Batteries.—It is impossible to give the preference to one certain cell under all circumstances, as these will differ very considerably. *Any* cell can be used which is capable of yielding the desired strength of current; but if we consider convenience, the time necessary to keep a battery in working order, its portability, etc., the number of useful cells will be reduced to very few indeed, and these only will be mentioned here.

In choosing a battery, an important consideration is whether it can be charged by the physician himself, or whether it has to be returned to the maker when exhausted. In the latter case the battery would be suitable only for those medical men who live within convenient reach of the manufacturer. The capacity of the battery, i.e., the amount of current which it will yield before having to be recharged, the cost of recharging, the price of the battery, and its size and weight are important.

It stands to reason that cells with high E.M.F. and small internal resistance have a considerable advantage over cells with low E.M.F. and high internal resistance, for 50 chloride of silver cells with 1 volt and 8 ohms internal resistance each, when connected in series will yield with an external resistance of 2,500 ohms—

$$\frac{50 \text{ volts}}{(50 \times 8) + 2{,}500 \text{ ohms}} = 0{\cdot}0172 \text{ ampère, or } = 17{\cdot}2$$

milliampères; whereas 22 bichromate cells of 2 volts and 0·3 ohm each would yield in the same case—

$$\frac{44 \text{ volts}}{(22 \times 0{\cdot}3) + 2{,}500 \text{ ohms}} = 0.0175 \text{ ampère, or } = 17{\cdot}5$$

milliampères.

In order to obtain 17 milliampères with 2,500 ohms external resistance, we should therefore require 50 cells of 1 volt each, whereas the same result would be obtained with 22 cells of 2 volts each; and, of course, with the latter, the batteries are smaller and less expensive in every way, on account of the smaller number of cells.

The cells most frequently used may be classified in two groups: Cells which contain acids, and where therefore the zincs have to be taken out of the fluid after the battery has been used—plunge batteries; and cells, the exciting fluid of which does not attack the zinc as long as the circuit remains open, and in which, consequently, the zinc may remain constantly immersed in the fluid.

Acid Cells for Plunge Batteries present practical difficulties in working which we do not find in the dry cells. They are plunge elements (*Figs.* 64 and 65) and the vessels cannot be hermetically closed, nor can spilling and evaporation be entirely prevented, though the use of specially shaped vessels and rubber floats helps to avoid these difficulties. Then, if used regularly, an acid cell wants cleaning and refilling once every three months, although the refilling is a fairly simple matter. Such batteries are most suited for occasional use. They have a high E.M.F. of 2 volts and small internal resistance, so that they give about 30 per cent more current per unit than a dry Leclanché cell.

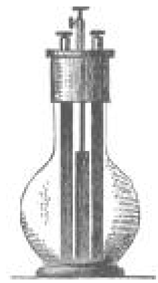


Fig. 64.—A common form of Acid Cell (Bichromate).

In all acid cells the elements are carbon and zinc, with solutions of varied composition. A common and useful one is 1 oz. potassium bichromate, 1 oz. hydrarg. bisulph., 2 oz. H_2SO_4 (strong), and a pint of water. The zinc lasts several years with average use, and can be replaced without skilled assistance.

Constant Immersion in which there is no Acid Used.—Of these the Leclanché cell is used more than all other kinds put together. For galvanization there is no more reliable and convenient cell to be found. The size of the cell must not however be reduced too much for the mere sake of portability.

The E.M.F. is good (1·5 volt), and the internal resistance is moderate (0·1 to 1 ohm), according to the size of the cell. So long as the circuit is not closed, there is theoretically no local action, and practically very little. It is always ready for use, and a well-constructed cell will last for two years without having to be seen to during that time. Moreover, every part is so easily accessible that the cells can be cleaned and refilled without technical aid. In order to clean Leclanché cells, the crystals which stick to the carbons and zincs have to be scraped off with a knife, carbon and glasses should be washed, and after the cells have been put together again, they are refilled with a saturated solution of pure sal ammoniac.

With Leclanché cells, as with most others, it is of the greatest importance not to select them smaller than is absolutely necessary, for the smaller they are made the less satisfactory they become. Many attempts have been made to construct them as small as 1 by 1 by 4 in., but have up to the present time invariably failed. The constancy of such

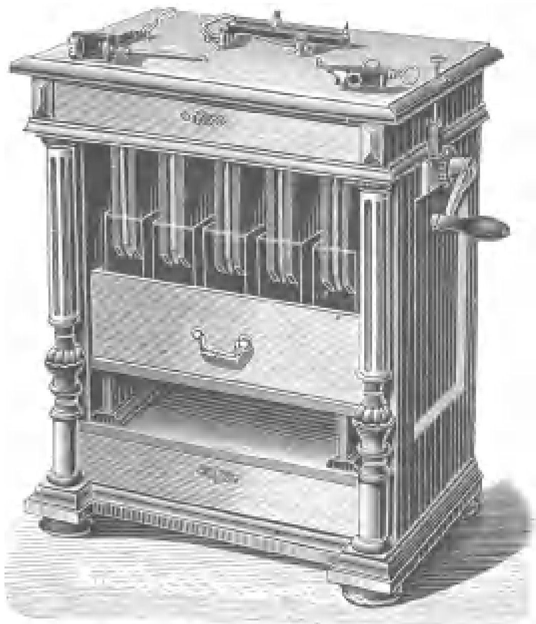


Fig. 65.—10-Cell Bichromate Battery.—This battery is suitable for all electric lighting and cautery purposes; but being a stationary apparatus, it is most suitable for hospitals or the consulting-room. Owing to the large surface of the plates and the capacity of the cells, there is ample reserve of power, and the solution will last from 6 to 12 months, when in constant use, without recharging. The rack action at the side allows of the plates being immersed only to the required depth. The cells should be entirely lowered when the battery is out of use. The apparatus is fitted with a rheostat, by which a certain amount of resistance is introduced into the circuit, and can be gradually reduced to the required point suitable for the various cautery points and lighting apparatus.

small Leclanché cells is insufficient, and for various reasons the local action is greater in the small than in the large kind.

Dry Leclanché Cells.—If portability has to be considered, the dry cells belonging to the Leclanché type (*Fig.* 66) have great advantage over the cells containing fluid, for there is no liquid to be spilled or to corrode the brass parts, and there is no glass, etc., to get broken. Their internal resistance is a little lower, and their E.M.F. a little higher, than that of the liquid Leclanché cells. They can be sent charged all over the world, and are very suitable for all batteries which have to be frequently carried about.

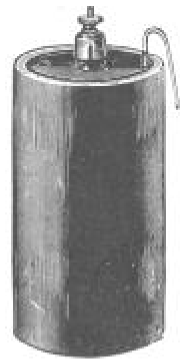


Fig. 66.—Dry Cell.

Their only disadvantage is that the cells, after being exhausted, cannot be recharged, but have to be replaced by new ones, and this makes the refilling rather expensive. On the other hand, batteries filled with good dry cells will certainly last from two to four years without requiring recharging, and they are less likely to need repairs than are those filled with liquid, because accidents like the smashing of glasses and spilling of corrosive fluids cannot happen, so that the difference in the cost of maintaining the batteries is not quite so great as it appears at first sight. The new cells can be sent by post, and can easily be inserted in the place of the old ones, so that the battery itself need not be returned to the maker.

Number of Cells.—The number of cells a battery ought to have will depend on the purposes for which it is required. Fifty to eighty volts are necessary for diagnostic purposes and for the treatment of nervous and paralytic diseases.

In addition to a suitable number of cells, one requires to have different appliances for regulating the strength of current, for interrupting, reversing, and measuring the current, and for applying it to the body. The strength of current can be regulated in two ways: either by varying the E.M.F., or by means of artificial resistances. The first-mentioned method is more frequently used, and is managed by means of a current collector.

Current Collectors.—These are used to increase or diminish the number of cells in the circuit, thus changing the E.M.F. and regulating the strength of current. They must be constructed so that the current is never *interrupted* while the number of cells is being changed, as this causes disagreeable shocks. Further, the cells should be put in the circuit one by one, not five by five, etc., as this will also cause shocks.

Crank Collectors are most frequently used. A number of pegs, equal to the number of cells in the battery, are arranged in a circle, so that a crank can be brought in contact with every one of them (*Fig.* 67). The cells are then connected with these pegs; a wire leads from the first zinc to the negative terminal, another wire from the carbon of the first cell to peg 1, another wire from the carbon of the second cell to peg 2, etc., and one wire leads from the crank to the positive terminal. By turning the crank the number of cells connected with the terminals can thus be conveniently increased or diminished. In order to avoid interrupting the current, the pegs are so arranged that the crank touches the next peg before having quite left the former one.

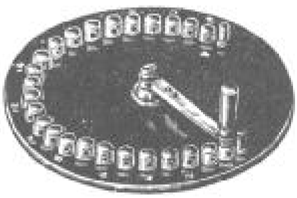


Fig. 67.—Crank Collector.

As long, however, as the crank touches two pegs—for instance pegs 5 and 6 (*Fig.* 69)—at the same time, the sixth cell is short-circuited, for the current can pass from the zinc of cell 6, which is connected with the carbon of cell 5, on to peg 5 through the crank of peg 6, and from thence back to the carbon of cell 6, without finding on its way any

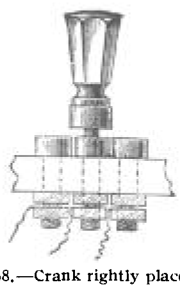


Fig. 68.—Crank rightly placed.

Fig. 69.—Crank wrongly placed.

resistance worth mentioning. If this state of affairs lasts but a very short time, it causes no damage, but if it continue, the short-circuited cell will be exhausted. It is therefore important with all crank collectors, to let the crank rest as in *Fig.* 68, and not as in *Fig.* 69, where it is in contact with two cells at once.

The number next to the peg on which the crank rests shows the number of cells in action. This kind of collector is convenient, but it has one drawback, especially if used with batteries containing a large number of cells, viz., that by being put in the circuit, the first cells of the batteries are exhausted more quickly than the last ones.

Double Collector.—This is designed to obviate the above difficulty, and has two cranks, which are placed on the same axis, but are insulated from one another; the zinc of

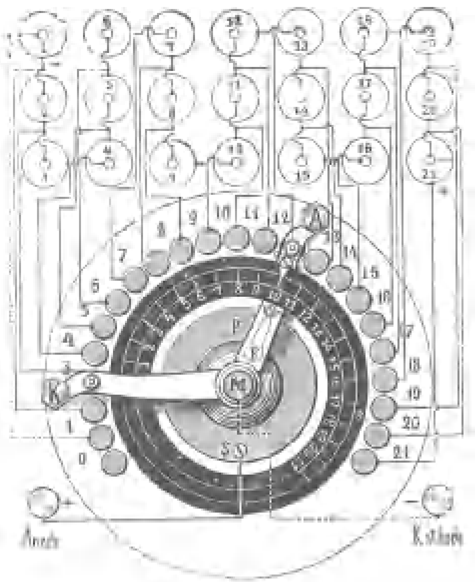


Fig. 70.—Double Crank Collector.

the first cell is not connected with a terminal, but with an additional peg 0. One crank is connected with the positive, and the other with the negative terminal. By these two cranks, any batch of cells may be inserted, and the whole battery be used up evenly. An index fitted to one of the cranks points to a division, thus showing the number of cells in action. Finally, each single cell can be connected with a galvanometer and tested, so that damaged or exhausted cells may be detected without trouble. The double collector is thus a great convenience in testing a battery, and is certainly the best current collector known at the present time (*Fig.* 70).

CURRENT FROM THE MAIN.

The electric current for lighting houses is now available in most towns, and even in some country districts. It is obviously much more convenient to obtain a current of perfect constancy by merely turning a switch, than to have to generate it in primary batteries or store it in accumulators. The transformers or rheostats controlling the current require no charging with corrosive liquids; most of them are not even subject to any wear and tear, and consequently are not liable to get out of order.

There are two kinds of current used for lighting houses, viz., the continuous and the alternating.

Continuous Currents.—In some towns the continuous or low tension current is supplied. The E.M.F. in the street mains is not higher than that which is used in the houses, and varies from 100 to 250 volts in different towns. A battery of large accumulators is nearly always employed in connection with the dynamos; during the evening the current is supplied directly by the dynamos, but during part of the daytime by the accumulators. Heavy copper cables are required to distribute such a low tension current, and it is therefore suitable only for thickly populated districts, and for comparatively short distances, not exceeding one and a half miles.

The continuous current is suitable for every purpose for which electricity may be employed in medicine, such as for galvanization, electrolysis, and faradization, the cautery and motors, X-ray and high-frequency apparatus, lamps for treating lupus, electro-magnets, etc.

Alternating Current.—In other towns, and in many country districts, the alternating current is being supplied. The current changes its direction from 50 to 100 times every second. The number of volts and ampères of such an alternating current can easily be raised or lowered; a high voltage, from 2,000 to 10,000 volts, is being used in the mains, but on entering a house this is transformed down to 200 or 100 volts and a greater number of ampères, making it suitable for incandescent lamps, etc. The advantage of this system to the electric lighting companies lies in the fact that the copper cables employed for the mains need be only one-tenth to one-hundredth part of the thickness required for the distribution of the same quantity of current at low voltage.

The number of ampères which a cable can carry without becoming hot is limited, and ought not to exceed 1,000 ampères per square inch (cross section) of copper. The number of volts, however, can be raised as far as the safety of the insulation will permit ; as many as 30,000 volts have already been used in wires suspended on porcelain insulators

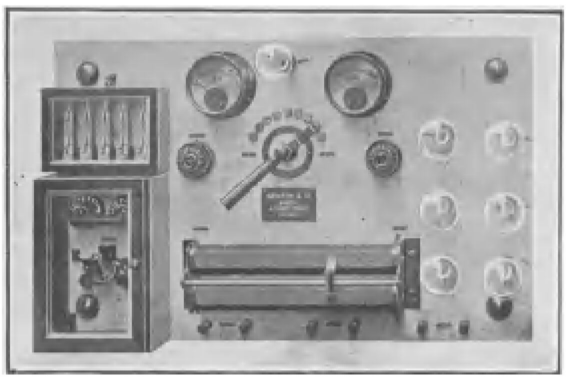


Fig. 71.—Combined Continuous and Alternating Current Switchboard.

on telegraph poles, and sent over a distance of more than 100 miles. A copper cable with a cross section of one square inch can carry 100,000 watts only with 100 volts, but 5,000,000 watts with 5,000 volts. The net gain to the electric light company is not nearly as great as these figures imply, because with cables intended for 5,000 volts a much better insulation is necessary than for 200 volts only ; moreover, accumulators cannot be used with the alternating current, and the engines have therefore to run all day long, and ultimately there is some constant loss in all the transformers fixed in consumers' houses as long as no current is being used. Nevertheless, the alternating current requires to be employed whenever it is to be sent over long distances, to reduce the heavy cost of copper cables.

The alternating type is very convenient for treatment with sinusoidal currents ; it can also be used for producing X rays and high-frequency currents (but not for galvanization) by means of Gaiffe's or Wright's special high-tension transformer.

Switchboard for High-Tension Transformer.—For the continuous as well as for the alternating current it is necessary to employ a *rheostat*, or a *transformer* of some kind (*Fig.* 71), to control the current's strength, or to reduce the voltage, etc., in order to protect the patient or the apparatus from overdoses or dangerous currents.

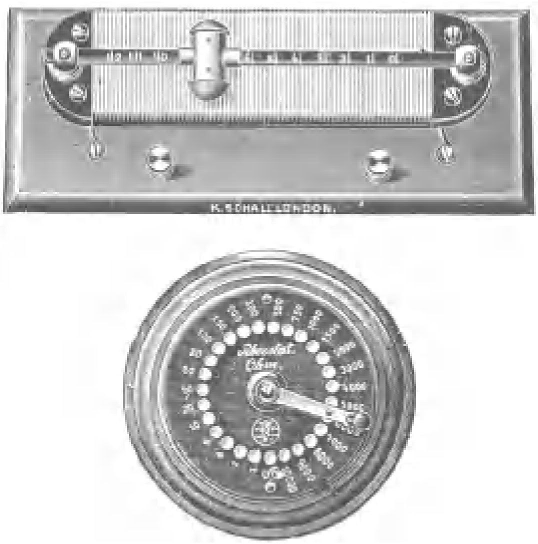
Rheostats.—Batteries provided with a good current collector need no rheostat as a rule, though such an appliance may be wanted. Rheostats may be used instead of the current collector as a means of regulating the strength of the current. In order to reduce the current of a battery of 45 volts to about a half milliampère, the resistance required would be, according to Ohm's law :—

$$\frac{45 \text{ volts}}{0{\cdot}0005 \text{ ampère}} = 90{,}000 \text{ ohms},$$

and it should be possible to diminish this resistance gradually, in order to avoid all shocks in increasing the currents.

Liquid Rheostats.—These have the advantage of cheapness. They consist generally of a glass tube, the lower end of which is closed with a piece of platinum, which acts as one electrode. The second electrode is a piece of zinc, which may be moved up and down in the glass tube. If the tube is filled with some badly-conducting liquid, and the piece of zinc is drawn out as far as possible, the resistance is greatest. The number of ohms depends on the length of the tube, the diameter of the electrode, and the conducting capacity of the liquid. The resistance is diminished by moving the zinc downwards. As decomposition must take place in these rheostats, small gas bubbles form on the electrodes, changing the surface of the electrodes and the resistance continually. In order to prevent this, a depolarizing substance—for instance, chloride of zinc—is mixed with the water. A weak solution of chloride of zinc, however, depolarizes but a little, and would therefore only prevent the gas bubbles with very weak currents; but a strong solution of chloride of zinc conducts pretty well, and in order to obtain a high resistance, the glass tube would have to be very long, an arrangement which is impracticable with portable batteries. On account of these difficulties, the use of liquid rheostats will always be limited.

Metal Rheostats.—These are generally employed. They alone are suitable for measuring purposes, as they are



Figs. 72, 73.—Metal Rheostats.

the most accurate and the least subject to changes (*Figs.* 72, 73). The instruments for medical purposes are provided with a crank like the current collectors; each peg is connected with its neighbours by long and fine German silver wire, through which the current has to pass till it reaches the peg on which the crank rests. In order to obtain high resistances without making the number of ohms between the various pegs too great, a good many pegs are necessary. As a rule, several crank rheostats are so arranged that the first increases the number of ohms, 10 by 10, up to say 200 ohms; the second, 100 by 100, up to 2,000, etc. Such rheostats, though convenient, are rather costly, and they are as a rule only used for the more expensive office batteries.

Graphite Rheostats. — Convenient and inexpensive rheostats of low or high resistances may be made of graphite, and they can be so arranged that the current may be varied without giving any shocks. The only disadvantage of graphite rheostats is that the conducting capacity of the graphite varies; this makes them quite unfit for measuring purposes, but is of no importance for rheostats required only for regulating the strength of currents, and certainly the graphite rheostats are up to now the most suitable resistances for portable batteries. They are best made of lead pencils; the length which the current has to pass through can be varied conveniently by a sliding spring on the pencils. Dr. Herschell recommends the Bailey Rheostat made by the Law Battery Company, U.S.A.

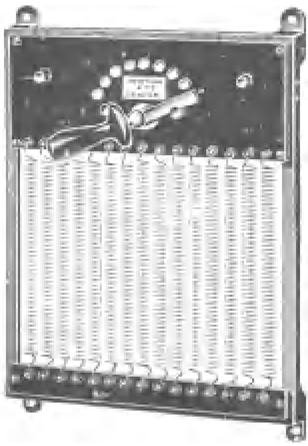


Fig. 74.—Series Resistance.

High-Tension Transformer. — A transformer consists essentially of a closed iron circuit, and a primary, secondary and safety winding, and is used to produce high-tension impulse with small consumption of primary current. A transformer is capable of withstanding any ordinary tension which it may be put to, and provided the apparatus is used properly, and there is no sudden reversal of current, for instance, there is no danger of the insulation giving way (*Fig.* 75). The secondary circuit being open, the tension manifests itself by a stream of sparks between the secondary, terminals, which vary in length up to 300 mm. These instruments are mounted on a carrier, and have terminals provided for primary, secondary, and low-tension windings. In conjunction with the instrument are used a choking coil and rheostat, and by means of the latter the capacity given off the high tension inside of the transformer is controlled and reduced to a usable condition, so that the tension does not strike an arc, but manifests itself in a continuous stream of sparks.

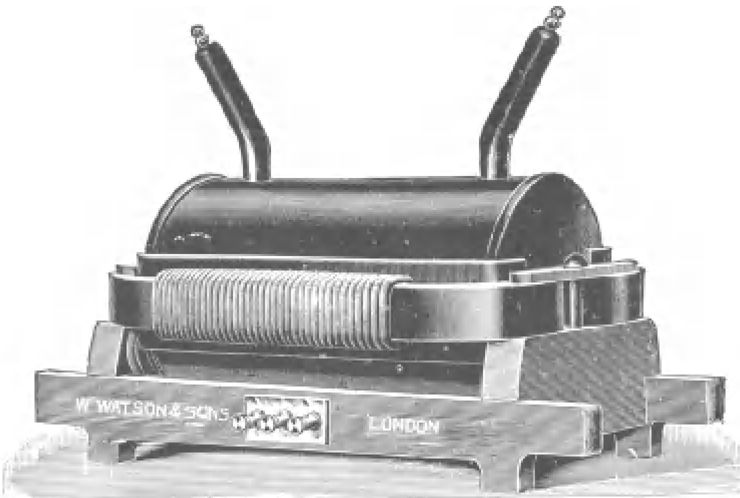


Fig. 75.—High-Tension Transformer.

Motor Transformers.—If a motor driven by the current from the main is coupled with a dynamo, we can produce currents of another type, or another voltage or ampèrage,

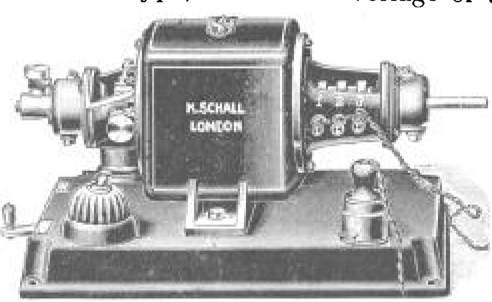


Fig. 76.—Motor Transformer.

according to the dynamo chosen. Such combinations are called motor transformers (*Fig.* 76). They are used for a great variety of purposes; in some cases an existing alternating current has to be converted into a continuous current, because the latter is better for a spark coil, or an arc lamp for treating lupus. In other cases an existing continuous current may have to be converted into an alternating current, either to obtain sinusoidal currents, or for transformers for high-frequency currents. Ultimately, the voltage of a continuous current may have to be reduced to make it suitable for arc lamps, or for charging accumulators; or else the current may have to be transformed as a measure of precaution, to make the current applied in a bath independent of the main and of leakages, and thus avoid all possibility of shocks.

The Safety of using Currents from the Main.—If a shunt rheostat and lamp, as described below, be used, it is scarcely possible for the patient to receive too powerful a current, that is a *dangerous* shock. Of course the current may be turned on by mistake while the spring of the rheostat is "strong" instead of "weak," just as this can happen while the current collector of the battery is still full on. In both instances a very unpleasant but not dangerous shock will be given. With the usual system of underground cables, the E.M.F. of a continuous current never rises suddenly to dangerous proportions.

In most installations, however, owing to defective insulation, there is a certain amount of leakage or escape of electricity to earth (*Fig.* 77). If the three-wire system be used, and the positive pole of the dynamo is connected with earth, a patient, also in good earth contact, may receive a shock when the electrode is applied, even if there is ample resistance, or if this electrode happens to be connected with the negative pole of the dynamo. Such shocks practically never occur, owing to patients being usually well insulated from the earth by a carpet or dry wooden floor. Operators have received unpleasant shocks from holding an electrode in one hand, while they attempted with the other to open a water tap to moisten the electrodes. It must be made a rule not on any account to touch gas or water pipes so long as one hand is in contact with the switchboard or an electrode. There is really no danger in local applications of the current if this rule is adhered to.

The case is, however, different if the current is to be applied in a bath. A patient might receive even a fatal shock if the necessary precautions are neglected. The water in a bath tub, even if the latter is made of porcelain, is usually in excellent contact with the earth through the waste-pipes, etc., which are of metal. If the current is intended to be applied in a bath, it is necessary to insulate the water by replacing the metallic waste-pipes by others

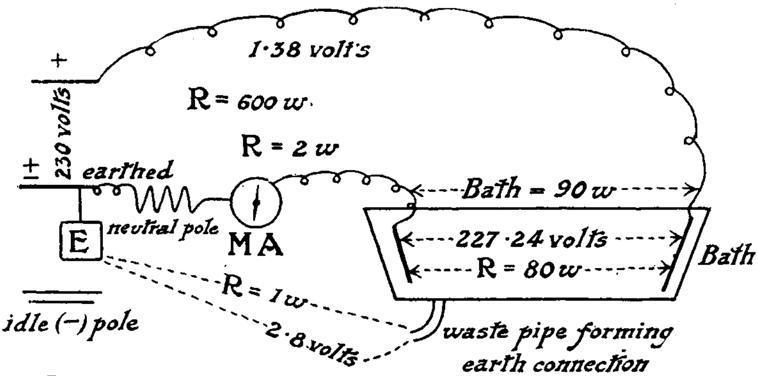


Fig. 77.—Scheme of Electric Bath Circuit to show how short-circuiting may take place by means of the earth contact with waste pipe.

made of earthenware for a considerable distance : or better, to let the bath discharge pipe run into an open gully connected with a main waste pipe (*Fig.* 78) ; by enclosing the inlet pipes and taps in wooden cases, so that a patient cannot possibly touch them ; and by using a bath tub made of porcelain or wood. If this cannot be done, the metal bath tub must at least be placed on porcelain tiles. If the leakage is bad, or if one pole of the mains is earthed, there should be no current reverser on the switchboard. If the current is used for an electric bath in a hospital or hydropathic, it is advisable to transform the current by means of an electric motor driving a small dynamo, which affords effectual protection against shocks.

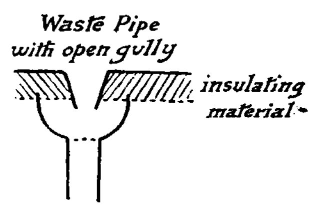


Fig. 78.

The above remarks apply to the full hydro-electric bath ; if the current is applied in small local baths to feet or arms, as, for instance in the Schnee 4-cell bath, there is no danger at all, because small earthenware or glass vessels are usually employed, which are not connected with the earth by waste-pipes.

Switchboard for Galvanization.—In order to control current from the main for galvanization and electrolysis,

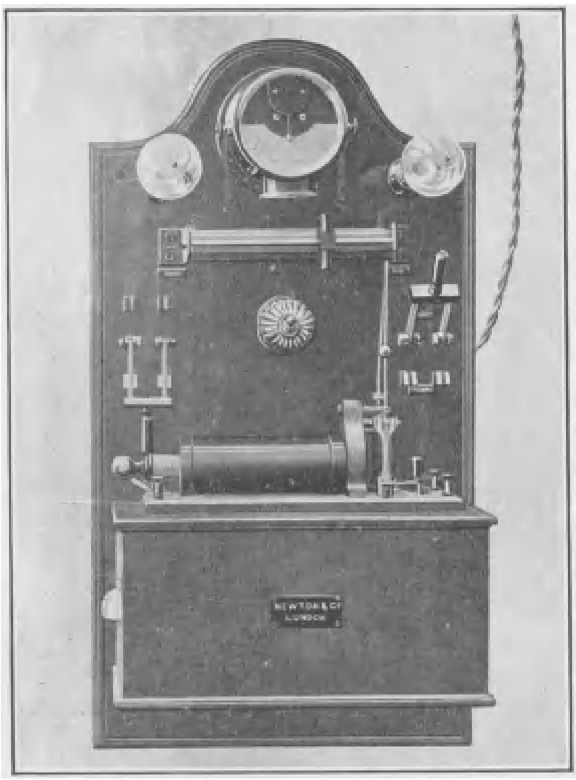


Fig. 79.—Switchboard for Galvanization, Electrolysis, and Faradization, consisting of Volt Selector to vary the current from the main from 0·1 volt gradually up to about 70 volts; Sledge Coil, Galvanometer with two shunts; Current Reverser and Dr. de Watteville's Key.

a special shunt rheostat or volt selector is used (*Fig.* 79). It consists of a slate core round which about 500 turns of fine platinoid wire are wound; the single turns are quite close together, but insulated from one another. The total resistance is over 500 ohms. An incandescent lamp of 15 to 32 C.P., or preferably two lamps in parallel, are also inserted in the circuit, partly as a safety resistance to protect the patient against an overdose, partly to increase the total resistance, so that the fine platinoid wire cannot be overheated. Moreover, the lamp burns with a dull red light as long as the switch is turned on, whether the electrodes are connected or not, and thus acts as a signal to the operator to turn the current off when the application is over.

If the sliding spring is on the right-hand near B, the E.M.F. between the terminals leading to the patient is only a small fraction of a volt. As we move the spring towards the left, the E.M.F. available at the terminals

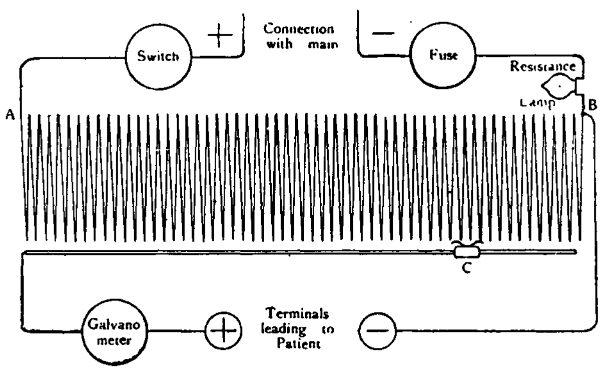


Fig. 80.—Diagram of Switchboard with Lamp and Wire Resistance.

will increase, but only very gradually. A galvanometer should always be used with these apparatus. The number of cells in a battery is some sort of guide to current strength; but with 100-volt current from the main it is dangerous to dispense with a galvanometer.

Galvanometers.—By means of these delicate instruments (*Fig.* 81) the current strength is estimated while passing through the patient, and the physician is in a position to accurately graduate the *dose*, with different batteries and with patients of different degrees of sensibility and resistance. For their introduction we are chiefly indebted to Edelmann and von Ziemssen.

Galvanometers may be vertical or horizontal. It is easier to read a vertical instrument, but they are not so reliable as the horizontal type, owing to changes which take place in the magnetism of the needles. Following these alterations, so also do the directing influences of the terrestrial magnetism and of the current change in the same proportion. Horizontal galvanometers are therefore generally to be preferred.

Fig. 81.
The d'Arsonval Galvanometer.

Suspension of the Magnet.—The inertia is least in the case of instruments the magnet of which is suspended on a cocoon fibre, and in this case the friction also remains the same. Such instruments have therefore the great advantage that if their graduation be correct for a certain locality, this graduation will always remain correct and reliable. These are no doubt the most sensitive instruments, as currents up to $\frac{1}{10}$th, or even $\frac{1}{100}$th of a milliampère can be measured. In all cases where perfect accuracy is required, only such apparatus should be used. As these instruments are somewhat delicate and expensive, portable batteries are now provided with galvanometers, the magnets of which are suspended on a steel point, as in a compass. Ordinary

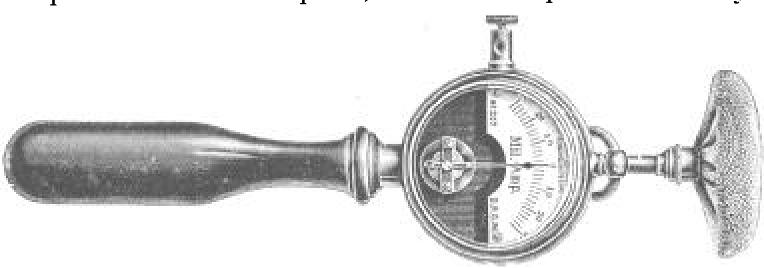


Fig. 82—Combined Electrode Holder and Galvanometer.

sewing-needles are used for this purpose, since they are easily replaced by new ones, in order to keep them sharp and the instrument sensitive.

The d'Arsonval galvanometers are so constructed as to work in any position with accuracy. They are provided with a movable horse-shoe magnet, which is deflected from its direction toward the north pole by an electrical current circulating in its neighbourhood. Kelvin suggested replacing this permanent magnet by a solenoid, and other scientists made practical use of the idea. Many turns of a fine insulated wire are bound on a frame of aluminium, which is suspended between two points so that it can move freely. Two hair-springs keep the frame in a certain position, and at the same time conduct the current to the solenoid. As long as a current passes through the solenoid, it is attracted or repelled, according to the polarity, by a current circulating in the neighbourhood, and the elasticity of the hair-springs is the power which has to be overcome, and which brings the frame back to its original position as soon as the current ceases. These galvanometers are therefore quite independent of the terrestrial magnetism, and can be used in horizontal, vertical, or any other position ; moreover, they are protected by a horse-shoe magnet, which acts as a screen against disturbing influences from outside. The galvanometers with a magnet dependent on the north pole are so much influenced by the current supplied for lighting houses, that it is impossible to take exact measurements in houses lit by electricity, whereas these new galvanometers remain correct even near dynamos.

These advantages render the d'Arsonval galvanometers specially useful for all apparatus utilizing currents from the main ; they are, however, equally convenient for batteries, their only drawback being that the hair-springs are easily damaged if too strong a current is sent through the galvanometer.

Shunt.—All medical galvanometers are divided into milliampères. In order to be able to measure weak currents for galvanization, as well as strong currents for electrolysis, with the same instrument, most galvanometers are fitted with a shunt, which can easily be switched on and off. So long as this shunt is not used, the whole current has to pass through a long fine wire, which is arranged to make the magnet decline from the magnetic meridian. If, however, the shunt is brought into action, by screwing home a screw marked X (*Fig.* 83) the current finds another passage through a short and thicker wire, which is wound so as not to influence the magnet, and in this way, two paths being open to the current, it will divide itself among both, so that its strength in each branch is inversely proportional to the resistance of the wire. If, for instance, the shunt wire is chosen so that its resistance is $\frac{1}{10}$th of the resistance of that wire which makes the needle decline, only $\frac{1}{10}$th of the current will flow through the latter wire, and $\frac{9}{10}$ths through the shunt wire. The magnet, therefore, will be influenced by only $\frac{1}{10}$th of the current which actually passes through the galvanometer; and consequently the numbers indicated on the dial have to be multiplied by 10 in order to find the real strength of the current. A galvanometer, for instance, which, without the shunt, indicates up to 25 milliampères one by one, will, if the shunt is used, show up to 250 milliampères 10 by 10. The resistance of the shunt can also be so arranged that the numbers on the dial have to be multiplied by 100.

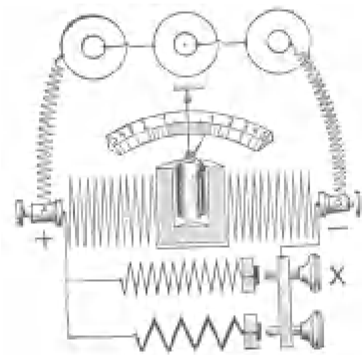


Fig. 83.
Plan of Shunt Circuits of a Galvanometer.

Voltmeter. — If the resistance has been increased up to 1,000 ohms, a milliampèremeter can be used for measuring the E.M.F.; for as a current of 1 volt produces 1 milliampère in 1,000 ohms, the number of milliampères is equal to the number of volts as long as the resistance in the circuit is 1,000 ohms. The body of a patient, or any other unknown resistance, must not therefore be in the circuit while the E.M.F. of the cells is being measured.

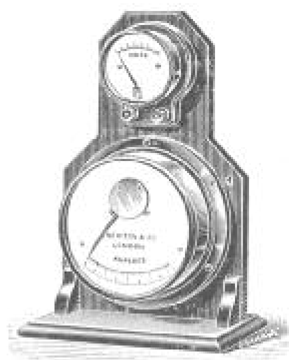


Fig. 84.—Voltmeter.

If the strength of current obtained through a patient is known, and the E.M.F. of the cells which has been used to produce the above strength has been measured in volts in the way just mentioned, the resistance of the patient can be ascertained with the formula :—

$$\frac{\text{E.M.F.}}{\text{Current}} = \text{Resistance.}$$

A galvanometer, the sensitiveness of which has been reduced by screwing home the shunt, is of course insensible to weak currents; on the other hand, however, a single cell is insufficient to deflect the needle of the galvanometer to a right angle as long as there is not the resistance of a patient in the circuit.

Current Reversers and Combiners.—It is important for most physicians to possess an arrangement which makes it possible suddenly to close or interrupt the current, or else suddenly to connect with the negative pole the electrode hitherto connected with the positive pole, and *vice versa*. These sudden changes produce contractions of the muscles, the intensity of which depends on the strength of the current and the sensitiveness and healthiness of the muscle. They are therefore very important for diagnosis. To interrupt and to reverse the current can be managed with a single instrument, of which we give a diagram (*Fig.* 85). The negative pole of the battery is connected with R and N, the positive pole with the metal piece between these two. While the cranks point towards N (normal), as in the illustration, the right-hand crank is connected with the negative pole, and the left-hand crank with the positive.

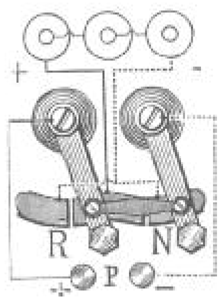


Fig. 85—Current Reverser.

By moving the cranks slightly to the left, so that they rest on R and N, both cranks are in contact with the negative pole, consequently there is no current at all; but if we move the cranks farther, so that they point towards R, the left-hand crank is connected with the negative, and the right-hand crank with the positive pole. From each crank a wire leads to a terminal screw.

Current reversers are manufactured in many shapes, but in principle their construction is always the same.

Current Alternator and Combiner.—In order to be able to change the continuous or the faradic current suddenly, without having to connect the electrodes with other terminals, and in order to be able to apply at the same time continuous and faradic currents combined, Dr. de Watteville has suggested a convenient apparatus, which outwardly resembles a current reverser (*Fig.* 86). While the cranks point to G, the galvanic current is connected with the terminals; while the cranks point to F, the faradic current is connected with the terminals; and while they stand half way (G F), the galvanic and faradic currents are connected with each other in series, i.e., the continuous current has to pass through the bobbin of the induction coil and the patient, and the faradic current has to pass through the patient and all the cells of the continuous current battery. Thus both currents pass through the patient at the same time.

Fig. 86.—De Watteville's Alternator.

Electrodes.—The various sizes and shapes are well known. Care should be taken that there is no hole in the chamois covering permitting contact of the metal with the patient's skin, as this would be painful, and even cause sores to break out. With plate electrodes a frequent fault is not to have them large enough. Dr. Herschell prefers sponge electrodes (*Fig.* 87) on a wooden cup base for galvanism, in place of the metal with leather cover.

Handles.—The handles are provided with a terminal for the reception of a connecting cord, and with a thread fitting the electrodes. They are also provided with an insulating handle, so that the physician holding them is not exposed to the action of the current. Many handles are provided with a trigger, for making or breaking the current; this can be conveniently managed on the handles with one finger only, whereas the hand is required to work an interrupter on the battery. There are also handles which contain a current reverser or a rheostat; but they are complicated, and are rarely of real advantage.

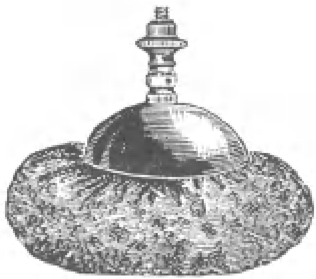


Fig. 87

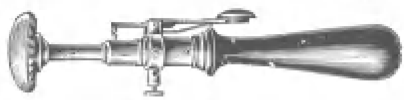


Fig. 88

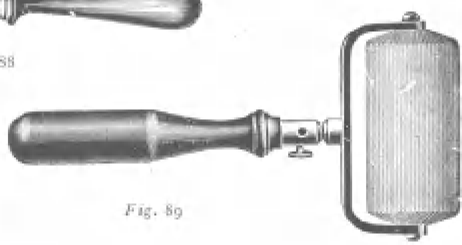


Fig. 89

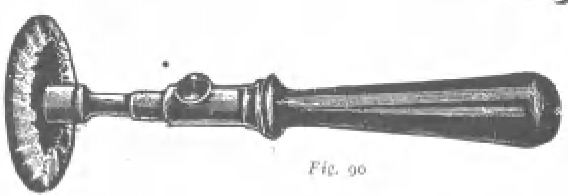


Fig. 90

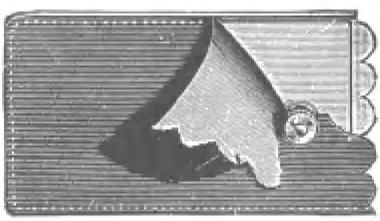


Fig. 91

Figs. 87 to 91.—Various forms of Electrodes.

Cords.—Two connecting cords of suitable length, covered with some insulating material, are necessary for conducting the current from the battery to the patient. Insulated copper wire, which is bare for half an inch at both ends, is sufficient ; but, on account of the greater flexibility, cords made of about twelve very fine wires, terminating at both ends in short and thick wires, are mostly used. These are fastened in the handles and in the terminals of the battery. The short wires should not be soldered on to the cords, as soldered parts stand no bending,—a ball and socket joint is best. Cords may be insulated by means of silk, or cotton or indiarubber may be used, but these soon perish. The silk-covered cords last a long time.

Density of the Current.—The size of the electrodes is of considerable importance. The larger the electrode, the smaller the resistance of the human body. Electrodes of ten square inches surface will pass through the body twice the current that can be conveyed by five square inches under otherwise equal conditions. This leads us to the density of the current, or, in other words, the proportion of the strength of current to the sectional area of the conductor. If, for instance, with electrodes of three square inches surface 20 milliampères are passing through the body, the current is three times as dense as if electrodes of nine square inches and the same strength of current were used. In other words, in the first case each square inch of the places of application receives 6·6 milliampères, whereas in the second case only 2·2 milliampères are received by the same area. The physiological and chemical effects would in the first case be three times as strong at and near the point to which we apply the electrode as in the second case. Statements that such and such results have been obtained with so many milliampères are therefore incomplete unless the diameter of the electrodes used, and the time of application, are mentioned as well. On entering the body the current divides itself into numerous loops and branches, and follows the best conducting parts till it reaches the other electrode. The density is greatest where the two electrodes touch the body ; it is a little less near the straight line connecting the two electrodes, and smallest in those parts of the body which are most distant from the electrodes ; but experiment shows that even those parts are reached by some small part of the current.

The effect of the current is frequently desired in one definite spot only, but as we necessarily require two electrodes to complete the circuit, they are chosen of very different diameter : a small one (active electrode) to concentrate the current on the nerve or muscle, etc., which is to be influenced by the current, and a large one (called the indifferent electrode) which may be applied to the hands or any easily accessible part of the body. If the latter electrode is chosen sufficiently large, undesirable effects, such as pain or blisters, etc., will be avoided.

Faults in a Battery.—If a battery does not work, it is essential to ascertain where the fault is : whether in the cells, in the connection between the cells and the terminals, or in the cords, handles, etc. The fault will most frequently be found in the connecting cords. They are liable to break, and this shows itself by their too great flexibility; they should be cut off at the defective point. In all batteries with a great number of elements, a spark appears if the two ends of the connecting cords are brought in contact and separated again. If no spark is seen, fasten one end of a cord to a terminal, and touch with the other end the other terminal. If still no spark is visible, touch the first peg with one end of a cord, and with the other end touch the last peg of the collector, and if there is still no spark, try with groups of, say, five elements each, either on the pegs of the current collector or directly on the terminals of the cells. If the elements are not very old, a spark will be obtained from several of these groups, and the faulty cells may be singled out. A whole battery may fail because one of the many screws on the cells may have become loose, on account of differences of temperature or shaking in transit, for a loose screw makes no contact with the wire which connects one cell with the next. This can easily be rectified by tightening the screw. Another reason may be, that in consequence of short circuit (caused by a wrong position of the current collector, or by a fault in the cell), a zinc is eaten through, or the fluid has escaped through a crack in the element vessel. In both cases the connection is interrupted, and the defective cell or cells must be removed and refilled, or replaced by new ones ; if this is impossible at the time, the last cells of the battery may be taken off and put in place of those which are defective until new can be obtained. (Batteries which are so constructed that each single cell can be taken out, are for this reason much better than those in which the cells are soldered together, or otherwise inaccessible ; for if one cell in the latter goes wrong, the whole battery has to be returned to the maker). A galvanometer greatly helps to locate such a fault : the cords are connected with the galvanometer, and the other ends are placed first on pegs 1 and 2, then on 2 and 3, etc. ; in this way each cell can be tested and any fault detected. In batteries provided with a double collector it is simpler still. If two wires connected with the cell be applied to the tongue of the operator, a peculiar taste is felt while the cell is working. This method, however, is dangerous if the battery contains more than ten cells.

It is rare that a fault occurs in the connections between the cells and the current collector, the wires being mostly well protected and all the invisible connections being soldered. The pegs of the current collector, as well as the current reverser, are liable to get oxidized, especially in acid batteries, and have to be cleaned occasionally with fine emery paper ; dust between the pegs should be removed with a fine hair brush. The screws which keep the cranks of the current collector and reverser on their axes may work loose, and have to be tightened. The handles with an interrupter may fail to make contact through oxidation, or through the spring being loose. *Cords, handles, or wet electrodes ought never to be placed on the current collector, etc., as they may cause short circuit.*

GENERAL TECHNIQUE OF GALVANIZATION.

The Galvanic Current may be employed locally or generally. The application may be (1) stabile or (2) labile. In the first method the electrode is kept in one position throughout the application. In the second it is moved about over the area to be treated, without, however, breaking contact. The active electrode may be anode or cathode, according to circumstances.

General Galvanization.—The patient is completely stripped, and lies on a couch with bare feet in contact with a large covered electrode, which is as usual moistened with a little warm vinegar and water or saline; alternatively, the patient may sit upon a chair and place his feet in a basin of warm water in which lies the cathode.

The anode is then rapidly passed over the surface of the patient's body, commencing with the head, then the back, spine, trunk, and limbs.

The current strength will vary from one to two milliampères for the head, up to eight or ten for the rest of the body. Generally, galvanism is only so employed for exceptional cases, being more commonly used in the form of the galvanic bath (*q. v.*).

Fig. 92.—Galvanic Battery with Collector and Commutator.

Central Galvanization.—The patient is stripped to the waist, and a flat plate electrode, 3 in. by 4 in., or large cup sponge electrode, is held against the epigastrium by the patient himself—the cathode being used for the purpose. For the active electrode the anode is used, the electrode itself being a medium size of cup sponge type. With a current of three milliampères in the circuit, this electrode should be first applied to the epigastrium, and rubbed backwards and forwards for about one minute. With the hair moistened, the electrode should be passed over the surface of the head, and be held at the vertex for about two minutes, while the current is increased up to ten milliampères, and then gradually reduced to zero again.

The neck is then treated with a current of about the same strength; the active electrode is next passed up and down the spinal furrow for about ten minutes, and then, the current having been reduced to zero, removed, and the skin carefully dried. It is of great importance to avoid any sudden changes of current strength. Pain is caused to the patient if the electrode be applied to any point where the skin is broken or cut.

Central galvanism is effective where we desire to influence the various centres in brain and cord, and often markedly improves various functional nervous conditions, such as hysteria, neurasthenia, insomnia, dyspepsia, and also chorea and exophthalmic goitre.

General Rules as to Dosage, etc.

1. The strength of the current employed in individual cases varies considerably; it will very seldom exceed twenty milliampères, and generally speaking will range from five to twenty. A reliable galvanometer is employed to determine the amount of current passing at any moment.

2. Children are much more sensitive to currents than adults.

3. The electrodes must be placed in position before the current is turned on. Much care is needed in turning on the current, and in increasing and decreasing the strength, to avoid sudden, abrupt changes, which are both unpleasant and painful to the patient.

4. As a rule, ten minutes suffices for an ordinary séance.

5. In chronic cases, treatment three times a week is usual; in acute cases it may be desirable to give several applications in one day.

6. The duration of a course must naturally vary considerably with the nature of the complaint. In paralytic cases treatment is sometimes continued for a year or more.

THERAPEUTIC INDICATIONS.

Stabile anodal applications of galvanic current are sedative in effect, and are of service in the treatment of painful and spasmodic conditions—neuralgia and sciatica, and various morbid states dependent on over-excitability. Stabile and labile applications of the cathode are stimulating in effect on nerves and voluntary and involuntary muscles; they are largely utilized in the treatment of various paretic and paralytic conditions.

FARADISM, OR THE INTERRUPTED CURRENT.

Michael Faraday found that in a close circuit a current is induced as often as a magnet is approached to or withdrawn from this conductor, or as often as a current is closed or interrupted in the vicinity of the closed circuit.

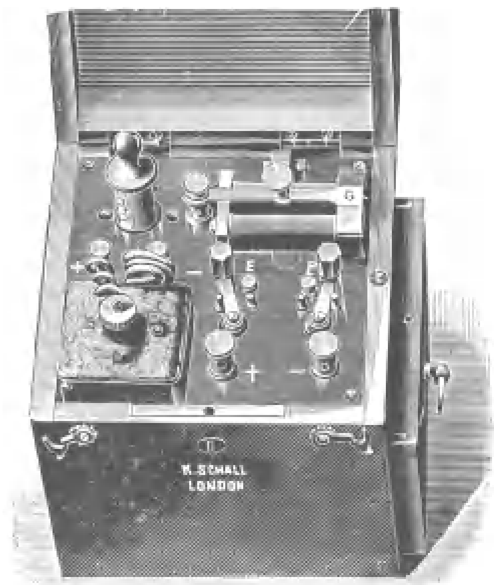


Fig. 93.—Spamer's Induction Coil, with Dry Cell.

This discovery was the first step in the direction of producing electricity by mechanical power—towards the dynamo, telephone, and all the other electrical innovations of the past half-century.

The Induction Coil.—This coil has been generally adopted as the source of interrupted currents in medical work. It is an inexpensive, portable, and generally convenient method of producing motor and sensory effects. Faradism is admirable where electrical stimulation is required, and its only drawback is that there is no easy or entirely reliable means of estimating the strength of the current we employ. There is a great variety of coils on the market. That of Spamer (*Fig.* 93) is very convenient, and with fair usage will last a long time. The writer has had one, made by Mr. Schall, for nearly fifteen years,

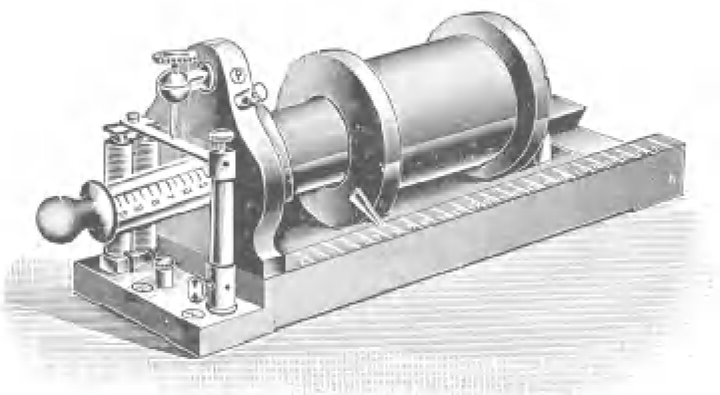


Fig. 94.—Lewis Jones's Sledge Coil.

and it is still in excellent working order. The current strength is more easily regulated if a sledge coil, such as Dr. Lewis Jones's, be employed (*Fig.* 94).

Construction of Medical Coils.—The shape and external appearance of the coils employed for medical purposes vary greatly, but (if we except the magneto-electric machines, which are now rarely used) they are all constructed on the same principle. The primary coils have between 100 and 300 turns of wire. The resistance of the primary coil should vary from five to fifteen ohms, so that even two cells can produce a strong current in it. The diameter of the wire ought, therefore, not to be too small. Insulated copper wire, No. 22 B.W.G., is generally used for the primary coils. The E.M.F. of the primary current varies under these circumstances between five and thirty volts, according to the number of turns, and whether the iron core is drawn out or pushed home.

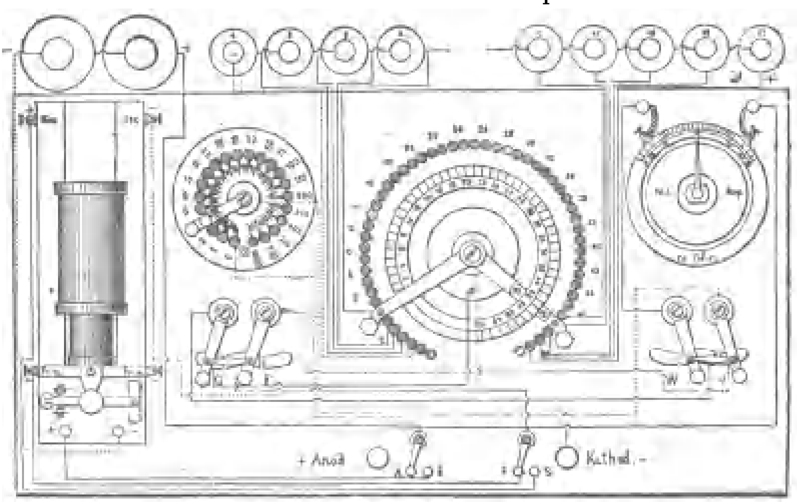


Fig. 95.—Scheme of Galvano-faradic Battery with Sledge-coil, Double Collector, Current Reverser, Galvanometer, and Cell Connections shown.

Origin of Induced Currents.—If the two ends of a wire are connected with a sensitive galvanometer, and a magnet brought near the wire, the needle of the galvanometer declines *so long as the magnet is approaching*, and returns to zero if the interval between wire and magnet is allowed to remain constant.

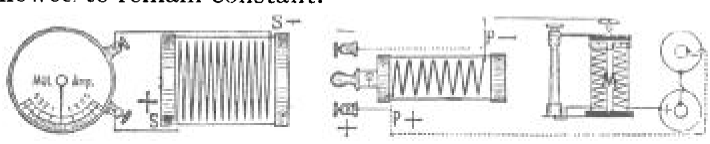


Fig. 96.—Diagram Illustrative of Induced Currents.

If the magnet be withdrawn, the needle declines again, but in the opposite direction. If in the neighbourhood of the closed conductor a second wire is drawn parallel to the first, and this second wire is connected with a galvanic cell, the needle deflects the moment the circuit is closed, although there is no connection whatever between the two wires; but it returns to zero immediately afterwards, and remains there, although the galvanic current continues to circulate in the second wire. If we diminish or interrupt the current, the needle deflects again, but in the opposite direction; thus showing that the approaching and withdrawing of the magnet—or the making and breaking of a current in a conductor close by—induces currents in a closed circuit, which are, however, of very short duration and pass in opposite directions.

Alternating Currents.—The currents induced by closing a galvanic current pass in the direction opposite to that of the inducing current, those induced by breaking

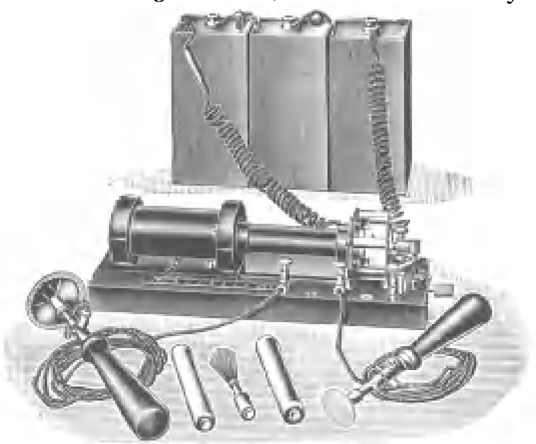


Fig. 97.—Hovent's Sledge Coil, with a special device for obtaining slow to rapid interruptions, varying from 30 to 1500 per minute.

the inducing current pass in the same direction as the inducing current. If we make and break the inducing current very often consecutively, we induce each time a momentary current in another conductor; but the directions of these induced currents keep changing, and for this reason we call them alternating currents, in contrast to those which keep their polarity.

Wagner's hammer is most frequently used for rapidly making and breaking the current. The current passes through the electro-magnet, through the hammer, the contact screw, and back to the battery; or else it can be made to pass from the contact screw, through the inducing wire, and then back to the battery. As soon as this arrangement is connected with a cell, the electro-magnet becomes magnetic and attracts the hammer, which consequently leaves the platinum point of the contact screw. This, however, interrupts the current, the electro-magnet ceases to be magnetic, and a spring causes the hammer to fly back; as soon as it touches the platinum point again, the current is once more closed and the hammer attracted, and this play lasts as long as the apparatus is connected with a cell giving a current.

Self-Induction. Extra Currents.—The wire through which the inducing current passes is called the primary wire, and the wire in which currents are induced is called the secondary; the induced current is called the secondary current. For various reasons the primary and secondary wires are not drawn in a straight line, but are wound in spirals on cylinders of wood, paper, etc., which are made of such sizes that the primary coil can be pushed into the secondary coil. In a spiral, each turn of the wire is parallel with the previous and following turns of the same spiral; and a current which passes through a turn of the spiral must therefore have an inducing influence on the other turns close by. This effect of the different turns of the same spiral on each other is called self-induction, and the current thus induced is called *the extra current.* If the current is made, the extra current, too, has an opposite direction to the inducing current, and thereby retards and weakens it and, consequently, the secondary also; but if the inducing current is interrupted, the extra current flows in the same direction as the inducing current, and thereby increases the latter considerably, and the secondary current as well. The shocks induced by making and breaking the inducing current are, therefore, of very unequal strength; those made by breaking the inducing current predominate very much, and the signs + and −, which are the terminals of the better induction coils, are intended to show the direction of the currents induced by breaking the inducing current. The signs would have no meaning if the currents resulting from making and breaking the inducing current had an equal strength, as they follow one another in opposite directions.

Primary Currents.—If we connect one or two galvanic cells with a Wagner's hammer, which is provided with a small electro-magnet only, and connect the cells by two further wires with two electrodes, which we hold in our hands, we shall not feel the making or breaking of the current. But if the current has to pass a primary coil with several hundred turns of wire besides the Wagner's hammer, each breaking of the current gives us a decided shock, the strength of which, amongst other things, depends upon the number of turns of the coil, and varies with the extra current. This is the primary current, which we obtain from medical induction apparatus; it is an intermittent galvanic current, very considerably increased by the extra current, but it is not alternating. The inducing effect of a current is considerably increased by letting it act simultaneously with a magnet, and this can be arranged easily if the primary wire is wound round *an iron core*, or better, if it is wound round a cylinder into which an iron core can be pushed. It is, however, preferable that the core should consist of a bundle of soft iron wires, as these take and lose magnetism much more quickly than solid iron.

The Electro-motive Force of the induced current depends (1) On the number of turns of wire which a coil has: the more turns the higher the E.M.F.; (2) On the strength of the inducing currents: the stronger the latter, the higher the E.M.F. of the induced currents; (3) On the presence or absence of an electro-magnet: its presence increases the E.M.F. of the induced current very materially; (4) On the suddenness of the break of the inducing current. Ultimately the E.M.F. of the secondary current depends on the distance between the secondary and primary coils: the closer they are together, the higher is the E.M.F., and *vice versa*.

Strength of the Induced Current.—This depends, too, on Ohm's law. If, for instance, an induced current has 70 volts, and the resistance of the secondary coil is 610 ohms, and the resistance of the patient 2,300 ohms, the strength of the current would be :—

$$\frac{70 \text{ volts}}{610 + 2{,}300 \text{ ohms}} = 0{\cdot}024 \text{ ampères} = 24 \text{ milliampères.}$$

The strength of an induced current cannot be measured with an ordinary galvanometer, because the secondary current is alternating, and would therefore make the needle deflect one moment to the right, and the next moment to the left. Some galvanometers which are constructed without permanent magnets might be used; but the chief obstacle is that the currents are intermittent, and since each impulse lasts but a very short time the galvanometer remains for a while without any current, until a second impulse occurs. If there are thirty interruptions per second, such a galvanometer would indicate more current than if there are only five interruptions per second, although in both cases the actual strength of current would not vary. The only possibility of measuring the currents of faradic coils in absolute units consists in measuring their E.M.F., and later on we shall describe an apparatus for this purpose.

The chemical action of faradic currents is small, principally on account of their very short duration, and, moreover, because they are alternating, so that each following impulse in the secondary current partly neutralizes the effect of the preceding impulse. The mechanical effect of these suddenly appearing and disappearing currents on the human body, however, is very intense. If we place electrodes on the body, the muscles contract each time the current is made, and much more so when it is broken, so that they can be excited with these currents to a great extent.

Differences in the Effects produced by Primary and Secondary Currents.—The effect produced by the secondary current depends a great deal on the diameter of the wire which is used. Very fine wires (0·1 millimetre, or finer) produce a pricking local pain, but not very strong muscular contractions; if we increase the diameter of the wire, the contractions become more powerful; if the secondary coils are wound with thick wire (No. 18 to 22 B.W.G.), they produce exactly the same effects as primary current, i.e., less local pain, but powerful contractions of the muscles near the electrodes, or even in the whole body. The primary or the secondary current produced in a coil with thick wire is frequently applied when the deeper-lying organs, such as, for instance, the bowels, are to be treated; whereas the secondary current produced by a coil with fine wire is chiefly used for treatment of muscles and nerves which lie near the skin. This is the practical difference between primary and secondary currents. It is no doubt entirely due to the great difference in the resistance of the coils and in the E.M.F., but it is impossible to draw a sharp line between them, and to define accurately in what cases the one or the other should be applied. For the electric bath the primary current, or a secondary coil with thick wire, only can be used.

Regulation of the Primary Currents.—The E.M.F. of the primary current can be regulated in different ways: for instance, by inserting a larger or smaller number of turns of wire by means of a crank, etc. The simplest and almost only practical method, however, is to regulate the E.M.F. by pushing the iron core in and out. The primary current is weakest if the iron core is drawn out, and becomes stronger as it is pushed in. Instead of drawing the iron core out, a damper in the shape of a brass or copper tube can be slipped over it with the same effect. If the iron core is entirely covered with the tube, its inducing power ceases, but the E.M.F. increases the more the brass tube is withdrawn. The position of the secondary coil has no influence on the strength of the primary current.

Regulation of the Secondary Current.—The secondary coil is generally constructed with a large number of turns of wire, about 2,000 to 6,000, for in most cases it is desired to obtain a high E.M.F. The wire used is generally thin copper, about No. 36 B.W.G. The resistance of the secondary coil varies under these circumstances between 100 and 900 ohms, and the E.M.F. between 10 and 200 volts. The strength of the secondary current can be regulated in different ways. If the apparatus has a small primary coil, it is sufficient for all purposes of treatment to regulate the strength of the secondary current by merely pushing the iron core in and out, for a current which is hardly to be felt when the iron core is drawn out, can be increased quite gradually to painful strength by pushing it home. The more complete coils, however, are so arranged that the distance between the primary and secondary coil can be easily changed (*see Fig.* 98). In this case the secondary coil slides on a sledge, and can be pushed over the primary, or be drawn away from it, an arrangement which allows an exceedingly fine regulation of the current. These sledge coils, which were first suggested by Du Bois Raymond, are decidedly preferable to any others for diagnostic and physiological purposes. The strength of current in this apparatus can be further regulated by pushing the iron core in and out (*Fig.* 100). The secondary current might also be regulated by means of a crank which inserts more or less turns of wire, but this does not allow of as fine graduation as the moving of the iron core or the coils; or it might be regulated by rheostats, but

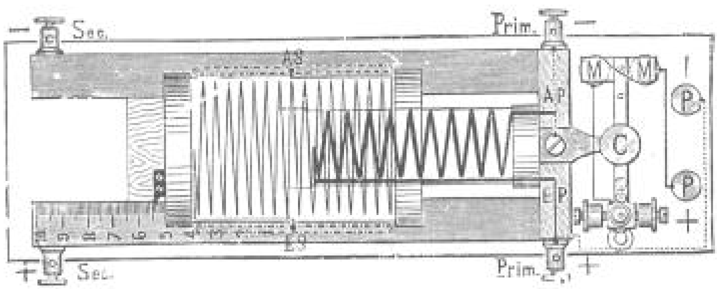


Fig. 98.—Diagram illustrating the Regulation of the Secondary Current.

this is not very practicable, and is seldom employed, as high resistances would be required.

Rapidity of Interruptions.—The Wagner hammer of an induction apparatus (*Fig.* 99) can be regulated within certain limits, so that the interruptions follow one another with greater or less rapidity. The sooner the hammer meets the platinum point again after having been drawn away from the electro-magnet by the force of a spring, the sooner the current is closed and the hammer attracted again. The further we close this contact screw, the quicker will be the vibrations; but if we make it too tight the hammer has no room for moving, and ceases to work, and vice versa; but we must not unscrew it too far, for the hammer must make good contact with the platinum point in flying back, or it will also cease to vibrate. The power of the spring as well as the strength of the inducing current, have, however, something to do with the rapidity of the interruptions. In order to make these still slower, the hammer can be lengthened with a bar, on which an aluminium ball can be raised or lowered. The longer this pendulum is, the slower are the interruptions ; they can be reduced to twenty or even less per minute. Some apparatus are fitted with clockwork, which can be made to run at any speed, and the interruptions produced per minute are accurately registered by this means. Slow interruptions produce more powerful and painful contractions than quick ones. If the number of interruptions is very great, anæsthesia can be produced, and apparatus of high rate of speed have been made for obtaining this result (*Fig.* 97).

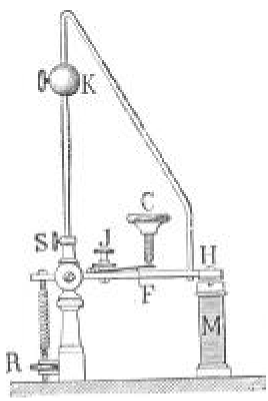


Fig. 99.—The Wagner Hammer.

Types of Cell employed.—The bichromate cell previously mentioned is one of the best. It has a high E.M.F., small internal resistance, and is easily kept in order.

Dry cells of the Leclanché type are so well suited for portable induction coils that they have practically superseded all other cells for this purpose. There is no corrosive fluid to spill, and they are constant in action. Schall finds that the Obach R cell, size $1\frac{3}{4}$ in. by $1\frac{3}{4}$ in. by $4\frac{1}{2}$ in. for instance, will work a Spamer coil for thirty to sixty hours (with the iron core out or in respectively), and the cell can be replaced at very small cost, less than that of the acid and zinc used in the same time, not to speak of the risk of spilling and injuring battery or clothes.

Failure to Work.—If an induction coil fails, it should first be seen whether the element is exhausted. Acid cells require refilling about once in a fortnight if the apparatus is in daily use. If it is certain that the cell is all right and gives the necessary current, one should see whether the interrupter is in order. The interrupter is the most delicate part of the induction coil, and therefore care is necessary not to interfere with the contact screw if it is not strictly necessary; for very often apparatus which were in quite good order have been spoiled by playing with this screw. The interrupter does not always start of its own accord, and has to be put in vibration by being slightly touched with the finger. The hammer should be arranged so that its distance from the electro-magnet is about the $\frac{1}{16}$th part of an inch, and the platinum point of the contact screw should just touch it. Those apparatus in which the hammer is fastened to a rigid bar, as in all sledge coils, are less liable to get out of order and to require readjustment than coils the hammer of which is attached to a watch-spring. The interruptions of these latter apparatus are also frequently less regular. If an interrupter has not the proper distance from the electro-magnet, it has to be carefully bent till it keeps the correct distance. The spark on the interrupter attracts dust, and the little platinum sheet should be cleaned occasionally with fine emery paper. Oil should on no account be allowed on the interrupter.

If the apparatus still fails, although cell and interrupter are right, see whether the connecting cords are in order. To try an apparatus by touching the terminals or the connecting cords with two fingers is useless. It can only be tested with well soaked and properly connected electrodes. The coil and the connections are very well protected, and can be damaged only by spilling a good deal of acid; the connections become oxidized in such a case, or the wires may even be eaten through. An apparatus damaged in this way has to be sent back to the manufacturer for repair.

The Regulation and Measurement of the Current Strength.—Some means of regulating, to a greater or less degree, the strength of the current, is necessary.

The following are the methods commonly employed:—

1. The strength of the magnetic field is varied by the use of a sliding core, as shown in *Fig.* 100. A small auxiliary electro-magnet is employed to work the interrupter. The current is a somewhat irregular one of low frequency. The interruptions are rather unpleasant to the patient, and such instruments are ill-adapted for delicate electrical testing.

2. A movable secondary coil is used, which can be brought into weaker or stronger parts of the magnetic field of the instrument. This method gives a wide range of current strength, but is only suitable for regulating the secondary current.

3. The iron core of the primary coil may be covered by means of a metal tube which slides over it and shields the coils from its magnetic action.

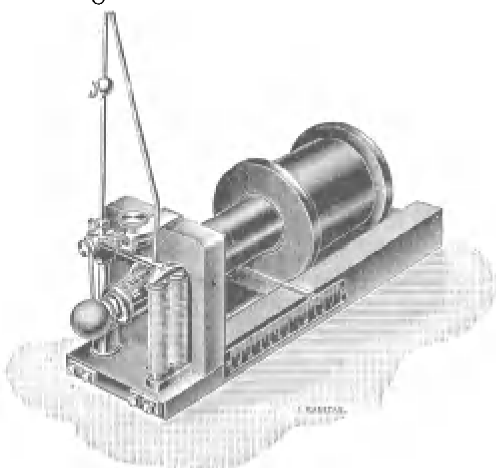


Fig. 100.—Du Bois Raymond's Coil, with Adjustable Interrupter and Sliding Core for regulating current strength.

4. The current strength may be varied by means of interposed resistance in the exciting or secondary circuit.

5. A switch may be used which brings into action a greater or less number of the windings of the secondary coil.

Measurement of Faradic Currents. — Galvanometers are not satisfactory for this purpose for two reasons: many of the instruments which are capable of measuring the alternating currents (for instance, the "hot wire" galvanometers) cannot yet be made so sensitive that they would indicate a few milliampères; they are only useful for currents from fifty milliampères upwards. The second, and more important reason, is that galvanometers cannot be used unless all the interrupters of the coils, the current of which is to be measured, vibrate at a uniform and fairly rapid rate, because, as mentioned previously, a galvanometer will register less if there are only five interruptions per second than if there are about twenty in the same time, in spite of the fact that the current may be of exactly the same strength in both cases.

Von Ziemssen and Edelmann have shown that currents of very short duration and a certain E.M.F. give the same physiological effects whether they are produced by an induction coil, a galvanic battery, or a condenser discharge. A coil was, therefore, constructed in which the scale was graduated in volts; the readings of the scale are correct as long as there is a primary current of exactly 0·3 ampère. Further condensers were constructed of one microfarad capacity, which could be charged from a battery and discharged through the patient in rapid succession by a key working like the interrupter of a coil. If the number of volts used for charging the condenser is known, the current can be measured, and the results compared, just as the number of milliampères with a continuous current.

The use of a continuous current with an interrupter worked by an electric motor has been suggested for testing the reaction of muscles, and for treatment with the interrupted current. The interrupter or reverser is fixed on the axis of the motor; it is in the circuit of a galvanic battery (or the current from the main), and a milliampère-meter is also in the circuit. By means of the latter the current flowing through the patient can be measured while the interrupter is at rest; when it is started, the galvanometer will indicate less, and the difference between the two readings can be used to find out the duration of the current. If the galvanometer indicates, for instance, one-fifth of its former reading, it shows that the current is closed for one-fifth, and "off" for four-fifths of the time of a period or revolution. The proportion between the time it is "on" to the time "off" can easily be varied and adjusted by altering the position of one of the two brushes.

It has been proved that more powerful contractions of muscles, with less pain, are obtained with short contacts and long intervals with no current, i.e., if the brushes are so adjusted that the time during which the current is closed is only about one-tenth of that during which the current is "off." The number of periods or interruptions per minute can be adjusted by means of the rheostat controlling the speed of the motor, and can be read off a speed counter. The E.M.F. used can be regulated by increasing or diminishing the number of cells in the circuit.

THE TECHNIQUE OF FARADIZATION.

The faradic current may be applied locally or generally, and by the stabile or labile methods (*Plate XXVII*).

The electrodes are similar in character to those used for galvanism, but there are some special types, such as the wire brush electrode. The sponges or leather covering should be moistened with salt and water, or if the sensory nerves are to be treated the skin should be dusted with cimolite or starch powder.

The large indifferent electrode should be placed at some remote part, such as the lumbar muscles, or the patient should hold it in his hand.

General Faradization brings every portion of the body under the influence of the current so far as is possible by outward applications.

The patient should be seated on a stool facing the instrument, and for the first part of the process should be stripped to the waist, and have his shoes and socks removed; his feet should be placed against a copper sheet warmed by means of a hot-water bottle; the surface should be moistened with warm water, and it should be connected with the negative pole of the battery. If the patient is paralyzed, he may lie on a couch with the copper plate beneath his buttocks. The other electrode consists of a brass ball (6 in. diameter) covered with damp wash-leather or felt, or the moistened hand of the operator, connected with the anode.

When the hand is used as the active electrode, the covered brass ball electrode should be held in the other hand, or allowed to rest on a table and be lightly touched, at first, with the other hand. The strength of the current can then be gauged by the operator's own sensation, and the flexibility of the hand allows of easy adaptation to varying surfaces. A very mild current should be used at first, and gradually increased.

PLATE XXVII.

ELECTRIC MASSAGE.

The current is here led from the main—after suitable resistance has been interposed—by a cord (not seen in illustration) to the spongio-piline pad under the operator's left hand. The patient lies on the negative (plate) electrode. It is often preferable for the operator to draw the current from a moist sponge electrode, which he holds with varying firmness in one hand, while he uses the other hand as an electrode, and with it massages the patient.

In this manner current strengths can be graduated with much precision, and faradism can be rendered extremely agreeable and painless. The flexibility of the hand, and its adaptability to any surface of the body, renders it a most excellent electrode.

The moistened hand should be first applied to the patient's forearm, and the circuit then completed by placing the other hand on two covered brass electrodes—the positive pole. The hand is then passed over the moistened hair of the patient's head, over his neck, throat, up and down the spine, arms and hands, then the surface of the abdomen, and finally the legs. Duration of séance, from five to twenty-five minutes; fifteen minutes is a very average time, apportioned in the following manner:—

Head - - - -	1 minute.
Neck and throat - -	4 minutes.
Upper and lower extremities -	4 ,,
Abdomen - - -	3 ,,
Back - - - -	3 ,,

The treatment is applied about three times a week, the length of the course entirely depending on the chronicity and nature of the case dealt with. After the treatment the patient feels considerably invigorated, the sensation of exhilaration continuing for several hours; sometimes drowsiness results. The pulse is steadied, depression relieved, appetite and digestion improved, and muscular energy and body-weight increased. Sometimes there is slight soreness of the muscles.

Therapeutic Indications.

General faradization is useful in the treatment of various functional nerve diseases, such as hysteria, neurasthenia, and nervous dyspepsia. It improves the tissues of the muscles in various paralytic conditions, and takes the place of exercise and massage.

Galvano-faradization.—The combined use of galvanic and faradic current, as suggested by de Watteville, is effected by uniting the secondary induction coil and galvanic battery in one circuit, by connecting with a wire the negative pole of the one with the positive pole of the other; the electrodes are attached to the two extreme poles, and both currents are sent through the body. The special key of de Watteville is useful in this combination. The effect of this combined current is at once stimulating and soothing.

CHAPTER XIII.

SINUSOIDAL CURRENTS.
HYDRO-ELECTRIC BATHS.
STATIC ELECTRICITY.

SINUSOIDAL CURRENTS.

THE word sinusoidal has been used to describe a wave-like alternating current, such as is produced by an alternating current dynamo, and to distinguish it from the irregular. jerky alternating current produced by a faradic coil. When a copper coil rotates with uniform velocity between the poles of an electro-magnet, the current collected is sinusoidal, i.e., its intensity is proportional to the sine of the angle between the plane of the coil and the line of commutation.

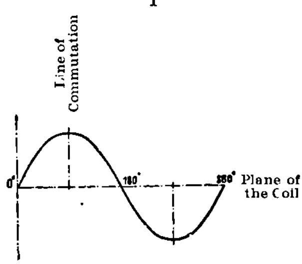


Fig. 101.—Curve of a Sinusoidal Current.

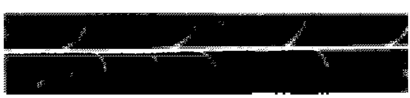


Fig. 102.—Curve of the Secondary Current of a Faradic Coil.

Figs. 101 and 102 respectively show the curves of a sinusoidal current and the more jerky movement of the secondary current of a faradic coil. The latter type produces somewhat painful contractions of the muscles, whereas the smooth sinusoidal currents may cause equally powerful contractions, but they are not so much felt by the patient. They are also free from the electrolytic effects produced by a continuous current.

We distinguish between single-phase and poly-phase sinusoidal currents. For medical purposes three-phase currents are frequently employed, and to obtain them a peculiar connection of the winding of the armature is necessary. It is arranged in three groups, each of which occupies one-third of the circumference of the armature. One end of each group is connected with one of the three collecting rings shown in the illustration (*Fig.* 103),

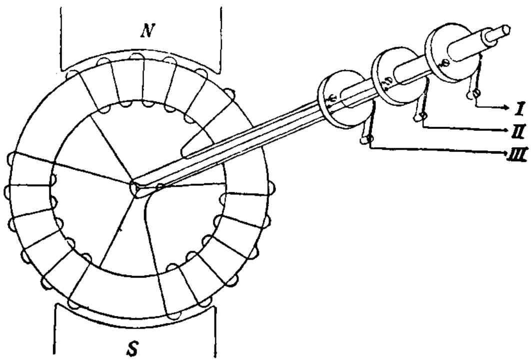


Fig. 103.—Diagram showing arrangement for producing Three-phase Currents.

and the other ends are connected together. While the first group is near the north pole of the dynamo, the second is 120 degrees farther ahead (*Fig.* 104), past the neutral point, and on the way to the south pole; the third

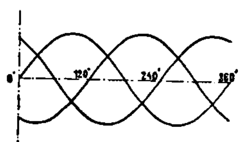


Fig. 104.

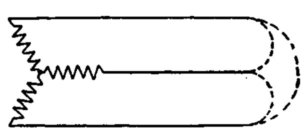


Fig. 105.

group is 240 degrees ahead, past the south pole already, and approaching the second neutral point. Three separate waves are thus generated, and are interwoven as shown in *Fig.* 105, in which the three zigzag lines on the left represent the three groups of wire on the armature, and the dotted curves on the right the three waves of current in the external circuit passing through the primaries of the three sledge transformers.

The most convenient way to produce sinusoidal currents is to have a continuous current motor provided with extra collector rings, from which the sinusoidal current can be taken off (*Fig.* 106). If it has two rings, single-phase currents only can be obtained; if it has three, single-phase or three-phase currents can be employed; in the first case two, in the second case three, electrodes have to be placed simultaneously on the patient. The three-phase sinusoidal current is the most pleasant to bear; and strong doses can be administered in this form.

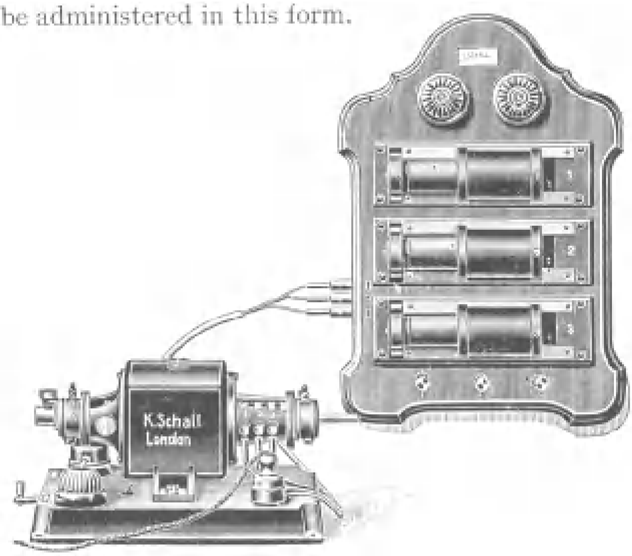


Fig. 106.—Motor Transformer, arranged for Single or Three-phase Sinusoidal Currents and including three Sledge Transformers.

The Herschell-Dean Triphase Generator.—This apparatus consists of a field armature with commutator, and having equidistant tappings connected to slip rings, on which brushes are held in contact by springs. The triphase currents are carried by flexible connections to the primaries of three induction coils arranged in parallel. Instead of the secondaries the primaries move simultaneously in an equal degree; this is the same electrically, but mechanically is an advantage. The secondaries of the coils are also in parallel, but are not mobile. The current is led from the coils to the electrodes by flexible cords, which are attached to a trident plug, which simplifies the manipulation of the cords. The electrodes being in intimate contact with the skin, the circuit is formed within the organism. The E.M.F. in the primary is controlled by a rheostat, and the periodicity by a break, which acts by virtue of the load borne by the generator, and reduces the number of revolutions. If the break be gradually applied with the machine

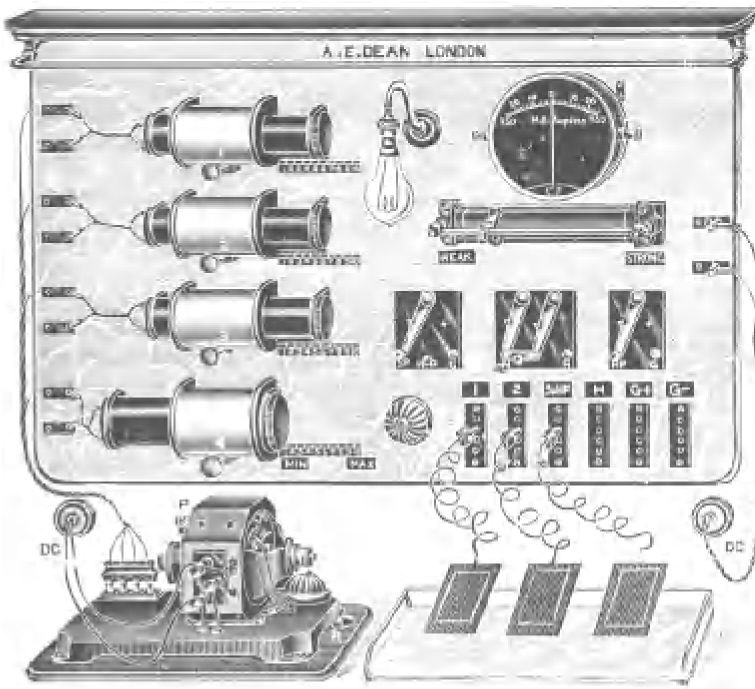


Fig. 107.—Herschell-Dean Sinusoidal Apparatus for Direct Current Mains, with complete control of tension and period.

running at full speed, a progressive reduction in revolutions and alternations is caused without change in E.M.F. of the currents. The machine should never be suddenly stopped with the electrodes in contact with the patient, or he will receive a shock. To stop the administration, the primaries must be moved back to starting-point, the rheostat be put at "weak," and the current switched off. The electrodes may then be safely removed (*Fig.* 107).

Two distinct types of current are obtainable: (1) A rapidly alternating current, with powerful action on metabolism and markedly tonic effect; and (2) A slowly alternating current, capable of especially influencing non-striped muscle tissue, and causing painless contractions.

The triphase current may be applied: (1) By electrodes—large flat felt, or sponge, electrodes being best suited for skin surfaces. Gastric and rectal electrodes are also employed; (2) By means of local baths, single or multiple (as in the Schnee bath); (3) By a general full bath; (4) External electrodes may be combined with baths.

Herschell finds an application of the triphase currents (1) Increases the tension and amplitude of the pulse; (2) Increases excretion of urea; (3) Increases the peristalsis of the intestines and contractions of stomach, and generally exerts a powerful stimulant action on non-striped muscle. He finds these currents of great value in the treatment of neurasthenia and gastric myasthenia, and in cases of constipation has achieved most brilliant results.

Reginald Morton has also lately drawn attention to the great value of triphase sinusoidal currents in atonic conditions of the stomach and intestines. An intragastric may be combined with a rectal electrode, and an external plate or pad applied to the epigastrium. The patient may in this way be at once treated for gastrectasis, and the constipation which so frequently accompanies it.

The sinusoidal current is an extremely pleasant and useful application, either in small local baths or the full electric bath. It resembles the faradic current, but the interruptions are smoother and much less painful to the patient. By means of these baths, various spastic and other paralyses can be conveniently treated. The current appears to lessen the late rigidity sometimes seen after hemiplegia.

THE HYDRO-ELECTRIC BATH.

The different forms of current employed are:—

1. **Continuous.**
   (*a*) Uniform (galvanic—from main).
   (*b*) Pulsatory (from a dynamo).

PLATE XXVIII.

THE SCHNEE 4-CELL BATH.

2. **Alternating.**

(*a*) Faradic (*c*) Galvano-faradic

(*b*) Sinusoidal (*d*) Galvano-sinusoidal

The bath may be sectional or local, or a *whole* bath. involving removal of all clothing and complete immersion of the patient.

The 4-Cell Bath of Dr. Schnee.—This is a sectional bath, merely the hands and forearms and feet of the patient being immersed in separate *tubs* or porcelain cells. Local baths may be similarly given to an arm and leg by means of a porcelain tub through which the current—galvanic. faradic, or sinusoidal—is conducted.

The four-cell bath can be used with the galvanic, faradic, or sinusoidal currents produced by batteries or by dynamos ;

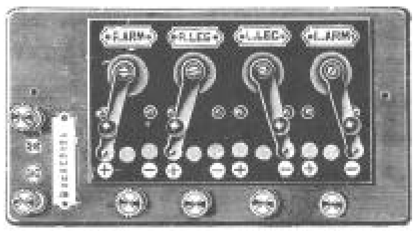


Fig. 108.—Special Commutator for a 4-Cell Schnee Bath.

in the latter case there is no danger of shock as in a full bath, because the porcelain tubs are not connected with the water-pipes, and are well insulated from earth (*see Plate XXVIII*). Drugs may be added to the water, and can be introduced through the skin by the continuous current. The quantity of water required is not great, so that the apparatus does not depend on the proximity of a water-supply.

This bath is specially adapted for applying all kinds of electric current, either from the mains or accumulators. Several advantages are claimed in favour of this as compared with the older form of ordinary full bath, among which may be mentioned the following :—

1. The whole electric current used is made to pass through the patient's body—which constitutes the only connection between the electrodes—without the slightest waste.

2. The intensity of the current applied to the patient is capable of being measured and regulated with absolute accuracy, for the reason just stated, unlike a full bath.

3. The current can not only be measured and regulated with absolute accuracy, but may also be directed more than fifty different ways through the body by a simple device on the switchboard.

4 It is not necessary for the patient to undress, it being sufficient to have the forearms and feet bare.

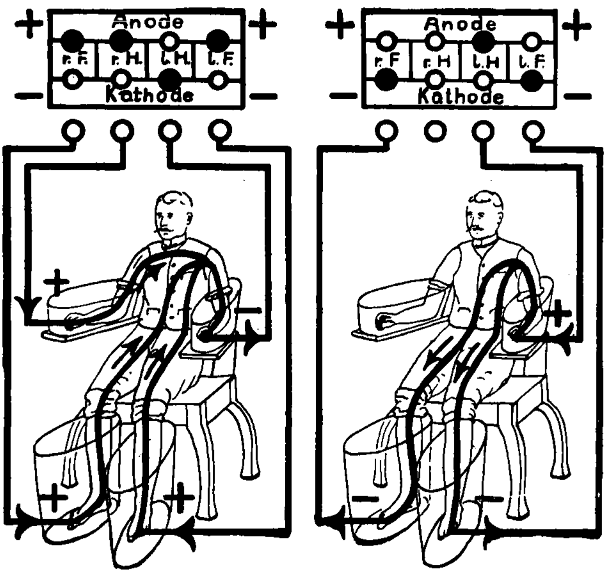


Fig 109.—Diagrams showing the Path of the Current by the 4-Cell Bath.

5. The patient sits erect. The chair is movable in all directions, and may, therefore, be so adjusted that the position of the patient is perfectly natural, and the danger of fright, oppression of the heart or chest, and the like, which frequently attend full baths, in nervous and cardiac cases, is removed.

6. The arms rest in the most comfortable position in the cell, the cell supports being exactly fitted to the bather by a double-joint movement and a height adjustment.

7. The bath may at once be stopped by the patient himself if desired, by simply lifting his arms out of the cells.

The strength of current may reach to about twenty milliampères. The current voltage required is about twenty-five volts. With the faradic current the patient can usually only bear five or six milliampères.

The Whole Hydro-Electric Bath.—The whole bath is a most efficacious method of applying electrotherapy when tonic and stimulating effects are desired. The bath should be made of porcelain or wood, and stand on vulcanite blocks. The current used may be continuous or alternating, faradic-galvanic or galvano-faradic. The bi-polar bath is the form most commonly employed. The electrodes are large copper plates and are placed in the bath, one at the head (the anode) and the other (cathode) at the foot, so that the current flows from the patient's head to his feet—through his body—the line of least resistance.

A bar and electrode are sometimes provided in addition, being placed transversely across the middle of the bath. The actual position of the patient's body will depend on the region we chiefly desire to influence.

The temperature of the water is usually from 36°–37° C., but in fixing this one is guided by the season of the year, the susceptibility of the patient, and the nature of the disease. An interval of two hours should elapse between the bath and a full meal. If the current is used from the main, it should be switched on before the patient enters the bath, and not switched off until he has quitted it.

It is always best to make a trial of the whole-bath circuit and to have a current of four or five milliampères flowing before the patient enters the bath, to avoid the possibility of a hitch, and alarming the patient when he is once in the water. The strength of the current may be gauged by the attendant placing a hand in the water at either end of the bath.

The patient having entered the bath and settled into a suitable and comfortable position, the current is gradually increased, care being taken to increase and decrease slowly and uniformly, as sudden changes may give the patient an unpleasant shock. A qualified physician or well-trained electrician should always be in charge. If the current be from the main, special caution is needed, and complete insulation and a reliable rheostat essential. The taps supplying the water should not be in contact with the bath itself, and *the waste-pipe must be insulated effectively* (see page 175, *Fig.* 78).

Further, while the patient is in the bath the waste-pipe should not be used to run off any water, nor should fresh water be added except from a pail or beaker of some sort. The patient must be warned on no account to touch the water-tap or electric switch with his hand while in the bath, for he might thus make a short circuit and receive a severe shock.

As regards actual current strength employed, no definite rule can be given or any amount specified; each case must be judged on its own merits.

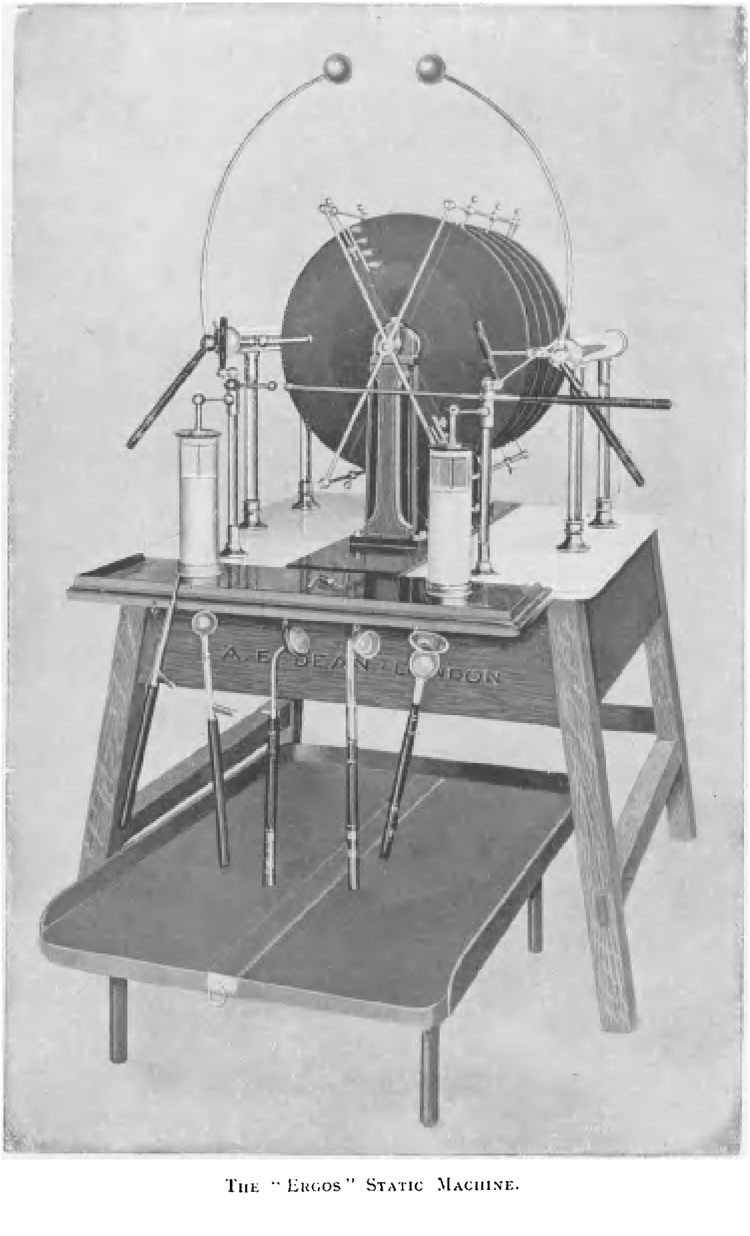
Too powerful a current will soon produce faintness in the patient. The current passing through the patient is less when the water contains salt, as the conductivity of the water is thereby increased. The amount of the current taken up by the patient's body will vary with the temperature of the water, its volume and resistance, and the specific resistance and position of the body itself. It varies from 25 to 50 per cent (Hedley).

Duration of the Bath.—This varies from ten to twenty minutes. After leaving the bath the patient should be carefully dried, and should rest for a little on a couch. He will feel refreshed and invigorated in a short time, and experience a pleasing sensation of *bien être* and exhilaration. Appetite is increased, and there is considerable increase of sexual desire. The pulse-rate is lowered by some 8–20 beats, and with this the blood-pressure falls somewhat, while metabolism is stimulated.

Therapeutic Indications.

Neurasthenia, hypochondriasis, and nervous diseases with tremor, such as chorea and paralysis agitans, gout, chronic rheumatism and rheumatoid arthritis, sciatica, and some anæmias are benefited in greater or less degree by a course of baths. Not less than half a dozen should be taken if any tangible improvement is expected.

PLATE XXIX



The "Ergos" Static Machine.

FRICTIONAL OR STATIC ELECTRICITY.

The best-known types of static machines are those of Holtz and Wimshurst. The difficulty with them is the uncertainty of their action ; in a damp atmosphere it is sometimes extremely difficult to get them to work satisfactorily or at all.

One of the most reliable machines on the market is the "Ergos," made by Dean. The maker claims for this that at all equal velocities it will produce 50 per cent more current than any other static machine of the same plate diameter. The special point which has been kept in view in designing the machine is to obtain a synchronous speed for all the plates. It is found that when all the plates revolve

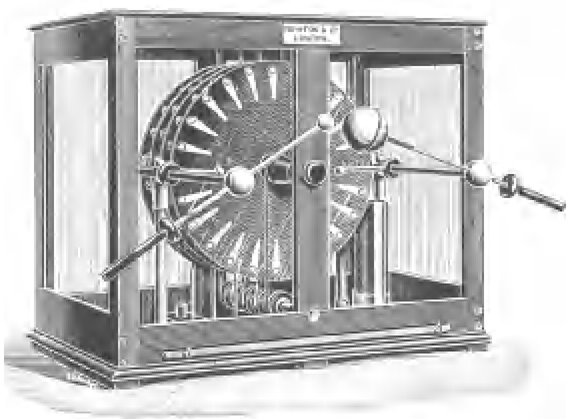


Fig. 110.—Electro-static machine of Wimshurst type (in air-tight case)

with one velocity, a much slower speed will produce a maximum voltage. The machine is driven, not by a belt but on the chain-and-sprocket principle. It can be worked by an electric or water motor. The plates are of ebonite and are sectionless, varying from 20 to 24 inches in diameter. Every plate can be quickly detached and cleaned, or adjusted if buckled. The number of plates varies from six to twenty-four (*Plate XXIX*).

Dr. Lewis Jones has lately introduced a reliable form of static machine with eight plates, made of glass or vulcanite. Glass plates are apt to break, but are made in sections, so as to be easily removed for cleaning.

A higher speed is permitted with safety when the vulcanite plates are used. These vary in size from 1½ to 3 feet in diameter. They are mounted on steel tubing, arranged on the cantilever principle, which forms a very firm and rigid stand. The machine is placed inside an air-tight case and worked by hand or a small motor, by a shaft carried through the side of the case (*Fig.* 110). The current from the main is used, a rheostat of 175 ohms resistance being interposed to suitably regulate the voltage. The case is perfectly dust-proof, and the contained air is kept dry by means of small jars containing chloride of lime.

The disadvantage of enclosing a machine in a case is that ozone is given off and exercises a destructive action on vulcanite plates. To avoid this there are various devices. The case can be filled with CO_2 from a cylinder, or fresh air can be constantly driven in by means of a fan worked by the same motor which runs the machine.

A small platform of wood with glass pegs is used to seat the patient upon, and this is connected to the machine by a rod with a hook to catch on to either of the poles. Metallic groundings (gas and water pipes will do) must be available for the electrodes ; if these pipes are not available, two separate pieces of iron tubing must be driven into the ground deep enough to reach subsoil water, and these must be connected by copper wire.

Insulated Platform.—The platform on which the patient is seated for treatment must be about 3½ by 2 feet in size, strongly made, and completely insulated. All corners should be rounded off and left smooth. The glass legs should be about 12 in. long. It is well to have a beading round the platform to prevent the chair slipping off.

Electrodes.—Those principally used are the single point, multiple point, the knob electrode, and the roller. The two first are for the "static breeze"; the roller is for sparking through the patient's clothing, and so used is a highly stimulating method. Satisfactory conductors must be provided from the active pole to the patient, who must be seated on the platform before mentioned, and have no contact of any kind with the ground (*see Figs.* 111–116).

Methods of Application :—

1. *Positive Electrification.*—This is a continuous process. The patient being seated as described, no part of his body should be nearer the negative pole than two feet. The pole should be grounded, and the metal plate under the patient's feet connected with the positive pole.

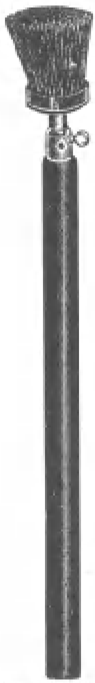


Fig. 111.—Metal Wire Brush Electrode.

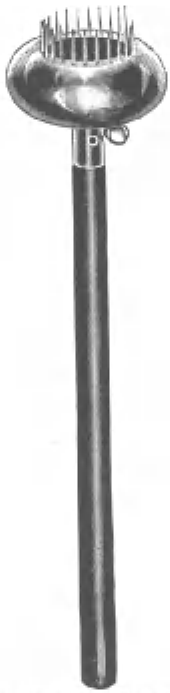


Fig. 112.—Point Electrode (Hesse's).

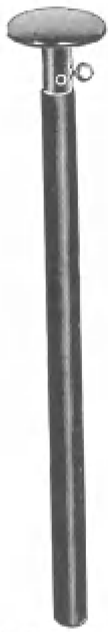


Fig. 113.—Knob Electrode.

Fig. 114.—Air Douche Electrode.

Fig. 115.—Roller Electrode.

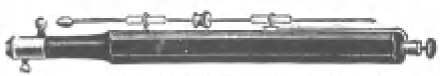


Fig. 116.—Bisoérie's Regulating Handle.

2. *Negative Electrification.*—Arrangements are just the same, *mutatis mutandis.*

3. *Oscillatory General Electrification* (*Interrupted*).—The patient must place his bare feet upon a reservoir electrode filled with warm water, and must be arranged as in (1). A large brass spherical electrode must be fixed in the

movable standard and placed near the positive pole, so that the ball of the electrode and the rod with crook touch each other. The electrode should be grounded to the gas fixture. The head breeze electrode should be arranged about three feet from the patient and connected with the same chain which connects the negative pole to the water pipe.

The machine is started in action and the ball electrode withdrawn with one hand from the crook, such a spark being produced as causes a gentle thrill to the patient with oscillation in his hair.

4. *Positive Static Breeze.*—The patient is arranged as for (2). For a stationary breeze the brass-pointed electrodes should be fixed on the standard at a suitable distance from the part to be treated. For a vertex head breeze, the hinged rod at the top may be used; it should be fixed over the patient's head and a wire-brush electrode adapted to it.

Fig. 117.—Massage Roller Electrode.

5. *Negative Static Breeze.*—The same, with negative pole in place of positive.

6. *Moving Positive Breeze.*—The pointed electrode should be attached to a chain, the end of which should be fixed to the gas bracket in order to guard it, and then swept over the body at a suitable distance.

7. *Positive and Negative Spray.*—An intensified breeze application. The patient is arranged as in (4), but the electrode is nearer the patient, so that there is a visible shower of electrified particles.

8. *Massage Roller Application.*—The chain is attached to either the positive or negative pole, the electrode (*Fig.* 117) applied to the insulated patient, and the opposite pole grounded. The intensity of the application depends on the distance between the two sliding poles.

9. *Positive Static Sparks.*—The patient should be arranged as for (2). The large brass electrode is brought near the patient, and a large spark, 1 in. to 6 in. long (percussive spark), or a series of minute frictional sparks drawn.

Static electricity is a most valuable therapeutic agent, one of the most reliable we possess in the domain of electricity. It has the effect of increasing the body-weight, promoting oxidation processes, increasing the flow of urine and amount of urea thrown out; the patient feels more vigorous, has a steady pulse, and both eats and sleeps better. Both the nerves and muscles are stimulated. General nutrition is promoted by general positive electrification, potential alternation, breeze spray, and spark application. The positive spray has a sedative effect.

CHAPTER XIV.

HIGH-FREQUENCY CURRENTS.

THESE currents are characterized by an exceedingly high E.M.F. and alternations of very great rapidity; both being much greater than in currents developed from a dynamo or induction coil. Their voltage may be as great as one million, and their frequency several millions, as

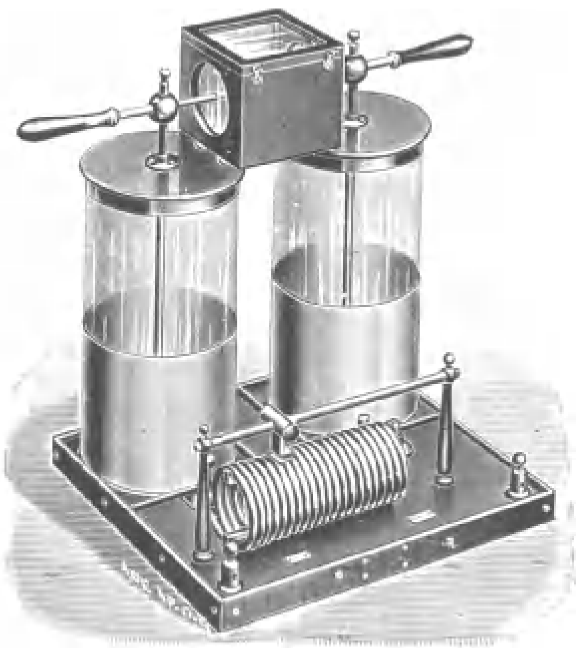


Fig. 118.—The D'Arsonval Transformer.

compared with the 40,000 or 50,000 volts of an ordinary induction coil. The oscillating character of the discharge of the Leyden jars used is the cause of the high frequency, which is so great as to be unapproachable by the use of any mechanical device.

PLATE XXX.

HIGH-FREQUENCY INSTALLATION.

The Production of High-Frequency Currents.—The following apparatus (*Plate* XXX) are necessary for high-frequency treatment :—

1. A spark coil such as is used for producing Roentgen rays ; any coil giving sparks of 10 *in. or more will do very well*, provided it is fitted with one of the modern interrupters, i.e., a Wehnelt, a Mackenzie Davidson, or Beclerc's coal-gas mercury break.

If the alternating current from the main is available, spark coils can be used without any interrupter, or a step-up transformer can be used instead of the spark coil. The

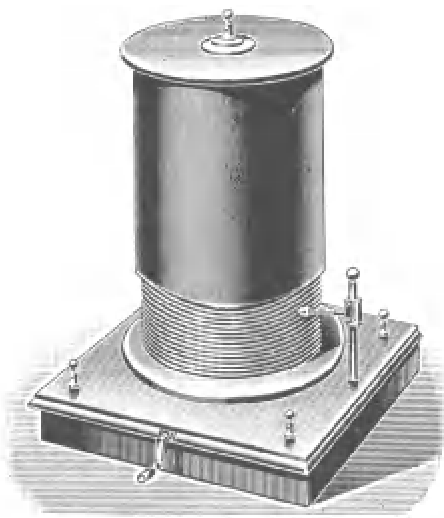


Fig. 119.—The Oudin Resonator.

coil or transformer are the sources of the electric supply required to charge

2. Two Leyden jars with an adjustable spark gap and a solenoid. This combination is usually called d'Arsonval's transformer (*Fig.* 118).

3. In most cases Oudin's resonator (*Fig.* 119) will be found very useful, and for treating skin diseases it is absolutely necessary. This consists of 200 feet of copper wire wound round a large framework of insulating material. If a suitable length of the wire be placed in parallel with a solenoid, the

resonator acts like the sounding-board of a musical instrument, and vibrates in unison with the solenoid, so as greatly to increase the E.M.F. The two being in proper accord, the upper turns and terminal of the resonator discharge a very powerful violet effleuve (best seen in a darkened room). The resonator should have a sliding contact to which the wire from the one end of the solenoid can be attached, and the contact is moved up and down until the desired results are obtained. The most correct adjustment is produced when the resonator can be rotated. Sometimes the solenoid is dispensed with entirely, and the lower turns of the Oudin take its place. Without the resonator the most usual method of producing high-frequency current is to allow Leyden jars to discharge through the primary coil of an induction apparatus, such as d'Arsonval's bipolar induction coil.

Instead of Oudin's resonator, a Tesla transformer may be used for raising the E.M.F. These transformers are usually submerged in oil, but can be also made for insulation in air only; in the latter case they are more bulky. A great quantity of ozone is generated by the effleuve from the Oudin resonator or the Tesla transformer.

4. Either a solenoid to enclose the patient, or a condenser couch, or some electrodes for local application, and a pair of heavily insulated cables to conduct the current, are also required.

The current strength is regulated partly by varying the current in the primary of the spark coil or transformer, and partly by adjusting the length of the spark gap, and by inserting more or less turns of the solenoids in d'Arsonval's transformer or in Oudin's resonator.

The currents are produced in the following manner: The secondary terminals of a spark coil (or an alternating current transformer) are connected with the inner coatings of two Leyden jars, and an adjustable spark gap is inserted between these two jars. When the spark coil is started, the Leyden jars become charged—one with positive, the other with negative electricity; and when the E.M.F. of the charge is sufficiently high, a spark leaps across the gap. To the naked eye this discharge appears as one single spark, but it actually consists of a succession of extraordinarily rapid electrical oscillations or waves. As long as the inner coating of a Leyden jar is charged with positive electricity, the outer coating must be charged with a similar quantity of negative; as soon as a spark leaps over, the charge inside disappears, but on account of the change the outer coating becomes positively charged, and this again induces a negative charge on the inside coating; plus and minus have changed places, and the quantity of the charge is a little reduced, but now there is a charge causing a second spark in an opposite direction, and this produces similar results. In this way it continues till the waves have calmed down and cease. If the discharge from a condenser (*Fig.* 121) is examined in a rapidly revolving cylindrical mirror, it appears as a conical band of gradually diminishing width and intensity, and from the length of this band and the speed of the mirror it has been calculated that the sparks follow one another in an opposite direction with an interval of about one-millionth part of a second only. It is on account of their rapidly oscillating character that such currents have been called "high-frequency" currents.

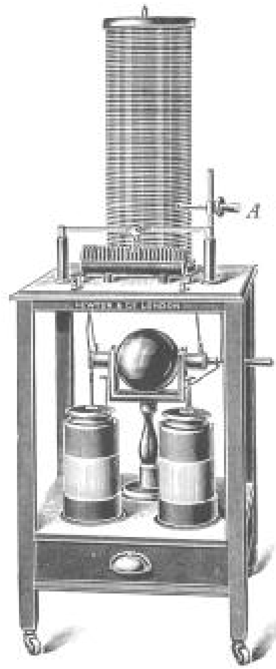


Fig. 120. — High-frequency Apparatus, with Leyden Jars, enclosed Spark Gap, Resonator, etc.

As already mentioned, every change of potential taking place on the inside coatings induces a similar change of the same intensity but in opposite direction on the outer coatings; and the currents thus generated between the outer coatings of the two Leyden jars are applied to patients in a manner to be described later on.

The E.M.F. of these oscillating currents can be raised by induction in various ways. For instance, a spiral with a few turns of stout copper wire can be inserted in the circuit between the two Leyden jars, and if this spiral is placed like a primary coil inside a solenoid of many turns of fine wire, a brush discharge, or sparks similar to those from a large static machine, are obtained from the terminals of the secondary solenoids.

The chief methods of applying high-frequency currents for treatment are :—

1. *Auto-conduction.*
2. *Condensation.*
3. *Local application of the effleuve*, or placing the patient in circuit by direct contact with suitable electrodes.

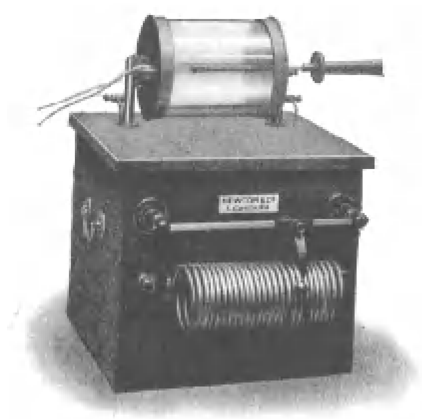


Fig. 121.—High-Frequency Apparatus, with Oil Condenser.

1. In auto-conduction the solenoid is made large enough to contain the patient without contact, and the patient steps inside, either standing or reclining (*vide supra*), according to whether the solenoid is vertical or horizontal. The patient forms the secondary of a gigantic induction coil, and will be the seat of induced currents. The danger of and objection to this method is cross sparking, which greatly alarms nervous patients.

2. In condensation the patient forms one of the plates of a condenser or Leyden jar. A couch, the lower back part of which is lined with a metal plate, is provided. It carries a terminal by which it may be attached to the Oudin or one end of the solenoid. The metal is covered with felt

or asbestos, and on this cushions are placed. The patient reclines on the couch, and is connected with the earth or other end of the solenoid by grasping an electrode attached to a chain, the other end of which may pass to a gas-pipe, or to the solenoid, or both. The felt and cushions constitute the di-electric (like the glass of the Leyden jar), and the patient the outer or earth-contact coating of the condenser. Every oscillation results in the patient being charged and discharged, the charges being alternately positive and negative.

3. *The Effleuve.*—A pointed electrode, with insulated handle, connected with the Oudin resonator, is brought near to the patient. As it approaches, a violet spark, the effleuve,

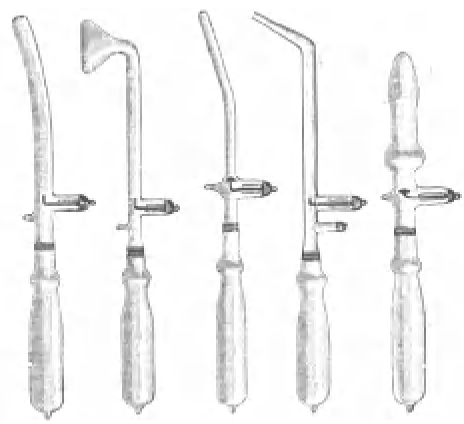


Fig. 122.—Glass " Condensing " Electrodes.

starting from both the point and the patient, completes the circuit. The form of the spark resembles the lines of force between two magnetic poles. Too close approximation will result in the passage of sparks which are painful to the patient.

If the pointed electrode is enclosed in a glass tube, it is called a *condensing* electrode (*see Fig.* 122). This is a milder form of the effleuve ; it may be safely allowed to touch the skin and will only cause a slight tingling sensation.

As an alternative, the patient may be interpolated in the circuit by firmly applying two large surface electrodes, attached either to the two ends of the solenoid, or one to the solenoid and the other to the resonator.

The effleuve is the only form of high-frequency current causing the patient any appreciable sensation. Slight smarting or tingling is caused, and local hyperæmia, which lasts for some hours or even days; *cf.* mustard plaster.

The strength of the application is graduated in the following manner:—

1. *The primary current of the coil is altered in strength or voltage.*
2. *The sparking gap is made smaller or larger—the longer the spark the stronger the oscillations.*
3. *The current strength will vary with the accuracy of tuning of the resonator to the solenoid.*

Fig. 123.—Portable High-Frequency apparatus, worked by an Accumulator.

Currents of three ampères and more pass through patients without discomfort or pain or even sensation, and d'Arsonval attributes this immunity to the tissues being incapable of responding to such rapid alternations, just as the human ear does not respond to sound vibrations more frequent than 40,960 per second (Preyer). Above 5,000 vibrations per second the effect on the tissues steadily diminishes.

As a result of the application, the blood-pressure falls, and more CO_2 is eliminated and more oxygen absorbed by the blood. Waste products are more rapidly excreted by the kidneys, and there is some increase in heat production.

Measuring the Current.—The strength of the current will depend on the width of the spark gap, but can also be graduated by regulating the current from the induction coil which supplies the Leyden jars.

Fig. 124 illustrates a hot-wire milliampèremeter for measuring the current. The strength used in high-frequency applications varies from 100 to 800 milliampères, or even more by some operators.

Fig. 124.—Hot-wire Milliampèremeter.

In auto-conduction the full power of the machines is commonly employed, but measurement cannot be made. In condensation the galvanometer is placed between the patient and his point of attachment, and in local applications it should be in series with the patient. In brush discharges the appearance of the effleuve is a guide to the current strength.

THERAPEUTIC INDICATIONS.

Great attention has been given of late years to high-frequency both in Great Britain and on the Continent. While possibly there has been a tendency in certain quarters to exaggerate the value of the currents, there is certainly no justification for the ultra-scepticism which is displayed by physicians in regard to their therapeutic value, and the term " quackery " is quite inapplicable to their reasonable and judicious employment. Granting that the effleuve is but an elegant and somewhat expensive form of linimentum A.B.C., or mustard plaster, it is unquestionably a most efficient counter-irritant, and it is generally conceded by those with experience in electrotherapy that auto-conduction and auto-condensation are a valuable means of reducing high blood-pressure. A sympathetic vibration of the electrons appears to be set up by the rapid changes in the magnetic field. The stimulation or inhibition of the nerve centres will depend on the rapidity of this vibration.

Simultaneous stimulation of the vasodilator and inhibition of the vasocontractor centres may thus be obtained at cne and the same time. To actual stimulation of the vasodilator centres is probably due the powerful action of high-frequency currents on the renal secretion.

Doubtless too much has been claimed for high-frequency treatment, and to vaunt it as a panacea for all nervous ills is the sheerest nonsense. At the same time there seems no sufficient reason why we should refuse to employ it in the treatment of the hysterical and neurotic who declare they feel benefited by a séance. The professed object of a physician is to cure disease, and when a patient suffering merely from functional ailments or neuroses comes before him, having tried many other physicians and drugs without benefit, there is surely no justification for refusing such an one the trial of a mode of treatment which appeals to his imagination and in which he thoroughly believes.

THE EFFECT OF HIGH-FREQUENCY CURRENTS ON THE BLOOD-PRESSURE.—There seems to be no reasonable doubt that a course of high-frequency treatment by auto-conduction or the condenser couch, or even the application of the effleuve, has a considerable effect in reducing blood-pressure. Moutier has recorded a reduction of as much as 30 mm. of mercury at a sitting, and Wilfred Harris has frequently found a drop of 20 mm. at a sitting as ascertained by a Riva-Rocci sphygmomanometer. Lewis Jones, Herschell, and even Clifford Allbutt, speaking as a physician and not an *electrical* physician, agree, that in the high-frequency currents we have a valuable agent in the treatment of hyperpiesis. In view of a somewhat widespread scepticism on the subject, it is well to mention these authorities.

It is hardly to be expected that long-standing arterial changes can be removed, or the "ipecacuanha-root artery" rendered elastic by any form of electrical treatment, but in early cases of hyperpiesis and arterial thickening there seems every reason to look hopefully for improvement when high-frequency currents are applied. It is well known that these conditions are often very resistant to any sort of drug treatment, and therefore a method with any promise surely deserves an extended trial.

The condensation couch seems to exercise a general tonic effect on debilitated patients, and paradoxical as it may seem in view of the remarks above, abnormally low pressure is sometimes raised, with improvement of the patient's general condition.

Painful fissure of the anus readily yields to this treatment in many instances. It has been known for several years that the H.F. currents beneficially affected this condition. Frenkel, writing lately on the subject, says not only has this proved to be the case, but he has found incidentally that the constipation which so often co-exists and aggravates this affection is quickly and easily cured at the same time. He treated a score or more cases of constipation in this

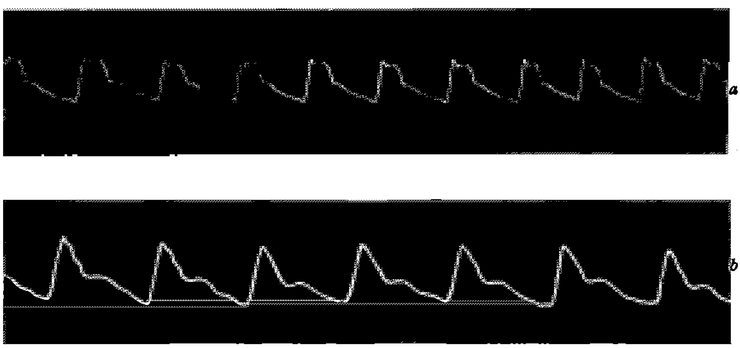


Fig. 125.—The Effect of High-frequency Currents on the Pulse-tracing: (*a*) Before treatment, (*b*) After treatment.

way and found improvement in each. The application was made with a unipolar connection, 110 volts, a cylindrical or conical electrode being used. The séance lasted fifteen minutes.

Apart from the very numerous neurotics who are often benefited to a marked degree by high-frequency treatment, the currents have been employed with good result in cases of gout, rheumatism, rheumatoid arthritis, diabetes mellitus and insipidus, obesity, tuberculous disease, gastric atony and dilatation, neuritis, and diseases of the spinal cord, e.g., amyotrophic lateral sclerosis and progressive muscular atrophy, and some skin diseases (eczema, pruritus, lupus, alopecia areata, etc.).

In tuberculous diseases, the current appears to possess some curative action. The bacillus is unable to resist repeated applications, and the reproductive power and virulence of the toxins appear to become weakened, while the human organism attacked grows stronger (Rivière). The flow of the blood- and lymph-streams is accelerated, and oxidation is favoured, so that toxins are the more readily eliminated. Phagocytosis is more active with alexins in free supply. The patient's resistance to the inroads of the disease is thus markedly increased. A number of cases of pulmonary consumption appear to have derived benefit from the application of the effleuve to the apex, in the hands of Chisholm Williams, Rivière, Chowry-Muthu, and others.

SECTION V.—*Diet in the Treatment of Disease.*

CHAPTER XV.

GENERAL PRINCIPLES AND COMPOSITION OF FOOD.

DIETETICS consists in the study of the substances which serve for food, and the process of nutrition in health and disease.

All living creatures derive their nourishment from the vegetable kingdom, either directly, or indirectly by living upon animals which in their turn subsist on vegetables. Foods are the substances which are required for the nutrition and maintenance of the body and for the replacement of its wastes and losses.

In connection with the nutrition of a healthy man, we find that there is great variety in the nature and quality of the food substances used, as well as in the quantity consumed, by different individuals. Nevertheless, the three main elements in all descriptions of human sustenance are albumin, carbohydrates, and hydrocarbons, to which may be added water.

Vegetarians, such as Hindoos, derive most of their sustenance from the vegetable kingdom, while Guachos, Esquimaux, and others live almost entirely on animal food. The happy and safe medium lies between these two extremes, and the highest dietetic authorities, such as Voit, Pettenkofer, Chittenden, and Pavy, recommend a mixed diet of animal and vegetable food. In this connection Rudolf Virchow remarked, "Although the Esquimaux and Kirghiz show us that life and health can be maintained for many generations on an exclusively nitrogenous diet, and other tribes such as the Hindoos live almost entirely on non-nitrogenous food, yet history shows us that the highest attainments of the human race have emanated from nations who have lived and do live on mixed diets. A mixed diet taken partly from the animal and partly from the vegetable kingdom is the most suitable and digestible form of nourishment for mankind."

We derive the greatest amount of carbohydrates from the vegetable kingdom, while much albumin is derived from animal food. The proportion of vegetable to animal albumin in our food should be as three to seven (Uffelman).

The larger portion of the food we consume is employed to generate the heat necessary for the maintenance of life, only a small portion going to make up for tissue waste. Food being thus intimately concerned in the production of heat, it is customary to speak of food in terms of its heat-producing capacity. A heat unit is the quantity of heat required to raise the temperature of 1 cc. of water 1° C. The term commonly employed in calculating food energy is "*great heat unit*," or calorie, by which is meant that quantity of heat energy which is required to raise the temperature of 1 kilogram of water 1° C. Each kind of food is ultimately oxidized in the body to its end-products, and for the most part exhaled in the form of CO_2 gas; the more carbon atoms it contains the more heat will it generate; thus 1 gram of fat generates 9·3 calories, 1 gram of carbohydrates 4·1, and 1 gram of albumin 4·1 calories. The quantity of nourishment taken being ascertained, it is easy to determine the energy value, or number of calories introduced, by multiplying the different types of food-stuffs by the above figures. The amount of heat which it is requisite for the body to generate daily for its maintenance has been estimated at 2,500 units (Koenig.)

Von Noorden gives the caloric value of food taken by the average working man as 40 units per kilogram of body-weight per day, *when working*, and as 34 units *when resting*.

By the following tables it is a simple matter to calculate, approximately, whether a given quantity of food constitutes an adequate diet or unit.

COMPOSITION OF COMMON ARTICLES OF FOOD (after Einhorn).

I. Dairy Products.

	Albumin, per cent.	Fat, per cent.	Carbohydrate, per cent.	Calories, per cent.
Cow's Milk ..	4–4·3	3–3·8	3·7	64
Cream	3·61	26·75	3·52	276·01
Butter	0·5	90·0	0·5	837
Whey	0·5	0·3	3·6	—
Buttermilk ..	3·0	1·3	3·0	3·67
Koumiss ..	3·35	2·07	3·0	33·99
Cream Cheese ..	25	30·0	3·0	394
Cheese	33	9·0	5·0	240
Eggs	12·5	12·0	0·5	165

II. Meats and Game.

	Albumin, per cent.	Fat, per cent.	Carbohydrate, per cent.	Calories, per cent.
Beef (fat) ..	17·19	26·38	—	315·81
Beef (lean) ..	20·78	1·50	—	99·15
Veal (fat) ..	18·88	7·41	0·07	146·61
Veal (lean) ..	19·84	0·82	—	86·97
Mutton (very fat)	14·80	36·39	0·05	399·31
Mutton (leaner)	17·11	5·77	—	123·81
Pork (fat) ..	14·54	37·34	—	406·88
Pork (lean) ..	20·25	6·81	—	146·39
Ham	23·97	36·48	1·50	453·69
Sweetbread ..	22·0	0·4	—	93·92
Pulverized Meat	64·5	5·24	2·28	322·53
Poultry ..	22·0	1·0	—	100·
Spring Chicken	18·49	9·34	1·20	167·59
Duck (wild) ..	22·65	3·11	2·33	131·36
Game	23·0	1·0	—	103·60
Hare	23·34	1·13	0·19	107·08
Venison ..	19·77	1·92	1·42	105·44

III. Fish.

	Albumin, per cent.	Fat, per cent.	Carbohydrate, per cent.	Calories, per cent.
Pike	18·5	0·5	0·75	83·57
Carp	20·61	1·09	—	94·64
Shellfish ..	17·09	9·34	—	156·93
Salmon	15·01	6·42	2·85	132·93
Oysters ..	4·95	0·37	—	24
Salt Herring ..	19·5	17·0	0·5	—
Caviare	28·04	16·26	7·82	—

IV. Cereals and Vegetables.

	Albumin, per cent.	Fat, per cent.	Carbohydrate, per cent.	Calories, per cent.
Sago	0·5	traces	86·5	356·70
Wheat Flour ..	8·5	1·25	73·0	345·78
Rye Flour ..	10·0	2·0	69·0	342·50
Wheaten Bread	6·0	0·75	52·0	245
Rye Bread ..	4·5	1·0	46·0	216
Roll	6·82	0·77	43·72	213·87
Zwieback ..	9·5	1·0	75·0	356
Cauliflower ..	2·0 to 5·0	0·4	4·0	35
Carrots	1·04	0·21	6·74	33·85
Asparagus ..	2·0	0·3	2·5	21
Rice	5·5	1·5	76·0	348·10
Beans	19·5	2·0	52·0	311·75
Peas	19·5	2·0	54·0	319·95
Potatoes ..	1·5	—	20·0	88
Oatmeal ..	12·5	5·26	66·77	338·80
Barley Meal ..	8·31	0·81	75·19	323
Spinach ..	3·49	0·58	4·44	38
Pickles	1·02	0·09	0·95	—

V. Soups and Beverages.

	Albumin, per cent.	Fat, per cent.	Carbohydrate, per cent.	Calories, per cent.
Milk Soup, with wheat flour ..	5·0	3·25	15·0	112
Meat Broth (ordinary) ..	0·4	0·6	—	—
Meat Juice (pressed) ..	6·0 to 7·0	0·5	—	—

SOUPS AND BEVERAGES, *Continued.*

	Albumin, per cent.	Fat, per cent.	Carbohydrate, per cent.	Calories, per cent.
Beef Tea ..	0·5	0·5	—	—
Leube's Meat Solution ..	9·0 to 11·0 albumin; ·79 to 6·5 peptone.			
Malt Extract ..	8·0 to 10·0	—	55·0	258·30
Barley Soup ..	1·5	1·0	11·0	60·96
Rice Pap, with milk	8·8	3·5	28·6	182·61
Coffee	3·12	5·18	—	—
Tea	12·38	—	—	—
Beer	0·5	5·25	0·3	—
Porter	0·7	6·0	0·3	60

VI. FRUITS.

	Free Acid, per cent.	Albumin, per cent.	Fat, per cent.	Carbohydrate, per cent.
Apples	0·82	0·36	—	7·22
Pears	0·20	0·36	—	3·54
Plums	1·50	0·40	—	4·68
Peaches ..	0·92	0·65	—	7·17
Grapes	0·79	0·59	—	1·96
Strawberries ..	0·93	0·54	0·45	1·01
Chestnuts ..	—	5·48	1·37	38·34
Sugar-cane ..	—	—	—	3·40
Honey	—	1·20	—	5·28

The average male adult consumes in the form of food about 120 grams albumin, 90 grams fats, 330 grams carbohydrates, and 2,818 grams water per day (Vierordt).

Eighty grams of albumin per diem is said to be the lowest amount consistent with proper nutrition. Foodstuffs are built up of these four elements, and also contain small amounts of certain inorganic salts.

ANIMAL FOODS.

These comprise besides the flesh (muscles) of the different mammals, birds, and fishes, several other portions of their bodies, as, for instance, various glands, the brain, lungs, liver, etc. Oysters and lobsters also belong to this group. In most instances the digestibility of this group of foods corresponds to their richness in fat. The less fat they contain the more digestible they are. Thus we have the following list of animal foods classified according to their digestibility :—

	Fat, per cent.
Calf's Sweetbread, Veal, Cod-fish, Pike, Oysters	0·4 to 1
Beef, Hare, Spring Chicken, Pigeon, Partridge, Carp	1 „ 1½
Mutton, Pork	5 „ 7
Goose, Caviare, Herring, Salmon, Eel	over 8

The digestibility of food is also greatly dependent on its quality and preparation. Young animals have soft and tender meat, whereas the flesh of old ones is tough. The different portions of an animal vary in their digestibility. The time that has passed since the killing of the animal is also of importance. Fresh meat which is yet in its rigid state is tough, and therefore very indigestible. In the preparation of the meat we must see that it is separated from all indigestible matter (fascia, tendons, cartilage). By pounding the meat the connective tissue surrounding the muscle fibre is torn. By chopping, scraping, or pulverizing the meat, its digestibility is increased. All other methods of preparing meat only serve to improve its taste; for raw meat is more easily digested than that which has been boiled, broiled, or fried. The application of heat, however, diminishes the danger of infection, as many micro-organisms are destroyed by it.

Eggs are especially rich in albumin and fat. Soft-boiled eggs (three minutes in boiling water) are easiest to digest. Then come raw eggs and scrambled eggs, while hard-boiled eggs and omelette are difficult of digestion. Soft-boiled eggs remain in the stomach one and three-quarter hours, hard boiled, three hours.

Milk is intended as the sole food of young animals, and as such contains all the elements of a typical diet: (1) Albuminous substances in the form of casein and serum albumin; (2) Fats in cream; (3) Carbohydrates in the form of lactose or milk sugar; (4) Salts, chiefly calcium phosphate; and (5) Water. Milk does not stay in the stomach much longer than plain water, and must therefore be considered very digestible.

Several articles of food are obtained from milk :—

(*a*) *Cheese*, which is the casein precipitated with more or less fat, according as the cheese is made of skimmed milk (skim cheese), or fresh milk with its cream (Cheddar and Cheshire), or of fresh milk plus cream (Stilton and double Gloucester). The precipitated casein is allowed to ripen, by which process some of the albumin is split up with formation of fat.

(*b*) *Cream* consists of the fatty globules encased in casein, and which, being of lowest specific gravity, rise to the surface.

(*c*) *Butter* is the fatty matter deprived of its casein envelope by the process of churning.

(*d*) *Buttermilk* is the fluid obtained from cream after butter has been formed. It is therefore very rich in nitrogen.

(*e*) *Whey* is the fluid which remains after the precipitation of casein. It contains sugar, salt, and a small quantity of albumin.

VEGETABLE FOODS.

All these contain more or less carbohydrates, and the principal amount of carbohydrates of our diet is obtained from them.

1. **Foods rich in Proteids.**—Leguminous foods (peas, beans, lentils, etc.) contain a nitrogenous substance called legumin (which is allied to albumin), in the proportion of twenty-five per cent. They form a chief source of the nitrogen of the food of vegetarians.

2. **Foods rich in Carbohydrates.**—Cereals. Bread made from the ground grain of various so-called cereals, such as wheat, rye, maize, barley, rice, oats, etc., is the most direct form in which carbohydrate is supplied in an ordinary diet. Besides starch, bread contains gluten (a nitrogenous body) and a small amount of fat. White bread is easier to digest than brown. Various articles of food are made from flour, viz., sago, macaroni, and biscuits.

The following table gives the approximate percentage composition of some of the principal foodstuffs :—

PERCENTAGE COMPOSITION OF FOODS.

	Water.	Proteids.	Starch.	Sugar.	Fat.	Salts.
Bread ..	37	8	47	3	1	2
Wheat Flour	15	11	66	4·2	2	1·7
Oatmeal ..	15	12·6	58	5·4	5·6	3
Rice	13	6	79	·4	·7	·5
Peas (split)	15	23	55	2	2	2
Potatoes ..	75	2	18	3	·2	·7
Milk	86	4	—	5	3·8	·8
Cheese ..	37	33	—	—	9	5
Lean Beef ..	72	19	—	—	3	5
Fat Beef ..	51	24	—	—	29	4
Mutton ..	72	18	—	—	5	5
Veal	63	16	—	—	16	4
White Fish	78	18	—	—	3	1
Salmon ..	77	16	—	—	5·5	1·5
Eggs	74	14	—	—	12	1·5
Butter ..	15	—	—	—	83	2

THE INFLUENCE OF COOKING ON THE DIGESTIBILITY OF CERTAIN FOODS.

Raw flesh has only one inconvenience—it sticks to the teeth, otherwise it is not at all unpleasant to taste. Seasoned with a little salt, it is easily digested, and must be at least as nourishing as in any other form. Man is a cooking animal, but broadly it may be stated that most forms of cooking actually lessen the digestibility of animal foods, rendering them in some cases tough and leathery, whilst they increase that of vegetable foods. It is a clinical fact that many patients can take raw or greatly underdone meats more easily than other forms of nourishment. This lessening of the digestibility of animal foods by cooking, regarded clinically, is in a measure made up for by advantages in their improved appearance and greater attractiveness, and by the new flavours developed in them serving to stimulate the secretion of gastric juice. They are also wholly or partly sterilized. The general effect of cooking on the structure of meat is to loosen its fibres by converting into gelatin the connective tissue which holds them together, and to remove fat; the chief effect on the chemical composition of meat is to diminish the amount of its water. That meat is rendered less digestible in proportion to the degree of cooking it undergoes is shown by the fact that $3\frac{1}{2}$ ounces of beef, taken raw, disappear completely from the stomach in 2 hours; if half-boiled, in $2\frac{1}{2}$ hours; if wholly boiled, in 3 hours; if half roasted, in 3 hours, and if wholly roasted, in 4 hours.

The effect of heat on the proteids of food is to coagulate them, which is effected at a temperature of about 77° C. If the temperature reached in cooking be beyond this, the value of the food is lessened by the hardening and shrinking of the proteid materials. The value of this fact, in its practical application to cooking, has long been recognized, though unfortunately it is commonly disregarded in practice. In boiling meat it should be plunged, for a few minutes only, in boiling water, sufficient just to cover it, when the superficial proteids are coagulated, the joint is "sealed," and its salts and extractives retained. The cooking should then be continued at a much lower temperature. With the exception of frying, it may be said generally that slow cooking is good cooking.

In roasting, the joint should be placed immediately close to the fire for a few minutes until it is "sealed," and then moved back, the drying of the continued roasting being prevented by persistent basting. In frying, the meat should be plunged suddenly into a deep pan of nearly boiling fat (or pure olive oil). The intense heat produces instantaneous coagulation of the proteids on the surface. So soon as the "sputtering" has ceased—in two or three minutes—the cooking is completed.

In the cooking of vegetables the moist heat swells up the starch grains and ruptures their envelopes, so that the starch grains form a paste or starch jelly. Unfortunately, though cooking increases the digestibility of green vegetables, it still further reduces their already low nutritive value. Their chief value lies in their bulk and in their mineral salts.

The fats are less affected by heat than the proteids and carbohydrates. By high temperature some of the fat may undergo partial decomposition, by which free fatty acid is liberated. It is suggested that the greater digestibility of cold fat over hot is accounted for by the fatty acid reuniting with glycerin to form neutral fat on cooling.

TEA AND COFFEE.

These resemble one another in that they both owe their dietetic value and stimulating properties to the presence of alkaloids identical in character, viz., theine and caffeine. Tea is used in this country to such a vastly greater extent than coffee that a few words may be devoted to the consideration of it from the dietetic point of view.

Formerly most of our tea came from the Celestial Empire, but in the latter part of the last century Indian and Ceylon teas became so popular as largely to displace China tea in the public favour. During the past few years a change has occurred, and China tea is steadily gaining favour again. On physiological grounds this is a desideratum. Both Indian and Ceylon teas yield much more of the deleterious tannin in their infusion than good China tea. Further, the longer Indian tea is infused the more tannin is yielded. When infused for ten minutes Indian tea yields nearly twice as much tannin as China tea, and thus tea from India and Ceylon is much more prone to cause gastric disturbance and discomfort in sensitive persons than China tea.

The greatest ignorance prevails on this subject, and there are a very large number of people who have given up tea altogether, and who try to satisfy their wants with cocoa or milk and water, who, did they know of its value, would be perfectly able to take and enjoy good China tea.

Those who have become accustomed to the somewhat harsh and stronger flavour of Indian tea are inclined to complain that China tea is flavourless. This is far from the case. Good class China tea has a peculiarly fine flavour all its own, but the cheaper sorts do not make very pleasant beverages. The late Sir Andrew Clark and Dr. Samuel Fenwick were both strenuous advocates of good black China tea.

There is no doubt whatever that in this country an immense amount of ill-health and suffering is caused by the abuse of tea, which, so far as abstainers from alcohol are concerned, may be described as the national beverage. The harm done is, indeed, only second to that caused by alcohol. Abuse is both qualitative and quantitative. Some people drink tea to excess habitually, and when they begin to suffer from irritable nerves, sleeplessness, palpitation, and muscular tremors, they wonder "Why?" Among the working classes the cheaper kinds of tea, consisting largely of the mid-rib of the leaf, are used, and these contain a proportionately greater amount of tannin.

It is a remarkable fact that the British hostess among the upper middle classes will guilelessly offer the late caller who confidingly trusts in her hospitality a cup of a beverage which would temporarily inhibit the peptic processes of an ostrich, and which is wholly devoid of stimulating and refreshing properties.

The meal so popular among certain classes under the name of "high tea" is neither dinner nor breakfast, but is a physiological atrocity which should be strenuously avoided. The digestion of freshly-cooked meats is greatly delayed by the presence of a strong infusion of tea. For persons with indifferent assimilative powers, tea taken three hours after a meal is least likely to interfere with digestion; it is at once refreshing and an aid to that process, as it helps to empty the stomach. The five o'clock cup of tea which has of late years become so popular is therefore physiologically sound.

ALCOHOLIC BEVERAGES.

It would be hazardous in the extreme—even did space permit—to deal at any length with the vexed subject of alcohol, so much difference of opinion existing on the subject, not only among the laity, but the profession. It may be safely said that a very large proportion of the medical profession are total abstainers. This is largely due, doubtless, to the amount of suffering and wretchedness which they see in the pursuit of their profession, owing to the abuse of alcohol by some of their patients.

The use of alcohol has the sanction of all the ages from the time of Noah to the present day. No reasonable person can deny that it was given us for our use. Whether we shall *use* it or not, and whether if we use it we are likely to *abuse* it, each individual must decide for himself. In spite of all that has been said by the ultra-total-abstinence fraternity, there can be no question that, dietetically considered, we have in alcohol a valuable stimulant.

Burney Yeo well says that it is at once a useful food, an agreeable stimulant, and a narcotic poison, according to the dose in which it is taken and the tissue reactions of the individual to whom it may be administered. Parkes' dictum that from one to one and a half ounces of absolute alcohol in the twenty-four hours is the maximum amount which a healthy man should take, "either in the form of wine, beer, or spirits," is regarded by the large majority of physicians as eminently sound.

In small quantities, taken with food, alcohol in most people improves the appetite and increases the enjoyment of food, and secondarily improves digestion. Many people take their food with greater relish and pleasure when accompanied by a glass of wine, and pleasure aids digestion. The sweeping statements of temperance fanatics as to the poisonous properties of alcohol are to be accepted with the greatest reserve. Gluttony is scarcely less objectionable than alcoholic intemperance. Unquestionably thousands of people die annually as a direct or indirect result of the abuse of alcohol, but it is open to honest doubt whether as many individuals do not die prematurely from over-eating as from over-drinking.

The percentage of alcohol contained in the usual intoxicating beverages is set out in the following table:—

Rum	60 to 75	Burgundy	8 to 14
Whisky	50 ,, 60	Claret	8 ,, 12
Brandy (British) ..	50 ,, 60	Moselle	8 ,, 12
,, (French) ..	50 ,, 55	Rhine Wines ..	7 ,, 16
Gin	48 ,, 60	Chablis	7 ,, 10
Port	15 ,, 18	Champagne	6 ,, 13
Marsala	15 ,, 21	Bitter Ale	6 ,, 9
Sherry	14 ,, 18	Porter	4 ,, 7
Madeira	14 ,, 17	Cider	2 ,, 9
Sauterne	11 ,, 18	Beer	2 ,, 4
Hungarian Wines ..	9 ,, 15	Ginger Beer (brewed)	1 ,, 3

RELATIVE DIGESTIBILITY OF FOODS.

Foods are described as easily digestible, and indigestible, or difficult of digestion. These terms require some qualification. It is not sufficient merely to consider the time taken to complete *gastric* digestion of any food ; its digestibility in the intestine must be taken into account, and the index of intestinal utilization is the amount of residue excreted by the bowels.

The approximate time taken for the gastric digestion of common articles of diet is shown in the following table.

TIME TABLE FOR GASTRIC DIGESTION.

Articles of Diet	Time required for Digestion.
Beef, boiled	3 hours.
,, roasted	3 to 4 hours.
,, smoked	4 ,, 5 ,,
Fish, boiled	1½ to 2½ hours.
Oysters (raw)	2 hours.
Lamb	2½ ,,
Mutton, boiled	3 ,,
,, roasted	3 to 3½ hours.
Milk	2 hours.
Sweetbread	2 ,,
Ham, boiled	2 to 3 hours.
Pork, roasted	5 hours.
Poultry, boiled or roasted	2½ to 4 hours.
Goose, roasted	4 ,, 5 ,,
Tripe	1 hour.
Veal (as prepared in the British Isles)	4½ hours.
Eggs, raw	2 ,,
,, fried or boiled hard	3 to 3½ hours.
Cheese	3 ,, 4 ,,
Apples	3 ,, 4 ,,
Cabbage	3½ ,, 4 ,,
Carrots	3 ,, 3½ ,,
Potatoes	2½ ,, 3½ ,,
Turnips	3½ ,, 4 ,,
Rice } if completely cooked	1 ,, 2 ,,
Sago } if completely cooked	1 ,, 2 ,,
Tapioca } if completely cooked	1 ,, 2 ,,
Wheaten Bread	3 ,, 4 ,,

An ordinary dinner is completely digested, leaving the stomach empty, in five to seven hours in the normal individual.

CHAPTER XVI.

DIET IN HEALTH AND IN THE INDIVIDUAL.

THE diet which we accustom ourselves to when in health should not always consist of the most easily digested substances; by so doing we may weaken our digestive system. While not going out of our way to select articles notoriously difficult of digestion, it is certainly not necessary or desirable that they should be avoided if the palate suggests them. A healthy diet is made up of a mixture in fair proportion of substances easy and difficult to digest, the former preponderating. Those foods which are usually found "digestible" and "indigestible" are indicated below.

Digestible.—Soups (clear); fish (*except* mackerel, salmon, crab, lobster, and eel); chicken, fowl, pigeon, game (not "high"), lamb, mutton; toasted or well-boiled bacon; tripe, sweetbread, cow-heel, calf's head; dry toast, plain rusks, stale bread; other farinaceous foods when in moderation, well-cooked potatoes, spinach, green vegetables generally in only small quantity; celery, French beans; fruit (without pips, core, or skin) in small quantity; milk, plain, or diluted with Vichy, soda, or seltzer water; tea (freshly made and not strong, and preferably China), coffee (not black), thin cocoa.

Difficult of Digestion.—New bread, wholemeal bread (usually), muffins, crumpets, buttered toast, pastry and sweets generally; hard, long-fibred meats, veal, pork, and beef; sauces, curries; all fried or re-cooked meats; fat or rich food such as duck, goose, and eels; green vegetables generally, save in small quantities for those whom they are known to suit; soups and broths, except in small quantity; foods generally which leave a large residue or which are in their nature irritating, such as seeds, kernels, rinds, skins, and stalks; acid or unripe fruits; sour wines; tea with meat, or otherwise, unless of moderate strength and freshly infused.

In regard to individuality of stomachs, a well-known physician speaks as follows: "If asked by a patient, 'What shall I eat, doctor?' say, 'Eat what you like!' If he says, 'How much?' reply, 'As much as your appetite demands!' If he asks 'When?' say, 'When you are hungry!'" Unfortunately, though this may be safe where the normal instinct exists, it is very often lost in dyspepsia and stomach disease, and such patients either eat too much and too often, or more frequently almost starve themselves.

No absolutely definite rules can be laid down as to the hours for eating. These will be influenced by so many different factors, such as the wishes of the individual, the size of the meals, and the exigencies of business. The more irregularity which the individual can tolerate, without suffering or discomfort, the higher his standard of health.

So far as the substances included in the diet of any individual are concerned, in spite of the valuable work of Chittenden and other prominent dietitians and physiologists at the present day, the fact remains that the practical physician has no little difficulty in formulating any definition of the normal diet for a healthy man or woman. We cannot help realizing that among a number of individuals in perfect health, of approximately the same age and body-weight, and performing a similar amount of physical labour, the food necessary to sustain them and keep up physical vigour varies greatly in quantity and character. While the general principle holds good that given quantities of flesh-food, breadstuffs, milk, butter, sugar, and condiments—representing the essential proportions of proteïds, carbohydrates, and hydrocarbons, etc., and their caloric value—are necessary for the average individual, yet the quantity of these consumed may be in inverse proportion to the size and stature of the individual; for we often find very small and very lean people consume much larger amounts of food than those of much ampler proportions.

Moreover, we find one man regards a beefsteak as the staff of life and foundation of physical energy, and looks with pitying contempt on the person who relies mainly for his sustenance on protein-containing vegetables and starchy dishes. Sir William Roberts used to say, "Our stomachs (meaning our digestive capacity and palates) are like our faces," and this very suggestive remark is only another way of saying one man's meat is another man's poison.

Physiological principles and facts only hold good to a certain degree, and it must be admitted that the dietaries of institutions such as prisons, poorhouses, and schools, based on stereotyped proportions of food-substances, are not wholly satisfactory in results, nor satisfying to all the individuals concerned. In prisons, while some convicts get on fairly well as regards diet, a proportion are invariably ravenously hungry. Again, in schools, some children are much happier and healthier when the amount of protein food is diminished and fats and starches increased, and *vice versa.*

It is useless ever to prescribe a dietary without taking into account the factor of personal idiosyncrasy, and Trousseau recognized this fact many years ago.

One of the most common metabolic idiosyncrasies is intolerance of purin-containing foodstuff, especially such articles as butcher's meat and strong tea and coffee.* While the majority of mankind are quite capable of consuming these articles with enjoyment, and, after abstracting a considerable amount of nourishment from them, eliminating the by-products of digestion, such as xanthin, hypoxanthin, adenine, guanine, and uric acid, without taking any hurt, not a few individuals suffer in no light degree from

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* Free and bound purins in common articles of diet, according to Dr. Walker Hall :—

		Purins.
Fish—		
Cod - - -	grs. per lb.	4·07
Salmon - -	,, ,,	8·15
Meat—		
Mutton - - -	,, ,,	6·75
Beef - - -	,, ,,	7·96–14·45
Chicken - - -	,, ,,	9·06
Liver - - -	,, ,,	19·26
Sweetbread - -	,, ,,	70·43
Eggs and Cheese, almost	,, ,,	0

consuming them. The writer remembers a valued domestic servant once in his service, who lived entirely on porridge, milk, cheese, bread and jam, butter, and weak tea or milk and water, and maintained a good standard of health, and in whom the slightest departure from this restricted dietary, such as the consumption of a small portion of fresh fish, resulted in a migraine attack and much discomfort and mental depression.

Such cases are, indeed, very common, and though one may hardly be disposed to admit the soundness of all the pronouncements of Alexander Haig, the well-known writer on the subject of uric acid, still there is, unquestionably, a large proportion of truth in them, and many of our aches and pains and attacks of "the blues" must be due to a quantitatively faulty dietary, and the daily endeavour of a certain type of metabolic activity to deal with nutritive material which it is quite incapable of handling. It is perhaps too much to say that every individual suffering in this manner is unhealthy or physically abnormal. Few people are absolutely healthy if the highest standard and conception of health be taken. The pathologists who take a somewhat morbid view of this question, often declare no one is in a condition of perfect health.

The maintenance of a condition of health and physical comfort, so far as the results of feeding are concerned, will depend in very many instances on a careful study of the individual as regards his digestive and metabolic capacities

		Purins.
Vegetables—		
White Bread, Rice,	grs. per lb.	0
Cabbage, Cauliflower, Lettuce	,, ,,	0
Potatoes	,, ,,	·14
Asparagus	,, ,,	1·5
Peas	,, ,,	3·54
Oatmeal	,, ,,	3·46
Beans	,, ,,	4·16
Beverages—		
Wines	grs. per pint	·0
Milk	,, ,,	·0014
Beer	,, ,,	1·09–1·27
China Tea (Methyl purins)	grs. per tea-cup	·075
Ceylon Tea	,, ,,	1·21
Coffee	,, ,,	1·7

or powers. There are many thousands of people in a condition of misery and physical incapacity, at the present time, from the constant occurrence of headaches and biliousness due to auto-intoxication, who may be entirely rehabilitated and literally set on their feet by the careful removal of purin-containing bodies from their daily dietary.

On the other hand, there are a very large number of people whose nutritional equilibrium and mental and physical activity can only be maintained by a diet containing a large proportion of animal food, who fall into ill-health on a starchy diet, and to whom milk puddings are as great a poison as black coffee and beef steaks are to the man intolerant of purins. Such individuals often have a higher percentage of free HCl in the gastric juices than the normal physiological man; and further, occupation and habits have much to do with the matter. Though the physiologist may dogmatically lay down to a grain the exact amount and proportion of food for the normal individual—according to whether his occupation is light, medium, or heavy labour—we are still compelled to recognize the fact that healthy people vary immensely in their metabolic activity. Whatever may be the caloric value of the food they consume, one *must* remember that it is transformed in very varying degrees and ways into kinetic energy by the chemical changes which it undergoes after absorption. There is much more rapid and complete combustion with some individuals than with others. We require to recognize clearly that different qualities and perhaps quantities of fuel are necessary to keep the various types and temperaments of the human machine in good working order; and the person whose metabolism requires more of one element than of another in his daily dietary can only be properly regarded as abnormal and diseased when his chemical processes are rendered faulty by his endeavouring to exist on stereotyped and conventional lines to which he is physiologically ill-adapted.

Milner Fothergill, for instance, emphasized the value of sugar, in the form of "toffee," for children, and the love for sweet things which young people almost invariably evince must be regarded as essentially normal and physiological. Their desire for heat-producing sugar, it is important to note, most frequently co-exists with an equally strong dislike of fat foods.

Parents, and those concerned in the upbringing and education of children, should realize that individual idiosyncrasy in diet exists with children as much as, if not to a greater extent than, with adults, and it certainly savours of cruelty, and is at any rate often very unwise, for reasons of discipline, to force a child to eat some article of diet for which it evinces a pronounced dislike.

How difficult it often is to settle on a food or milk mixture which absolutely suits an infant when the natural food fails, any nurse of experience can tell; and it is often found that after ringing the changes on various patent foods, one of analytically poor food-value does best, where one of ideal synthetic composition has ignominiously failed. Metabolic idiosyncrasy evidently begins very early in life.

As old age creeps on, additional care in the arrangement of diet is needed, and almost invariably the amount of butcher's meat taken requires to be greatly reduced. In those with arterial thickening and hypertonus, this is of special importance, and many lives are shortened by the tendency to "keep up the strength" with nutrition, often meaning highly stimulating, nitrogenous food. Sir T. Lauder Brunton cites the case of an ancient millionaire whom he put on a pauper's diet, chiefly of toast and gruel, which was all his metabolism was equal to. On this he lived comfortably; but possibly resenting this restricted diet, he changed his physician, and being put on a more generous scale paid the penalty by an early demise.

The loss of teeth, from which the majority of old people suffer, is at any rate suggestive on the part of nature, and possibly the substitutes willingly furnished by the prosthetic dental surgeon are not unmixed blessings if we put æsthetic considerations aside.

In old age, small meals are best, but should consist of light, protein-free foods, with carefully chosen green vegetables (the coarser kinds such as cabbage and turnips being avoided). Flatulence is the curse of old age. *Pace* the total abstinence advocates, a small dose of well-matured spirit or good wine would seem of value, and Fothergill well describes wine as "the milk of old age."

Putting age and occupation aside, the season of the year and the climate does and must influence our appetite and capacity for utilizing food. Most people consume and really require a larger proportion of food in winter than in summer, and on a keen frosty day an amount of fat and oily matter can be consumed which would be offensive and nauseous in summer. The love of the Laplander for whale blubber and fat of all kinds is notorious, and with the need for hydrocarbons which his cold environment have occasioned, he has been endowed by Providence with the peculiar digestive activity for satisfactorily utilizing them. There appears to be no constant balance in the human species between the amount of animal and vegetable food necessary to sustain any individual. We recognize the average individual, but we are forced by clinical experience to admit that there are not a few types and modifications one way and the other, or our therapeutics will be futile in many cases. From the type of " the perfect man," physiologically, there are variants who so long as they live on food composed of elements proportional to their needs must be regarded as normal individuals. The fact that metabolic diseases are almost peculiar to man, shows how common these variants from the ideal type are, and how frequently those with individual peculiarities suffer from attempting to accommodate themselves to the dietary and habits suitable to the average man. The proportion of animal *versus* vegetable food required by them differing from the average standard, their efforts to conform to this standard result in imperfect metabolism of either the protein or carbohydrate elements, and they fall into ill-health. The man who tries to convince his audience that a diet of nuts, or one free from fish and meat, is the only way to physiological salvation, would probably hesitate to feed a sheep on beef-steak ! And yet the anomaly is no more glaring than certain individuals attempting to maintain health and bodily vigour on a strictly vegetarian diet.

On the extent to which the physician is able by careful investigation on scientific lines to gauge the metabolic capabilities of individual patients, and properly guide them as to their dietetic habits, will largely depend his success in treating many forms of disease, and especially chronic disease.

CHAPTER XVII.

DIET IN DISEASE.

IN disease the diet may vary considerably from the normal: it may have to be increased above the amount ordinarily required by the body, or it may have to be diminished as regards all its constituent elements; or one or more of these, either albumin, fat, or starches, may require to be lessened, or even entirely removed from the patient's dietary. We require therefore to consider reduced diet, increase of diet, and special diet.

On the integrity of the various digestive glands, and their proper supply with blood, and on the normal condition of the nervous system, will depend the digestion and utilization of an amount of food sufficient to maintain health.

The digestive function may be affected in the following different ways: (1) Functional or organic disease of the special digestive organs; (2) Any constitutional dyscrasia, or toxæmia; (3) By the nervous system affecting reflexly or directly the mobility, secretion, or blood-supply of the special organ.

Further, diets may have to be modified owing to the functional or organic lesions disordering metabolism. The digestive and assimilative activity of the cells in the body tissues are altered, and metabolic activity lessened; this occurs in gout, diabetes, and obesity, and may follow various acute infective diseases.

Hutchison, who may be regarded as one of the greatest British dietetic authorities at the present day, lays down the following rules to be observed in drawing up any plan of dietetic treatment:—

1. When prescribing a diet for a case of local disease, care must be taken not to sacrifice the whole to the part. The organs are members one of another, and the patient's general

nutrition must not be interfered with in the interests of any one of them. To avoid digestive discomfort this is too often done in cases of dyspepsia, and the general vitality of the patient lowered by too much abstemiousness.

2. No article of food must be forbidden without a good reason for doing so. Arbitrary restrictions must be avoided.
3. In acute disease one should recommend ; in chronic disease forbid.
4. Before recommending any article, it is necessary to ascertain both whether the patient likes it, and whether it agrees with him.
5. If any special article of food does not agree with the patient, it is better to reduce it than altogether cut it off from his dietary.
6. General changes of dietary should be made gradually.

The following are directions for the diet and general regulation of life in certain diseases, but are of course only general, and need careful modification for individual cases.

ANÆMIA.

Patients require a full, generous diet, containing relatively much albumin ; soups (unless there be dyspepsia, when the quantity should be very small) ; fish ; meat of all kinds (except veal and pork), scraped, pounded or minced, when necessary, and for preference underdone ; poultry, game, sweetbread, calf's head, tripe ; bacon, toasted or well boiled (never fried) ; eggs in any form except hard boiled ; all farinaceous foods, including wholemeal bread ; vegetables of all kinds ; all fruits ; milk (plain or peptonized), koumiss, whey, cream and butter ; red wine, beer, stout, or porter ; chalybeate waters and mineral waters generally ; tea, coffee, cocoa. Salt in abundance. Fluids generally in abundance.

Articles Forbidden.—Pork, veal, highly spiced foods, all re-cooked foods, vinegar and pickles.

General Directions :—

1. Abundant rest, especially in well-ventilated rooms (sunny if possible), in the open air and in the sunshine.

2. Moderate exercise, gradually increased, but always stopping short of tiring point. It should be taken preferably in several short walks rather than one long one. Patients suffering from anæmia, and invalids generally, often bear better the exercise taken after noon.

CARDIAC DISEASE.

When failure of compensation occurs owing to weakness and atrophy of the myocardium, dietetic treatment is especially called for.

The late G. W. Balfour laid down the following rules for such cases :—

1. At least five hours between each meal.
2. No solid food between meals. Hot water to be sipped about three hours after each meal.
3. The most important meal should be in the middle of the day.
4. The meals should be as dry as possible, and the bulk of the fluid should never exceed five ounces.

Animal food should be taken in moderate amount : lean meat, game, or poultry. White fish is permitted. A small quantity of fat, in the form of butter, e.g., is allowed, but no sugar, and farinaceous articles of food are all reduced. Fresh vegetables and certain kinds of fruit may be permitted.

Such a diet is especially adapted for a patient whose heart is believed to be fatty.

Where fair compensation has established itself, plainly-cooked wholesome food taken at regular intervals, with avoidance of excess, either solid or fluid, is indicated.

Tea and tobacco are to be banned, and some physicians think alcohol hardly more desirable.

DIABETES.

The principle to be kept in view in ordering the food of a diabetic patient is that by an exclusively animal diet the excretion of sugar in slight cases can be entirely suspended, and in severe cases kept at a very low figure.

So far as is practicable, therefore, fats and albuminates should form the sole food of the patient. The more severe the nature of the case, the more rigid the adherence to this rule should be.

It will be found essential, however, to have some regard to the feelings and wishes of the patient. Some will almost invariably resent being placed on a diet composed exclusively of fats and meat, and apart from their wishes such a diet may be actually injurious to them when used exclusively. Certainly, present opinion is that sudden withdrawal of all starches tends to bring about the always dreaded condition of acetonæmia. There is an inclination just now to allow the patient a limited amount of bread stuff, toasted preferably, and this is well, for the most difficult problem in the dieting of diabetics has ever been to find some substitute for bread which is at once palatable, easily prepared, and inexpensive. Probably the power of utilizing sugar is not wholly lost in any diabetic.

A dietary somewhat as follows may be regarded as in agreement with the views of most physicians at the present time :—

Ceteris paribus, patients are allowed : All clear soups and broths ; fish of all kinds (except cod's liver), including shell-fish (with plain melted butter only) ; meats of all kinds ; eggs in all forms ; cream, butter, cheese, gluten, bran and almond breads and biscuits ; greens, spinach, broccoli, turnip-tops, watercress, mushrooms, mustard and cress, cucumber, lettuce, tomatoes, celery (sparingly), endive ; French beans, cauliflower, and asparagus (the green part), all in great moderation ; strawberries, gooseberries, raspberries, currants, peaches, and nectarines, in very small quantity, and occasionally only ; oranges and lemons ; nuts of all kinds, except chestnuts ; pickles, olives, vinegar, oil jelly (sweetened, if preferred, with " saxin " or levulose) ; whipped cream, custards ; koumiss, milk in great moderation ; tea, coffee, cocoa (nibs) ; claret, hock, dry Sauterne, Chablis, Burgundy, brandy and whisky, soda-water, Apollinaris, seltzer, Contrexéville, Vichy, Vals or St. Galmier waters ; saccharine or levulose as a sweetening agent. Any alcohol should be ordered in great moderation.

Articles Forbidden.—Sugar and starch in any form, bread and biscuits (unless in small quantity when specially directed) ; rice, tapioca, sago, vermicelli, arrowroot, cornflower, oatmeal ; potatoes, peas, broad beans, parsnips, beetroot, carrot, Spanish onions ; pastry and puddings of all kinds ; fruits of all kinds, fresh or preserved, except those named (in moderation only) ; milk (except in small quantity), ale, stout, porter, port, champagne, liqueurs, and cider. No flour should be used in the frying of food for diabetic patients.

General Directions :—

1. Regular daily exercise is extremely important, but fatigue should be avoided.
2. Flannel clothing next the skin always, most carefully guarding against "catching cold."
3. A calm, equable, regular life, with good hours, and without worry or excitement or over-work.
4. Regular action of the skin should be encouraged by tepid sponging, followed by skin friction, by warm bathing, massage and Turkish baths.

It is usually the better practice to gradually lessen the carbohydrate foods until the sugar has disappeared, and afterwards to tentatively replace them, noting the effect of each addition as a guide.

GASTRIC DISEASE AND INSUFFICIENCY.

Formerly the diet for patients suffering from stomach trouble would come under the general heading of dyspepsia —a word which, until recently, was used as a cloak for want of accuracy in diagnosis.

During the past decade our knowledge of stomach disease has been greatly enriched, and the analysis of gastric contents and use of test meals have become almost as common as urinary analysis.

Putting aside actual malignant disease, we generally recognize at the present day the following gastric affections which require consideration from the dietetic point of view: Gastritis (acute and chronic), gastric neurasthenia and myasthenia, hyperchlorhydria and hypersecretion, gastric dilatation and gastric ulcer.

In dealing with all forms of gastric disease, the problem facing the physician is to give sufficient food to allow for the nutritive wants of the organism, and at the same time to adapt the food given, both in form and quantity, to the digestive capability of the patient.

Acute Gastritis.—At first, the main indication is rest for the stomach, and entire abstinence from food must be enforced for about twenty-four hours, hot water being taken in sips at brief intervals. This lessens the nausea and washes out undigested débris from the stomach.

When the more acute symptoms have subsided, milk and lime-water or soda-water, chicken broth, toast-water, or barley-water may be taken every two hours. A gradual return to normal diet is then permitted.

Chronic Gastritis.—Avoidance of all articles of an indigestible nature (see list, pages 241–2), and the taking of three well-cooked digestible meals and no more in the twenty-four hours are indicated. There should be no "snacks" between meals. All highly-seasoned food, sauces, and spices must be studiously avoided.

While the patient is dressing in the morning, he should sip a glass of water, as hot as can be taken with comfort.

Hyperchlorhydria.—This condition may be associated with chlorosis or neurasthenia, and be purely functional in character, or it may be a symptom of a serious disease, hypersecretion, or gastro-succorrhœa continua chronica.

In either case the dietetic indications are much the same. Such patients are most comfortable with, and are best able to digest, a dietary which largely consists of proteid material. Starches make them uncomfortable, and are not digested. Swallowed saliva can scarcely be expected to exert any diastatic action when there is ·5 per cent free HCl in the gastric juice ; nor, when the gastric contents pass on to the duodenum, can the pancreatic secretion act efficiently. It is argued by some physicians that by giving much proteid food we are merely exciting increased secretion of HCl already excessive, and they plead for a modified starch diet. This view is not generally held, however, and personally, having carefully noted the effect of starch diet on cases of this nature which have come under my notice, I have invariably found the patients were made worse.

Proteids enter into chemical combination with the free acid, and alleviate the pain from which such patients almost invariably suffer.

All ill-cooked and indigestible forms of meat, salt beef, and salt or smoked fish should be absolutely avoided, but well-cooked boiled or roasted mutton or beef, fresh fish, milk, or raw eggs, should form the larger part of the food taken. A limited amount of altered starch food may be taken, such as Veda bread, and as improvement takes place, toast, rusks, etc., may be added.

Strong tea or coffee, spices, pickles, and sauces are entirely objectionable, and indeed the patient will usually voluntarily avoid them, as he knows too well the discomfort and pain which he invariably experiences after taking them. Milk and soda-water or whey may be taken as a beverage, and the meals should be limited to three in the day.

In **Gastric Myasthenia and Dilatation of the Stomach** the indications are practically the same. Perhaps the most important is the limitation of fluids. A wineglassful may be taken with each meal, and between meals fluid in quantities of a wineglassful or less at intervals of thirty to forty minutes. If it is not possible to give the patient a sufficient amount of fluid for the needs of the organism in this way, water may be administered per rectum.

Meals must be small in bulk, digestible, and nutritious in character. Probably the best arrangement is to give four small meals at intervals of four hours in the day.*

Gastric Ulcer.—In the first stage, when the ulcer is in an active condition, complete rest in bed, with rectal alimentation alone, is often needed.

After ten days a diet of peptonized or plain milk may be employed, and after this has continued for a couple of weeks, more solid food is given. The milk may be thickened by the addition of cornflour or arrowroot, thin gruel or lentil food may be taken, and then chicken purées, creamed fish, and finally tender meats.

Gastric Neurasthenia.—It is impossible to lay down anything but the most general principles in the dietary to be prescribed for an ailment in which the symptoms and the personal factor differ so much. No two cases of gastric neurasthenia are alike. In some there is excess of hydrochloric acid, in others there is a condition approaching achylia gastrica. Further, the condition of the gastric secretion varies much from week to week, and even from day to day. The general line should be to *see that the patient takes a sufficiency of good, wholesome food, whether he suffers discomfort after or not.* Very often the difficulty

* In gastric dilatation dependent on pyloric stricture, simple or malignant, dietetic treatment is mere temporizing. Such cases are surgical in their nature.

in this class of case is to prevent the patient from leaving off article after article until he has cut down his diet far below the limits of health, and is actually perpetuating his disease by an over-restricted diet.

CONSTIPATION.

Constipation is often induced and perpetuated by a too exclusively nitrogenous diet, which is too easily digested, and leaves but little residue as the result of digestion. A normal amount of indigestible residue acts as a stimulus to the mucous membrane of the intestine. Further, if the supply of fluid to the blood be limited, less fluid is likely to be secreted by the intestinal glands, and the intestinal mucous membrane becomes drier. The freer the supply of water to the blood the more fluid the intestinal secretions are likely to be.

Articles Allowed.—Clear soups ; fish ; meat of all kinds, except veal or pork ; game, ham, bacon ; bread (white, brown, or wholemeal), choose the coarser breads with bran or wholemeal when possible. The bread should be taken in fairly large quantities, and the kinds varied from time to time ; it should never be new ; the crust also should be eaten. Toast, with plenty of butter or dripping, is good. Gingerbread often acts well. Nuts are usually contra-indicated, but in some cases Brazil nuts or dry walnuts, well masticated, appear to help. Oatmeal, crushed oats with sugar and milk, or golden syrup, or old-fashioned treacle; cabbage, cauliflower, sprouts, French beans, endive, celery, spinach, salads with abundant oil; Spanish onions; apples, stewed or baked; figs, prunes, dates, Normandy pippins or pears, stewed; oranges, grapes, bananas, strawberries, gooseberries, currants, etc.; jam, marmalade, preserved fruits; hot or cold water; tea, always freshly-made and never strong or taken with meat ; coffee, thin cocoa ; beer ; waters, such as Vichy, Vals, St. Galmier, Kissingen, Carlsbad, Marienbad, etc.

Articles Forbidden.—New bread and pastry; eggs, except in moderation and lightly cooked (best when "scrambled") ; peas, broad beans, new potatoes, rice, tapioca, etc. (unless with fruit or jam or honey) ; nuts of all kinds; milk (except in small quantities or mixed with Vichy or similar water); sherry.

General Directions:—

1. The patient must be urged to take a full quantity of fluid—for an adult at least two and a half to three pints daily. Many women suffering from constipation will be found to take only one to one and a quarter pints daily; their constipation often depends upon this alone, and yields when a sufficient quantity of liquid is taken.

2. This fluid may well include a tumblerful of water, cold or hot, immediately on getting out of bed in the morning, and a tumblerful of hot water at bedtime. Where hot water, with or without a saline aperient, is ordered to be taken in the morning, the effect is often enhanced if it be slowly sipped while dressing.

3. No meat to be taken with tea; fruit or jam, honey or treacle with farinaceous foods (e.g., blancmange or rice), and order every night or early morning a full quantity of such fruit as stewed figs, baked apples, Normandy pippins, bananas, etc.

4. The body should be warmly clothed to avoid the skin getting chilled, and the feet kept warm and dry by thick boots, with a cork or asbestos sock.

5. Tepid or cold sponging, followed by sharp friction with a rough towel and flesh-glove, daily, to secure a vigorous action of the skin.

6. Abdominal massage for ten minutes before rising, every morning. This (which can readily be done by the patient), followed by the cold or hot water on rising, is often sufficient to produce a speedy evacuation.

DIARRHŒA.

A general dietetic rule that applies to all cases of diarrhœa is to avoid all foods that leave much undigested residue behind which would tend to irritate the surface of the intestinal mucous membrane.

The patient may be allowed: cold milk (boiled for preference), plain or peptonized, alone or with lime-water or barley-water; koumiss, whey, white wine whey, albumin-water, rice-water; soups (without vegetables) thickened with arrowroot, rice, sago or tapioca, and with or without brandy in addition ; raw meat, pounded meat ; sweetbread, tripe ; calf's-foot jelly ; eggs, lightly boiled or poached, or beaten up with brandy ; plain biscuits, rusks ; gruels, brandy or port wine, whisky and water, or whisky and a natural mineral water such as Apollinaris or seltzer.

Articles Forbidden.—Rich soups and meat essences ; green vegetables, acid fruits, nuts, potatoes ; brown bread, wholemeal bread ; all hard foods, or hard meats, or rich, fat meats, especially veal and pork ; beef tea, malt tea, malt liquors and wines.

General Directions :—

1. Warmth and absolute rest in bed.
2. Warm clothing, especially for the abdomen.
3. The food should be given in small quantities, frequently ; it is usually better given cold.
4. During convalescence the food should be increased cautiously.

GOUT.

Views as to the etiology of gout have of late years undergone a marked, almost revolutionary change, and the part played by uric acid and its salts is now regarded as a comparatively unimportant one. While at the present moment there is complete absence of unanimity as to the actual cause, there is general agreement that derangements of the gastro-intestinal tract constitute an important factor in the development of acute and chronic gout. It is therefore of essential importance to secure a healthy condition of the gastro-intestinal mucous membrane, and a gouty patient can always diminish the frequency and severity of his attacks by a carefully arranged diet, by insuring a daily evacuation of the bowels, and by taking sufficient active exercise.

No single diet can be regarded as suitable for all gouty patients, but as a general principle in many cases the following articles are allowed : All fresh vegetables freely (with exceptions named) ; fish (with exceptions named) ; eggs in moderation, lightly boiled or poached ; meats (those of the lighter and whiter kinds) in great moderation ; rice, sago, and tapioca ; fresh ripe fruits (with exceptions named) ; soups ; toast or stale bread ;

potatoes, salads, celery, and green vegetables (with exceptions named) ; milk, skimmed, diluted with Apollinaris, Vals, Vichy, or seltzer water ; lime-juice freely diluted ; China tea, freshly infused and not strong ; coffee, which should be taken only in moderation, and not at night ; cocoa ; tobacco in moderation.

In small quantities only.—Bread, plain biscuits, potatoes, asparagus, tomatoes, haricot beans, broad beans, peas, and lentils ; eggs ; whisky or brandy (not to exceed two ounces in the twelve hours), unsweetened gin, claret, or hock, freely diluted ; butter and cheese.

Articles Forbidden.—Fats and rich foods, re-cooked foods, sauces, rich gravies and made dishes ; the harder or richer meats, beef, pork, or veal (as prepared in the British Isles) ; smoked, dried, or pickled fish, pork, or other meat ; pastry, jellies, sugar ; meat essences and strong soups ; rhubarb, gooseberries, currants, strawberries (except in moderation) ; oysters, mullet, mackerel, salmon, herring, eel, lobster, crab ; duck, goose, hare ; mushrooms, truffles, pickles and spices ; preserved fruits ; ale, porter, stout, port (usually), champagne (nearly always), Burgundy, sherry, Madeira, and all liqueurs.

General Directions :—

1. Moderation in animal food, liberality in vegetables. The proportion of these must be adapted to each case.

2. Abundant fluid, of which plain hot water (for preference slowly sipped), night and morning, may form an important part.

3. Regular exercise. A gouty patient should walk daily not less than from three to four miles, unless there be reason to the contrary in the individual case. Gout, however, is not uncommon in those who take exercise freely, and the degree and kind of exercise must be carefully prescribed in each case.

4. Warm baths, tepid or cold sponging, skin friction, massage and Turkish baths.

5. Free action of the skin, kidneys, and bowels, regular hours, warm clothing, and the avoidance of fatigue are essential.

6. Not less than seven nor more than eight hours' sleep. The patient should go to bed early and get up early.

OBESITY.

Unless the patient is habitually excessive in the amount eaten, or unless the obesity be so marked in degree as to cause actual physical disability or disease, it is best not to prescribe any very restricted dietetic treatment. Some individuals, though extremely stout, enjoy excellent health, and a revolutionary alteration in their habits should not be lightly undertaken.

Changes in quantity and quality must be gradually effected. It is unsafe to put any patient on a very restricted diet suddenly. A weekly loss in weight of three pounds should not be exceeded. Many diets have been prescribed by many authorities, only differing in details. They all resemble one another in the reduced caloric value, the aim being to make up deficiency in this respect from the fat of the patient's tissues.

Generally speaking, something like the following is suitable.

Articles Allowed.—Clear soups in small quantity only; broths, not thickened or containing such ingredients as rice or barley; fish, and lean meat (with exceptions named); eggs; fruit; green vegetables; stale bread, toast, rusks and biscuits in great moderation, or gluten and almond bread or biscuits; butter; water (hot or cold); milk (skimmed), diluted with Vichy, Vals, seltzer, or other natural water; tea or coffee, with saccharin instead of sugar; natural mineral waters; claret, hock, Chablis, whisky or brandy, in moderation.

Articles Forbidden.—Thick soups; eels, mackerel, salmon, herrings, sardines, with oil; pork, duck, goose; rice, tapioca, macaroni, oatmeal, sago, arrowroot; potatoes, peas, broad beans, parsnips, carrots, beetroot; pastry and sweets; sugar, starchy cocoas; cream and milk, except in great moderation; ale, porter, stout, port, champagne, and liqueurs.

General Directions:—

1. An active life, with full occupation, short hours of sleep, and the most vigorous exercise compatible with the physical condition. Cycling, horse exercise, and fencing are especially valuable; but the form and amount of exercise must be carefully adapted to each case.

2. Free action of the bowels and skin, with regular Turkish baths.

3. The entire quantity of liquid taken, of all kinds, should be moderate.

[*See also the "Salisbury" and "Banting" Systems, pp.* 265].

PHTHISIS.

In the early Victorian era the tendency was to underfeed patients who became consumptive, for fear of setting up inflammatory processes. The average life of the individual stricken with pulmonary tuberculosis was proportionately brief. After 1840 a change occurred, and a more liberal diet was allowed until the closing years of the last century, when the sanatorium treatment of consumption began to boom, and the idea seems to have got about that the patient should *habitually over-eat*. The effect of this in some cases has been disastrous, if less so than the starvation regimen.

The production of a gastrectasis early in the treatment of any case of pulmonary phthisis will naturally largely diminish the patient's chances of regaining his health.

In a word, while a liberal diet is very necessary, reasonable moderation is not less so. The object to be aimed at is to get the patient to eat enough, but not over-eat.

Further, the diet, as to quantity and quality, and also as to time, frequency, and method of administration, must necessarily vary widely according to the stage of the disease, and the condition of the appetite and of the digestion.

Articles Allowed.—All soups, broths, meat essences and juices; eggs, preferably raw; fish, poultry, game, meat (scraped, pounded, or minced, when necessary); all vegetables in moderate quantities; all fruits; milk, koumiss, cream, tea, coffee, cocoa, chocolate; alkaline mineral waters; beer, wine, or spirit, as required for each case.

Articles Forbidden.—Veal, pork, hard or salt meat, re-cooked foods, and pickles.

General Directions.—The method of feeding in phthisis is as important as the quantity and quality of the food. All food should be appetisingly cooked and daintily served. The greatest variation possible, even in the matter of serving milk, should be introduced.

1. (*a*) On waking, milk, hot or warm, gradually increasing in quantity till ten to twelve ounces are taken. It may contain a little sodium phosphate to help the bowels, or sodium bicarbonate or sodium citrate to render it more easy of digestion.

(*b*) If preferred, there may be given, as a morning stimulant, a breakfastcupful of tea made with milk instead of water.

(*c*) Breakfast, one hour later, should be substantial, and is better taken in bed before washing and dressing.

(*d*) One hour and a half after breakfast (so as not to spoil the appetite for luncheon), one raw egg, or two if possible, broken into a glass and swallowed whole, with pepper and salt, or beaten up with a little milk ; or raw meat, alone or in sandwich.

(*e*) Mid-day, a substantial meal with (when indicated) beer, red wine, or spirit.

(*f*) One hour and a half after luncheon, milk or raw eggs, or raw meat.

(*g*) In the afternoon, tea made with milk, or milk, with raw eggs, or raw meat, and abundant bread and butter.

(*h*) At 7 or 7.30, a substantial meal.

(*i*) At bedtime, milk, and if possible a raw egg in it or with it.

2. Every hour possible should be spent in airy, sunny rooms, or in the open air and sunshine.

3. All rooms should be bright, and kept well ventilated night and day.

4. Clothing should be light and loose. It should be woollen, night and day, winter and summer. The boots should be thick and sound, and contain a cork or other sock to keep the feet not only dry but warm. Chilled feet may be as harmful as wet feet.

5. Every night the whole body should be sponged with warm water, or, where the patient can bear it, with cold water (rapidly), followed by friction with a rough towel and a flesh-glove. The regular, long-continued attention to the action of the skin forms one of the most important factors in the hygienic treatment of phthisis. It should be carried out in a warm room, under conditions which prevent chill ; it is better done for, than by, the patient.

When there are night sweats, it may be necessary to regularly precede the skin friction by a soap and water cleansing.

6. Regular exercise carefully adapted to each case, regular hours, and the avoidance of fatigue.

RENAL DISEASE AND ALBUMINURIA.

No rigid system of diet can be formulated for all kidney diseases, nor for all stages of any form of nephritis. In determining the diet attention must be directed for the most part to the actual condition of the urine, but in addition to that, other factors, such as the patient's general nutrition, the presence of dropsy, the condition of the cardiovascular system, and the presence or absence of uræmic symptoms, must be taken into consideration.

When dropsy and uræmia are present in a marked degree, the ordering of the diet must be based on the principle of reducing the work thrown upon the kidneys as far as possible, and this is especially the method to be adopted in acute renal disease. Indeed, in acute nephritis it is often advisable to withhold all food for a few days; in subacute and commencing chronic cases, to allow only milk until the albumin percentage is low. In chronic disease of the granular or "mixed" type, the indications are to administer food which is readily assimilable, will not tax the digestion, and will furnish the smallest amount of nitrogenous waste calling for elimination by the damaged kidneys.

The patient should have a diet something as follows: Soups thickened with arrowroot, vermicelli, rice, or barley. Fish, fowl, pigeon, game, butter, cream; eggs in moderation; green vegetables, celery, onions, salads, mushrooms, artichokes, cauliflower, turnips; milk (plain or with alkaline water or peptonized), skim-milk, whey, koumiss, milk diluted with rice-water or barley water; farinaceous foods such as bread (stale), toast, rice, tapioca, vermicelli, arrowroot, sago, macaroni; tea, cocoa and coffee, in moderation; soda-water, seltzer, Vichy, Vals, Ems, Salutaris, plain water (unless hard); in certain cases a little old whisky, freely diluted, or red wine in small quantity and freely diluted with water or mineral water.

Forbidden Articles.—Sugar, ices, pastry and sweet foods generally; new bread, butcher's meats, especially of the brown kinds; beef tea, meat essence and jellies, strong soups; re-cooked meats, stews, hashes; highly spiced food, pickles and sauces; rich foods, such as hare, duck and goose; potatoes, peas and broad beans, except in great moderation; cheese; every form of alcohol (with the occasional exception of those previously named).

General Directions:—

1. A quiet life without worry or excitement.
2. A warm, dry, equable climate.
3. Woollen clothing next the skin, night and day, all the year round.
4. Hot-air, vapour, or Turkish baths; daily tepid sponging with skin friction. Avoid hot and cold baths, but warm baths may be taken.
5. Regular daily exercise, always stopping short of fatigue.
6. A free, regular action of the skin, kidneys, and bowels should be maintained.

CHAPTER XVIII.

SPECIAL DIET CURES.

THE SALISBURY SYSTEM.

THIS system was first introduced by Mr. J. H. Salisbury, of New York, who in 1887 published a book entitled, "Brief Statement of the so-called Salisbury Plan for the Treatment by Alimentation of various Diseases produced by Unhealthy and Indiscreet Feeding." The principles laid down in the treatise have been widely adapted in the treatment of various morbid conditions.

Salisbury's system was intended to influence diseases due to improper feeding (obesity for example), all sclerotic conditions, and those "associated with excessive developments of either the connective or fatty tissues," and various forms of dyspepsia. The essentials are the taking of hot water, and a diet consisting of about two-thirds lean meat and one-third vegetables.

The water should be taken as hot as the patient can bear it; one pint in bed in the morning or on rising, one pint one hour and a half before each meal, and half an hour before bedtime. It should be slowly sipped, so that the time taken be 5 to 15 minutes, uncomfortable distention being thus avoided. If there be thirst between meals, the patient may take hot "clear" water, lemon water, or "crust coffee." At meals, five to eight ounces of clear tea or clear coffee is allowed. Food should be either the muscle pulp of beef, broiled, broiled beef-steak free from fat, roast beef, broiled or roasted lamb or mutton; oysters, raw, or broiled or roasted in the shell; broiled or boiled fish; chicken, game, and turkey, broiled or roast; salt, pepper, Worcester sauce and chutney in moderation; celery. All meats should be fairly well cooked, and meals should be taken regularly, either alone or in the company of others taking the same diet.

It is claimed that under this system adipose tissue will rapidly disappear, the loss of weight being at the rate of 10 lbs. to 30 lbs. per month, according to the degree of fatness, the strictness of the diet, the amount of exercise, and the mental condition of the patient. If the loss of weight be too rapid, so that the skin hangs in folds, such food as bread, toast, rice, cracked wheat, and potatoes may be added. The loss of 10 lbs. to 15 lbs. a month is advocated as the ideal rate of weight-reduction. When the desired weight and bulk have been reached, the fat-forming foods should be taken in such proportion as may suffice to maintain them, usually two parts of meat to one part of vegetable bulk. It is stated that the relish for beef may become so great that from one to two pounds may be taken at each meal.

The body should be washed twice daily with soap and water, and afterwards rubbed with equal parts of glycerin and water. Regular exercise, short of fatigue, should be taken; or, where this is impossible, the body should be well rubbed from head to foot for from ten to twenty minutes three times daily. Flannel or silk should be worn next the skin, and the body be kept comfortably warm. All methods calculated to maintain health should be observed.

The above diet will cause most people to lose weight quickly. Before advising anyone to rigidly adhere to it, however, it would be well to exclude the existence of chronic granular nephritis. A dietary with so great a proportion of nitrogenous food will tax severely any but the healthiest kidneys.

THE BANTING SYSTEM.

In 1863, Mr. William Banting published a letter on "Corpulence," addressed to the public. It was "respectfully dedicated to the Public simply and entirely from an earnest desire to confer a benefit" on his fellow-creatures. It was issued at the price of sixpence, any profit yielded being devoted to the Printers' Pension Society. The author spoke pathetically of the "parasite of obesity," and told how he had just emerged from a very long probation in this affliction, and how he hoped the publication of this letter would lead to the same comfort and happiness he now felt under the extraordinary change. He recorded that he was 66 years of age, 5 ft. 5 in. in stature, and in 1862 weighed 202 lbs. He was of active and regular habits, and (as he believed) did not indulge in anything to excess. There was no hereditary tendency to corpulence. He had adopted increased bodily exertion, and especially rowing, with, unfortunately, development of a prodigious appetite, which he was in some degree constrained to indulge. He tried fresh air and bathing and Turkish baths (ninety); and took "gallons of physic," "adopted riding on horseback, the waters and climate of Leamington, Cheltenham and Harrogate, and spared no trouble or expense in consultations with the best authorities in the land." His last state, however, was worse than his first, for he records that he could not stoop to tie his shoe and had to go down stairs slowly backwards. He took yet further advice from a gentleman, who left him in a worse plight than ever to go for his annual holiday. "This," said Mr. Banting, "was the greatest possible blessing to me." He found another adviser, who dieted him, with the result that in about a year he recorded that he had not felt better in health for the past twenty-six years; that he had suffered no inconvenience; that he was reduced 13 inches in bulk and 50 lbs. in weight; that he was cured of umbilical rupture; that he had sight and hearing surprising at his age, and that his other bodily ailments had become mere matters of history. His personal appearance improved, he bore the stamp of good health, ate and drank and slept well, had no indigestion, left off using boot-hooks, and could stoop with ease and freedom. He suffered no longer from faintness, and left off his knee bandages.

The author of this quaint historical, clinical record, states that his diet before treatment was bread and milk for breakfast, or a pint of tea with plenty of milk, sugar, and buttered toast; meat, beer, much bread, and pastry for dinner; the meal of tea similar to that of breakfast, and generally a fruit tart or bread and milk for supper. The diet ordered for him by his adviser, Mr. Harvey, of Soho Square (whom he consulted for deafness), who learned it from M. Bernard's Paris Lectures for Diabetes, and himself initiated it for obesity, forms the Banting system detailed below. The remedy might have been, says Mr. Banting, as old as the hills, but the application of it was of very recent date. The forbidden foods were bread, butter, milk, sugar, beer, and potatoes. The author's own view was that "saccharin matter is the great moving cause of fatty corpulence."

Breakfast (8 to 9 a.m.): Four or five ounces of beef, mutton, kidneys, broiled fish, bacon, or cold meat of any kind except pork; a large cup of tea (without milk or sugar), a little biscuit, or one ounce of dry toast.

Dinner (1 to 2 p.m.): Five or six ounces of any fish except salmon, any meat except pork, any vegetable except potato, one ounce of dry toast, fruit out of a pudding, any kind of poultry or game, and two or three glasses of good claret, sherry or Madeira—champagne, port and beer forbidden.

Tea (5 to 6 p.m.): Two or three ounces of fruit, a rusk or two, and a cup of tea without milk or sugar.

Supper (9 p.m.): Three or four ounces of fish, similar to dinner, with a glass or two of claret.

Nightcap (when inclination directs): A tumbler of grog (gin, whisky or brandy, without sugar), or a glass or two of claret or sherry.

The Banting system is sound in principle, has the advantage of simplicity, and forms the basis of most dietaries for corpulent people at the present day. The danger of an almost exclusively nitrogenous diet, as above mentioned, must here also be borne in mind.

THE DRY CURE.

In Germany, Schroth introduced the "Dry cure," and established an institution in which it can be practised. It has received the notice of eminent physicians. Amongst other complaints, it has been applied to cases of gastric dilatation, to the removal of chronic peritoneal effusions and rheumatic effusions into joints, and to cases of inveterate syphilis.

The "cure" consists in gradually depriving the patient of fluid to an extent which is said to be absolutely intolerable in many instances, causing intense suffering from thirst, and exciting in most cases a considerable amount of fever, the temperature rising as high as 104° F. The body is at the same time submitted to warm, moist packing. Fatal cases of scurvy have been induced by this treatment, and the results obtained have been by no means brilliant; it is therefore not necessary to occupy further space by describing it in detail.

There are, however, undoubtedly many morbid affections in which a judicious limitation of fluids is calculated to be advantageous, and in which a diet as dry as can be conveniently tolerated is advisable. This is the case in circulatory disturbances with a tendency to venous engorgement and to exudation into the serous cavities; in cases of chronic inflammatory effusion which are slow to disappear; in gastric dilatation; in cases of flatulent dyspepsia induced by too free use of tea, coffee and other beverages; and in certain cases of excessive corpulence. In considering the dietetic treatment appropriate to the last condition, we have pointed out how and to what extent the limitation of fluids may be applied. It must, however, be borne in mind that in gouty cases, with a tendency to uratic deposits, a deprivation of water is calculated to do harm.

THE MILK CURE.

The "Milk cure" has been systematically applied to the relief of many ailments, such as the following: Dropsies of all kinds, cardiac, renal, and hepatic; obstinate intestinal neuralgias; incorrigible dyspepsias with grave disturbances of nutrition; chronic colitis; hepatic disorders, such as hyperæmia, simple hypertrophy, and fatty liver; asthma, when the consequence of pulmonary catarrh and emphysema; neurasthenic, hysterical and hypochondriacal states associated with serious disturbances of nutrition; and especially in disorders of nutrition dependent on latent catarrhs of the stomach and intestines; also in obesity.

Karell, of St. Petersburg, considers the methodical application of the "milk cure" produces its curative effects by acting as a "regulator of nutrition"; and he maintains that it is highly beneficial, not only in the cases already enumerated, but also in rheumatic and gouty affections, organic diseases of the heart, advanced renal degeneration, and especially in degeneration of the arteries.

The milk used should be *well skimmed*—as creamless as possible—and it should be obtained fresh twice daily from country-fed cows. At first the doses should be small. Weir Mitchell prescribes 4 oz. every two hours, and as the doses are increased, the interval between them is lengthened to three hours; he also allows a glass during the night, to which a little lime-water is added to keep it sweet.

At the commencement 3 oz. to 6 oz. are given three or four times a day, and these doses are scrupulously adhered to, and no other food is taken. The doses should be taken at equal intervals, and drunk slowly in small mouthfuls, so that the saliva may mix with it. Taken in this way, it will be readily digested, whereas drunk *ad libitum* it would cause indigestion. In winter the milk should be warmed by standing the glass in hot water; in summer it should be taken of the temperature of the apartment. It should not be boiled except in rare cases of diarrhœa.

If the milk is well digested, as indicated by small solid motions, the dose is slowly increased. The first week is the difficult one to get over; during the second week 3½ pints a day may be taken, at fixed intervals, viz., 8 a.m., 12 noon, 4 p.m., and 8 p.m. These hours may be changed, but the intervals must be maintained.

When there is great objection on the part of the patient to its use, with nausea or disgust, Weir Mitchell allows it to be flavoured with a little tea, coffee, caramel, or salt. He also advises, in certain cases, that the general diet should be displaced slowly until the exclusive milk diet can be tolerated. When it provokes acidity, some alkali may be added, such as lime-water or Vichy water; or it may be scalded with a quarter boiling water and a little carbonate of soda and salt added; or a little barley or rice-water may be mixed with the milk to prevent firm clotting. The patients seldom complain of either hunger or thirst, but if those who are seriously ill attempt to take, instead of the four cups of skimmed milk, four large glasses of milk direct from the cow, they will certainly not be able to digest it, and the treatment will be discredited. In obstinate sickness and diarrhœa, Karell has obtained the best results from these small doses, and he cites one such case in which he gave only four tablespoonfuls of skimmed milk three times a day. No doubt, in a case of this kind, the almost absolute rest of the digestive organs which such treatment affords is an important agent in the cure.

Constipation may be regarded as a natural consequence, and a sign that the milk is absorbed. It may be remedied by a simple enema of water, or by a small dose of castor oil or rhubarb ; and if obstinate, a little coffee should be mixed with the morning milk, or some stewed prunes or a baked apple may be eaten at 4 p.m.

Flatulence is, as a rule, completely relieved by this diet ; if, however, any flatulence or diarrhœa should be complained of, it is owing either to imperfect skimming of the milk or to its being taken in too large a quantity. Thirst may be relieved by simple water or seltzer water.

If during the second or third week there should be a great desire for solid food, a little stale bread with salt, or a small portion of salted herring is permitted ; and once a day a little soup made with milk and thickened with groats. After five or six weeks some modification is admissible ; milk, however, should still be taken three times a day.

It is almost unnecessary to point out the importance of combining rest with this treatment at the commencement, for the patients lose weight at first and feel weak on account of the small amount taken ; after long use, however, they increase in weight. For the first week or two it also causes sleepiness. The tongue becomes covered with a white, thick fur, and the patients complain of an unpleasant, sweetish taste in the mouth on waking. The stools are of a yellowish colour, and have a peculiar odour. There is usually a large flow of urine which may exceed in quantity the fluid ingested, and so lead to the removal of dropsical effusions. Weir Mitchell has also observed that uric acid disappears almost entirely from the urine, which assumes "a singular greenish tint," and when hot nitric acid is poured upon it, it no longer gives the usual mahogany tint at the plane of contact ; and it would seem that during a diet of milk, "the ordinary pigments of the urine disappear or are singularly modified." The substances which give rise to the ordinary fæcal odours also disappear.

"The changes here pointed out are remarkable indications of the vast alterations in assimilation and in the destruction of tissues which seem to take place under the influence of this peculiar diet."

The duration of the cure is ordinarily about six weeks. At the end of this period the quantity of milk should be gradually reduced and solid food slowly introduced in the place of the milk meals, beginning with raw scraped beef and stale bread. But for several months the diet should consist largely of milk.

THE WHEY CURE.

In many of the German and Swiss spas, and especially in those with alkaline and salt springs, where chronic catarrh of the respiratory organs is treated, such as Ems, Ischl, Reichenhall, etc., the so-called "Whey cure" is applied. This consists in drinking warm whey, either alone or mixed with the mineral water, in definite quantities at set times. Many physicians regard this practice as in all respects similar to the use of skimmed milk, and in no respect preferable except in persons who find the casein of milk indigestible. About 20 oz. daily are taken.

It relieves irritable laryngeal coughs, and exercises a favourable influence over chronic laryngeal and bronchial catarrhs. It has been found useful in certain forms of dyspepsia, intestinal catarrhs, and in chronic phthisis. It acts also as a diuretic, especially in combination with the saline mineral waters, and recent observations have shown that "lactose" possesses distinctly diuretic properties. It has been recommended in the treatment of chronic Bright's disease.

The "whey cure" is not an exclusive diet cure, but it is usual strictly to limit the quantity of animal food taken, and to augment the amount of fruit and vegetables; it adds, however, to the diet a certain amount of milk-salts and milk-sugar. There are various methods of preparing whey. The following is a good one:—

Take half a pint of fresh milk heated to 60°–65° C., and one and a half teaspoonfuls of wine of pepsin or Fairchild's essence of pepsin, and stir just enough to mix. Stand the mixture in a warm place until coagulation occurs. Next beat up the curd until finely divided, and strain. Whey contains in solution the sugar and salts of milk, and also holds in suspension a considerable portion of fat and casein which passes through the strainer.

At the health-resorts mentioned, whey is prepared from the milk of the sheep and goat, as well as from the cow's milk.

THE KOUMISS CURE.

Koumiss, or the fermented milk of the Steppe mares, is used as a food and as an intoxicating beverage by all the nomadic tribes of the south-eastern Steppe country of Russia.

The treatment in the Steppes lasts two or three months, and is often renewed the following summer.

Annaeff's establishment for the koumiss cure stands in a park on a hill on the banks of the Volga, three versts distant from Samara. It is provided with a library, theatre, and other comforts. The koumiss is prepared by a Tartar family in the sight of the patients, and with due regard to cleanliness. In its manufacture the milk-sugar is converted into alcohol, carbonic acid, and lactic acid. The casein is in a state of fine subdivision most easy of digestion.

TABLE OF THE RELATIVE COMPOSITION OF SEVERAL STRENGTHS OF KOUMISS (*Stange*).

	Mare's Milk.	Koumiss—Duration of Fermentation.			
		6 Hours.	18 Hours.	30 Hours.	4 Days.
Carbonic Acid ..	—	3·8	6·0	7·0	11·0
Alcohol ..	—	18·5	19·5	30·0	30·0
Lactic Acid ..	—	3·9	5·6	6·4	6·4
Milk-sugar ..	51	18·8	16·3	—	—
Albumin ..	23	22·5	22·6	20·0	16·0
Fat	19	18·9	20·0	19·0	19·0
Salts	5	4·5	4·0	4·0	4·0

An analysis of koumiss, made in Moscow after two days' fermentation, gave alcohol, 1·65 per cent; fats, 2·05; milk-sugar, 2·20; lactic acid, 1·15; finely divided casein, 1·12; salts, 0·28; carbonic acid, 0·70. Dr. Stange came to the conclusion that "favourable results can only be obtained from the koumiss cure in the Steppes, since, besides the employment of a genuine koumiss, a hot and dry climate is absolutely necessary"; that it is especially beneficial in catarrhal conditions of the respiratory and gastric mucous membrane; that it is often successful in the first stage of phthisis—in the second stage it simply improves the general condition, in the third stage it is badly borne; that it is especially curative in cases of defective nutrition generally—anæmia, chlorosis, malarial cachexia, scrofula, etc.

Artificial koumiss is prepared in England by the Aylesbury and other dairy companies. But it is in the Steppes themselves that the best koumiss and the best results of the koumiss treatment are obtained, although the Moscow and St. Petersburg institutions exist for the application of this cure, where koumiss prepared from Steppe mares is employed. A special select breed of mares yield the milk made use of. The summer climate of the Steppes seems to be especially favourable to the treatment of pulmonary complaints, but the winters are extremely severe. The nomads appear to possess the art of making koumiss in the greatest perfection; but its composition is by no means stable. It is comparatively rich in sugar, and poor in casein and fat.

Large quantities of koumiss can be easily digested, and it has been observed to exert a diaphoretic or a diuretic action, according as the external temperature is high or low. Its use is constantly attended by a gain in weight.

Many cases of phthisis are reported to have been cured by this treatment when followed in the Steppes of Orenberg or Samara, where doubtless the dry climate has also a curative influence.

The best koumiss is made from the milk of light-coloured, unbroken mares, pasturing in the Steppes, near mountain ranges, where they can get running water and salt-beds. They should be able to bathe frequently, and they must not have either hay or oats.

Two kinds are prepared, one light and slightly fermented, the other strong and highly fermented.

The patients are made to rise early and take a glass of koumiss every half-hour, except during the two hours preceding dinner and supper. Meat and fats form the chief part of the ordinary food; sweets, fruits, and salads are avoided, as well as ices, coffee, and spirits.

Lime-water is used to arrest the diarrhœa koumiss often causes. At first a few glasses only are taken daily, so as to gradually accustom the patient to the cure.

Most invalids digest it well; it relieves constipation and acts as a diuretic. They gain in weight and show signs of increased blood-formation. Much exercise in the open air is no doubt an important adjunct to the cure.

Good koumiss is a milky looking, frothy liquid, with an agreeable, slightly acid taste. It contains about 1 per cent of alcohol and lactic acid. Its ready digestibility has been referred to the alcohol in it stimulating the digestive secretions, and the carbonic acid allaying gastric irritability.

The proportion of alcohol in koumiss is too small to produce any symptoms of intoxication; but a tendency to sleep and to mental and bodily languor has been noticed to follow its use. Excitement of the sexual organs has also been noted by several observers to follow the use of koumiss.

THE GRAPE CURE.

The "Grape cure" is another dietetic cure of which a brief account must here be given. The nutritive value of grapes is not great; they contain, however, much sugar as well as potash salts. They are an agreeable form of food, and afford one of the few means at our disposal between nutritive substances on the one hand and medicinal substances on the other. Much of the benefit referred to this cure may doubtless be attributed to the climatic advantages presented by those agreeable localities, such as Meran and Montreux, where it is usually followed.

The effect of the cure is aided by a good supporting diet. Pulmonary patients should not take more than an average of 2 lb. daily, beginning with about a pound; and other patients should not exceed 4 lb. In cases of gastric catarrh, 3 lb. a day may be eaten, the diet at the same time being carefully regulated. Constipation, with hepatic congestion and "abdominal plethora," may be benefited by 3 lb. to 4 lb. daily; and in these cases the dose may, exceptionally, be increased to 5 or 6 lb. The laxative influence of 4 lb. to 6 lb. of grapes eaten daily has been found beneficial in hæmorrhoidal affections and in cardiac diseases with a tendency to visceral congestion and venous engorgement, in hyperæmia of the liver, and in chronic constipation.

The tendency of the renal and hepatic concretions is often advantageously modified by this cure. It is best to begin with half a pound of grapes in the morning fasting (or an hour or two after a light breakfast if they disagree when taken fasting), and another half a pound at 5 p.m. After two or three days a third half-pound should be taken between 11 and 12 noon. Little by little the dose is increased to about a pound each time. In other cases, which bear the cure well, larger quantities may be prescribed. In some cases of dyspepsia a bunch or two at dessert may be substituted for the mid-day dose.

The aperient effect may not be manifest at first, but it usually shows itself after a few days.

Figs and pears are also permitted with the cure at Meran, in order to diminish the repugnance to one kind of fruit alone.

Some irritation of the gums is apt to be excited during the cure; this may be relieved by rinsing the mouth with cold water, to which a little bicarbonate of soda is added. It has also been recommended that the patient should, while eating the grapes, take from time to time a small piece of fine white bread to remove any portion of the fruit adhering to the teeth.

Towards the end of the cure, which lasts from four to six weeks, the quantity of grapes should be gradually diminished.

The main composition of grapes, according to Koenig, is: Water, 78·17 per cent; sugar, 14·36; free acid, 0·79; nitrogenous extractives, 1·96; stones and woody fibre, 3·60; total ash, 0·53. The ash consists chiefly of potash salts, together with salts of lime and magnesia.

The grape cure may prove beneficial, and is prescribed with success in those cases of "abdominal plethora" associated with a deposition of much superfluous fat;

much of this fat may be removed if the laxative influence of the grapes is aided by a spare diet in which the fats and carbohydrates are strictly limited. It cannot be credited with any real curative influence in phthisis, but it appears to be useful in cases of chronic bronchial catarrh and emphysema ; and has been found beneficial in cases of gastric and intestinal catarrh in anæmic persons, in vesical catarrh, in gouty concretions, and in cases of malarial cachexia.

SECTION VI.—*The Modern "Cure."*

CHAPTER XIX.

HYDROPATHIC AND "CURE" ESTABLISHMENTS.

PROBABLY at no time in the history of mankind is "a cure," annual or, at any rate, periodic, more necessary than at the present day. Certainly at no period has the struggle for existence, the striving for place and position, been so keen, or the pressure so great, as in modern life, more particularly modern city life. The evil effects of over-feeding and over-drinking, gout and plethora, high blood-pressure, etc., are historic, and the recognition of the value of change and the use of mineral waters for these conditions dates from very early times. But during the past century a new congeries of symptoms or disorders has sprung up with the introduction of railways, the electric telegraph and the telephone, and that last terror, and in some ways shortener of the span of life, the automobile.

There is no special name for this disorder, unless we call it *acute neurasthenia* ; we usually say those suffering from it "need a change," "are below par," or "have been overdoing it." The person concerned may be male or female, a votary of pleasure, or one who shuns amusement, whose mind is never at rest, and who is constantly engaged in the pursuit of wealth. We may think of a man who has a large and usually prosperous business, with various branches and departments, numerous clerks, managers, sub-managers, and artisans in his employ. His "right-hand man" goes down with typhoid fever, and he is left for six weeks or two months with practically two men's work on his hands. During this time, possibly a coal famine occurs, embarrassing his business very materially, and we may further imagine that there is money stringency, and that in this threefold manner his ordinary normal daily worries are multiplied tenfold. The strain of the position is soon felt even by an ordinarily healthy man, the telephone bell becomes a continual jar on his nerves, the telegrams pouring in are just so many worries clamouring at the door; he becomes irritable and hasty in temper, flies into a passion at a moment's notice, about what he would usually consider a trifle; noises ordinarily unnoticed, such as the banging of doors and whistling of trains, jar acutely on his nerves; appetite fails, and finally sleep goes too. The appetite may be flogged on by sherries and bitters, sleep may be coaxed by bromides and the newest hypnotics, his acuteness of care and anxiety may be dulled by the free use of alcohol; but, for the time, a physical and mental breakdown has occurred which no drug can cure, for which "tonics" are useless, and nothing but complete removal from the field of labours, with rest and a thoroughly wholesome natural life, can restore such an individual to his usual good health. Under such conditions, many men go off for a month's golfing holiday, and might do much worse; but if thoroughly disordered and broken down, as such cases often are, there is little inclination for much physical exercise; if this be taken to any extent, they become unduly fatigued, the bottle is once more resorted to, and the last state of the unfortunate individual may be worse than the first. It is in such circumstances that a health resort of some kind, with proper medical care, may be of infinite value, and stay the advent of general paralysis of the insane, or some other form of organic disease.

One may cite another case. A woman passes through a time of great strain and difficulty. She may have the trying task of nursing a husband or near relative, and have gone through the physical labour and vigils entailed with the additional emotional excitement, swayed by hopes and fears, and forgetful of, or at any rate denying herself, what everyone requires, in the way of fresh air and rest when assaying this arduous task. Thus, whatever the event be for the patient, the nurse grows pale and thin, and looks weary and bloodless. She eats little and digests less; is tired on the slightest exertion; and becomes mentally depressed and emotional.

Here, again, *drugs are useless.* A change of environment and removal from the scene of her recent labours and struggles is essential, and a month or so spent in a judiciously chosen health-resort, under medical care and advice, may save her life-long invalidism. Many parallel cases might be cited, but these will suffice.

Of "cures" and health-resorts the Continent offers great wealth and variety, too many to enumerate; the chief difficulty would be the choice of any particularly suitable one. Again, many of these resorts are closed at certain seasons of the year for several months; to get to them there is often a long, tedious, and possibly expensive overland journey, for which our invalid is quite unfit, and which will only aggravate his condition. Then, too, on arrival, he will probably find there is no English physician, but possibly a German or Swiss medical man speaking only fair to indifferent English, whom he will find some difficulty in getting to see things from his point of view, and who will be unable, in many instances, to do what is important in the first degree—gain his complete and entire trust and confidence. Things being so, the best results cannot be expected.

Such an individual is wise to give consideration to the health resorts of his own country. Bath, Cheltenham, Buxton, Harrogate, Matlock, Strathpeffer, and finally one of the numerous excellent hydropathic establishments which have sprung up during the past sixty years, and which offer, for situation, practically every possible range of climate which is available in Great Britain.

It is to be feared that among certain classes of people there is a horror of anything which goes under the name hydropathic. It is a word which, from some unfortunate experience, they probably associate with a Turkish bath, indifferent cuisine, shocking attendance, and a crowd of noisy and somewhat aggressive visitors, who go on the principle that to reside under the same roof for a couple of nights constitutes an introduction, and gives them the right to address to you anything from the comparatively harmless question which sometimes takes the form of, "How do you like the Hydro?" to, "What are *you* here for?"! With these somewhat unpleasant features, not a few will couple the fact that they were totally unable to obtain in the establishment any form of alcoholic liquor, which, if not absolutely forbidden at table, could only be obtained, in dubious form, from a neighbouring chemist or grocer. Then, again, those *amusements*! There is nothing more intensely irritating to one who is fatigued or out of health than to be constantly asked by some rather forward and persistent person who has been appointed "President of the Amusements Committee," to join in the egg-and-spoon race, the hat-trimming competition, or something equally frivolous, if innocent and harmless. A quiet rubber is another story; but even to this there may be an objection, for it is not unusual at the present day to find people who come away in search of health, having become out of health owing to too constant an application to "bridge," and the late hours entailed hereby.

There are practically three types of hydropathic establishment: (1) The most hopeless and objectionable kind, which is simply a poor kind of boarding-house; (2) The pure pleasure resort, which, however well managed, is more suitable for the completely healthy and joyous, than for those who are really ill; (3) The best type of hydro, which offers all the advantages of a modern hotel, and, while by no means a hospital, is so managed, arranged, and constructed that the nervous, gouty, rheumatic, or convalescent person can lead a pleasant, wholesome life there, without fear of noisy crowds or amusements.

We may here briefly attempt to sketch the chief points in an ideal establishment of this nature:—

1. The building should be of modern construction, and at an elevation of several hundred feet above the sea.

2. The situation should be in the country, away from all town smoke, and preferably on an open moorland, although the building itself should be properly sheltered from exposure to the north and east.

3. The building should face the south, and the rooms be so arranged as to have a maximum south exposure.

4. The rooms should be large, airy, and well ventilated, with fires rather than steam radiators for heating, and be lit by electricity.

5. The sanitary arrangements should be of the most modern description and faultless in every respect.

6. The public rooms should be large, airy, and sufficient to accommodate the maximum number of visitors comfortably and without unpleasant crowding.

7. The corridors should be wide and well lighted.

8. The baths should be properly equipped with all modern hydrotherapeutic arrangements and electrical apparatus.

9. The cuisine should be that of a first-class hotel, and proper arrangements should be made for the provision of such special invalid diets as may be required from time to time.

10. A qualified physician should be available in the establishment, with special experience in this particular department of medical work. The advantage to the health-seeker of having a reliable physician within call is obvious ; whilst the assistance to the physician of having patients collected near his immediate observation, especially in unusually difficult and obscure cases, is very great. This is an advantage from which the ordinary medical attendant is necessarily debarred. It has been the writer's experience on not a few occasions to have patients sent to be treated by hydrotherapeutic measures for some special conditions, and to find after a week or two of careful observation, that the cause of the patient's ill-health was something widely different, and the special conditions referred to by the medical man merely symptoms of a much more serious disease.

11. On the essential need for good management in every department it is needless to dwell, for the same applies to any house, hotel, or public establishment.

The Use of Drugs in "Cure" Establishments.—As patients placing themselves under the care of a spa physician, or coming to take a "cure," have often been already treated with almost every known drug in any way applicable to their particular condition, it is plainly the reverse of common sense to continue medication which, after careful trial, has produced no benefit. The manifest object in coming to a "cure" establishment is to try what can be done by *natural* methods. It is well, therefore, to start fair and avoid confusion of issues. There must arise from time to time special circumstances, under which the prescription of some drug is desirable or even essential, and no blind adherence to any special form of treatment can be expected to lead to the best results. An open mind and eclecticism in method are always best; but patients who arrive with bundles of prescriptions and bottles of physic are at the very start best advised to put away the former and throw away the latter, commencing their treatment *de novo*. Otherwise intellects are confused, and, if the invalids improve, it is impossible to say what is doing them good.

One of the most important factors in the "cure" at any establishment is the attitude of the patient himself. Hopefulness in regard to his case is of course essential, but in addition, the invalid visitor must be freed from all mental excitement, and from the cares and vexations connected with his home or business. So far as is possible he must leave all these behind him, and reports and letters from managers or partners should be, if possible, interdicted. A man who endeavours to combine his "cure" with negotiations for the purchase of a large estate or a "bull" operation in copper, is wasting his time and money, and stultifying himself and the physician under whose charge he has placed himself. The financial column in the daily paper should be studiously avoided.

Indeed, the visitor in search of health cannot do better than lay to heart the old Roman inscription on the baths of Caracalla.

> *"Curæ vacuus hunc adeas locum
> Ut morborum vacuus abire queas,
> Hic enim non curatur qui curat."

* "Light of heart approach the shrine of health,
So shalt thou leave with body freed from pain;
For here's no cure for him who's full of care."

CHAPTER XX.

FOREIGN MINERAL WATERS.

THE most important element in the curative properties of any mineral water is, on the authority of Burney Yeo, the water itself.

In certain mineral waters, at various Continental spas, however, there are valuable salts in solution, to the benefit derived from which many people attribute their restoration to or maintenance of good health. Happily, at the present day it is not necessary to travel afar to get the benefit of these trusted waters, for, owing to the enterprise of Messrs. Ingram & Royle, they are now to be had in bottles all over the kingdom, and can be taken as part of the cure at any English health-resort or cure establishment. Thus in Great Britain, without the trial of crossing the Channel and a long land journey, the invalid is able to combine dietetic regimen and general treatment with the special water which the physician decides is best adapted to his diathesis and digestive capacity.

THE SALINE PURGATIVE WATERS.

Æsculap.—This is a saline aperient water. The spring is situated in the Kelenföld, Budapest. It was discovered by a peasant in 1868, and subsequently purchased by a company who have taken every means to prevent any surface contamination of the spring. The bottling is carried out under English supervision. The temperature of the water varies from 6° to 14° C.

Æsculap salts contain 90 per cent of purgatives. The active ingredients are magnesium sulphate, 173 parts, sodium sulphate, 139 parts, and calcium sulphate, 21 parts, in 10,000.

Dose.—As an aperient, half a tumblerful before breakfast.

Apenta.—A saline aperient spring also situated near Budapest. It is rich in the sulphates of magnesium and sodium, containing 3,210 parts of $MgSO_4$, and 187 parts of $NaSO_4$. It is of value in gouty conditions, and strongly purgative.

Dose.—A wineglassful or more.

Arabella.—A water of similar character and properties to the two former. It contains 22 parts of magnesium sulphate and 15·5 parts of sodium sulphate in the litre. It is useful in bilious and gouty conditions.

Dose.—A wineglassful should be added to half a tumbler of boiling water, and sipped while dressing in the morning.

Carlsbad.—The waters of Carlsbad are somewhat milder in character than the foregoing. The springs contain varying proportions of sulphate, carbonate, and chloride of sodium. They are therefore alkaline in character, and mildly purgative. To produce free purgation it is necessary to supplement the ordinary water with some Sprudel salt.

They help to relieve gastric and duodenal catarrh with accompanying jaundice, are diuretic, and undoubtedly possess a restraining action on the abnormal excretion of sugar, and are for that reason much employed in glycosuria and diabetes. They are also of service in gouty conditions and obesity.

Dose.—Several small tumblerfuls should be taken each morning before breakfast, fifteen to twenty minutes being allowed to elapse between each glass, and the patient occupying himself in walking prescribed distances meanwhile.

The Carlsbad Sprudel salts may be had in powder and in crystals.

Franz Josef.—A saline aperient water from a spring in Hungary. It is useful in constipation, hepatic congestion, gastric and duodenal catarrh. The active salts are sodium and magnesium sulphate, the former being considerably in excess.

Dose.—From half to one-third of a tumblerful.

Friedrichshall.—A saline aperient water, which, owing to its richness in chlorides, agrees with delicate stomachs somewhat better than other waters of this class, and is less apt to be followed by "reactional" constipation. It stimulates the flow of bile, which it renders more fluid in character. It is useful in gallstones, biliary colic, duodenal catarrh, and jaundice.

Analysis :—

	In 1,000 parts
Sulphate of Magnesium	6·2
Sulphate of Soda	5·2
Chloride of Soda	7·9
Chloride of Magnesium	4·9

Dose.—As a strong purgative, one tumblerful. When used daily, one or two wineglassfuls before breakfast.

Hunyadi Janos.—The spring is near Budapest, and the water has for upwards of twenty-five years had a great reputation throughout Europe. It has marked cholagogue properties, and so tends to prevent fermentative changes in the intestinal canal, and to relieve the discomfort due to flatulence.

The proportions of sulphate of soda and magnesium in this water are about equal, there being nearly 4 ounces of each in a gallon of the water. In addition there are 119 grains of chloride of sodium, 47 grains of bicarbonate of sodium, and a small amount of free carbonic acid.

Dose.—One-third to one-half a tumblerful.

Marienbad.—These springs have recently been rendered famous from the annual Royal patronage. They are situated in Bohemia, at an altitude of nearly 2000 feet. The waters are chalybeate as well as alkaline in character. The water from the Ferdinandsbrunnen has the following composition :—

	Grs. per gallon.
Sulphate of Sodium	387·7
Bicarbonate of Sodium	139
Chloride of Sodium	154
Bicarbonate of Calcium	60
Bicarbonate of Magnesia	52

The complete absence of sulphate of magnesium is to be noticed. The salts are extracted from the waters, and are to be had in powder or crystal form, which are convenient for travelling.

Dose.—A bottle may be taken daily, as the water is not strongly purgative.

Pullna.—A Bohemian water situated at an altitude of 1200 feet. It is a bitter water, owing to the large proportion of sodium sulphate which it contains. The temperature of the water at the springs is low. Each gallon contains approximately 3 ounces of sulphate of sodium and rather over 2 ounces of magnesium sulphate.

Dose.—One wineglassful before breakfast.

Rubinat.—This water is obtained from a mineral spring situated in the Pyrenees, and belongs to the group of cold sodio-sulphated waters. It has a slightly saline, not disagreeable flavour.

It is a valuable water in the treatment of constipation and bilious conditions. It is remarkable for the large proportion of sodium sulphate which it contains, the Llorach spring having 1,486 gr. in each gallon, while the Serre spring contains about 1,200 gr.

The water contains only a very small proportion of magnesium salts.

Dose.—Half to one wineglass on rising, and the action is helped if it be followed by a cup of hot tea or plain water.

MILDLY ALKALINE WATERS, &c.. &c.

Contrexéville.—The springs are in the Vosges, in France, situated at an altitude of over 3000 feet. The water is cool and bright, and the presence of a considerable amount of free carbonic acid gas renders it " digestible "—that is to say, not so heavy on the stomach as a flat water. Indeed, it somewhat stimulates appetite and digestion when given before meals. The active ingredients are soda, potash, lithia, and magnesium. It also contains a small quantity of iron, but it is used almost entirely for its antacid and antilithic properties. It appears also to possess the property of diminishing the amount of sugar excreted in diabetes and allied conditions. It is a water which is very widely prescribed and used, apart from the spa to which it owes its name.

Dose.—Several small tumblerfuls may be taken before breakfast at intervals of fifteen minutes.

Vichy.—This is a water of similar character from Allier, in France, where are situated the thermal establishments of the State Springs of Vichy, one of the largest and best equipped in the world.

There are several springs, of which the following are most commonly used :—

The *Celestins* water is most commonly used for bladder and kidney affections, also in gout, rheumatism, and diabetes. The taste of this water is agreeable.

Grande Grille.—The waters of this spring are more active in their properties. They are used in strumous conditions, and also for gallstones and hepatic congestion.

Hôpital.—The water of this spring is milder in character, and is of great value in the digestive disturbances of delicate people.

Dose.—A bottle a day of either of these waters can be safely prescribed before meals, and the greater part before breakfast preferably.

Wildungen.—An alkaline water of very similar character, and useful in similar conditions.

Dose.—Several tumblerfuls may be taken daily.

Levico.—This is an arsenical water obtained from a spring situated near Trient, in the South Tyrol. The water springs from four fissures in the floor of a grotto known as the Vitriolo cavern. It contains 25 parts of protosulphate of iron, and 13 grains of persulphate of iron, with ·087 parts of arsenious acid in each 10,000 parts by weight.

A milder form of the water is obtainable from the Ocker cavern, containing one-tenth the amount of arsenic and 25 per cent of the iron in the stronger water.

Dose.—A tablespoonful, gradually increased.

La Bourboule.—This water is also mildly arsenical in character. It is obtained from springs of the name at Puy de Dôme, in France. There is no risk of overdose of the arsenic, for one litre of the water contains only 28 mgrams of arseniate of soda, and three-fifths of a pint contains an average dose of arsenic.

The water is valuable in the treatment of all forms of cachexia, chlorosis, anæmia, struma, etc.

Dose.—Half to three tumblerfuls may be taken daily at or after meals.

Schwalbach.—This water is chalybeate in character, and is useful in cases of anæmia and associated debility.

There are 5 grains of protoxide of iron and 1 grain of manganese in each gallon of the Stahlbrunnen water, and a considerable quantity of free carbonic acid gas.

Dose.—Several tumblerfuls daily.

TABLE WATERS.

The following are agreeable dietetic table waters of mildly alkaline character :—

Johannis.—This spring is situated near Zollhaus station, Aarthal, in the Province of Hesse Nassau, in Germany. The water issues from a deep cleft in the rock at 10° C.

St. Galmier.—Obtained from the springs in the Province of Loire, France. This is the most popular natural mineral table water in France. It is very refreshing, and suits dyspeptics admirably.

Apollinaris is too well known to be more than mentioned. It has acquired a great reputation among Americans.

Perrier and Rosbach are both admirable table waters.

SECTION VII.—*Medical Climatology and the Principles of Climatic Treatment.*

BY NORMAN HAY FORBES, F.R.C.S. (EDIN.), F.R.S. (EDIN.)

CHAPTER XXI.

IT is a matter for regret that there is no systematic teaching of medical climatology in this country. We hope that the following rough notes on climatic treatment may not be considered out of place in a volume on Natural Therapy. The importance of the influence of climate, both in health and disease, is apt to be overlooked in these progressive days of the latest theories and the newest forms of treatment. The selection of a suitable climate in any individual case is always a highly important, and often a difficult, matter.

"Un climat n'est pas un élément simple, c'est une résultante de la combinaison de très nombreux composants," writes a French climatologist. It is comparatively easy to rectify the unsuitability of a prescription, but to prescribe an unsuitable climate, in other words, the wrong place for change of air and treatment, with the attendant expense and fatigue of travel, will seriously imperil the reputation of, and confidence in, the prescriber. The educated public believes in climate; many of its intelligent members have found out from personal experience the most suitable health resorts and climates. The general practitioner, whose knowledge now-a-days must be encyclopædic, is often consulted about a "change of air," or about health resorts in general, or a climate for residential and educational reasons, or concerning climatic treatment in some special disease. His responsibility is as great in condemning any climate as in recommending it. Advice based on *personal* acquaintance with any particular health resort or climate is more likely to be of practical value than extensive reading or a detailed study of meteorological data.

"In prescribing a climate," writes Dr. Huggard, "we must first of all remember that the name of the disease never suffices to indicate the appropriate remedy; we must have resort to a general and systematic physiological stocktaking," and always endeavour to ascertain, and then deal with, the *cause* in each case.

We shall proceed, then, to define the terms "weather" and "climate;" then briefly enumerate their physiological effects; afterwards describe the chief characteristics of the climate of the British Isles, and conclude with a short general survey of diseases amenable to climatic treatment, especially in these Islands. We venture to suggest certain "golden rules" which we hope may be of some use to the busy practitioner.

(*a*). First make sure that the general sanitation, water, and food supply of the proposed health resort are quite above suspicion. Remember that "change of air" implies change of habits, change of diet, change of environment, and of mental occupation and interests.

(*b*). Find out all the *local* features of the climate and of the district recommended; e.g., minute local characteristics of temperature, relative humidity, rainfall, sunshine, wind, especially local currents and shelter from winds, barometric pressure, and amount of cloud. "A climate cannot be separated from a place" (N. Wood).

(*c*). Remember that the most fundamental point in the action of climate is its influence on tissue change (Huggard).

(*d*). Remember that different individuals react quite differently from the same external conditions; in other words, what is normal to one individual is not necessarily normal to another.

(*e*). Therapeutically, climates are best classified on a physiological basis, that is, according to the demands made by the climate for the production of heat, which also corresponds with the demands for tissue change (Huggard).

(*f*). Do not always prescribe "some good bracing climate" for a delicate and weakly convalescent whose metabolic powers are unable to respond to the demands of such types of climate (L. Williams).

(*g*). Do not select the type of climate which you have found to be best suited to your own case (L. Williams).

(*h*). Carefully consider the patient's fitness for travelling, the psychic effect on his disposition, what his environment will be when he arrives at the selected resort, what are his habits and tastes, as well as the probable cost of living, the quality of the food, and who is to be the most suitable person to accompany him.

(*i*). Remember that " of all the therapeutic measures at our disposal, climate alone is uninterrupted in its action " (N. Wood).

(*j*). Bear in mind that it is impossible to prescribe particular climates, like ready-made prescriptions, for particular diseases. The climate or health resort must be wisely chosen on thoroughly scientific and rational grounds, and any empirical guess may lead to disappointment and dissatisfaction.

(*k*). In the choice of a health resort, the selection of the local physician is an important psychotherapeutic factor. " Tant vaut le médecin, tant vaut la station."

(*l*). As a rule, when a British health resort is likely to fulfil all the ordinary requirements (medical, climatic, and social) of a particular case, it is better to combine those with the comforts of home, than subject a patient to a long Continental railway journey, and probably to more or less general inconvenience in a foreign land.

(*m*). The average amount of bright sunshine, the relative humidity, the equability of temperature and pressure, the rainfall, and the prevailing winds, must all be taken together in estimating the therapeutic value of a climate—no single element should be allowed to acquire a place of disproportionate importance.

Meteorology is that branch of natural science which treats of weather and climate. The subject of weather is more or less of unending interest ; often it is the opening topic of every-day conversation ; all those actively engaged in out-door occupation, e.g., farmers, shepherds, sailors, gardeners, and sportsmen, are keen observers of current weather conditions. A witty writer remarks, that " there is no weather so good as English weather. Nay, in a real sense there is no weather at all anywhere but in England.

In France you have much sun and some rain; in Italy you have hot winds and cold winds, in Scotland and Ireland you have rain either thick or thin; in America you have waves of heat and cold, and in the Tropics you have sunstrokes varied by thunderbolts. Only in our own romantic country do you have the strictly romantic thing called weather. Why, the French have not even got a word for weather, and you must ask for the weather in French as if you were asking for the time in English."

The term "weather" includes the actual condition of the atmosphere at any moment and from day to day, with reference to temperature, wind pressure, moisture, cloud, rainfall, sunshine, and electrical state. The term "climate" usually denotes the average condition of the various meteorological phenomena at any given locality or district. The chief factors of medical importance in a climate are latitude, altitude, configuration of land, distribution of water (rivers, lakes, sea), prevailing winds, rainfall, temperature, humidity, sunshine, soil, and vegetation.

Let us take a bird's-eye view of the physiological influence of climate in its effect on a healthy body. We shall briefly enumerate the effect of five chief climatological factors: (1) High temperature, or heat; (2) Low temperature, or cold; (3) Humidity; (4) High atmospheric pressure; and (5) Low atmospheric pressure.

1. Speaking generally, high temperature lowers muscular power and lessens nervous tone.

The usual effect of a hot climate on the nervous system is sedative, depressing, and often more or less enervating; on the heart and blood-vessels the effect of quickened action and vasodilatation of the superficial vessels is well-marked. There is also increased sudorific activity in the skin, and an increase of the excretion of watery vapour and of carbonic acid from the lungs, as well as an increase in the intestinal secretions.

2. Sudden exposure to a moderate degree of cold has a stimulating and tonic effect on a healthy organism; its influence on metabolism generally, by increasing the functional activity of all the internal organs, is well marked. Cold, when excessive and long continued, lowers nervous energy, lessens muscular activity, and has a vasoconstrictor

effect on the blood-supply of the skin, which if long continued may lead to impairment of its nutrition. A moderate and not over-prolonged degree of cold induces certain reflex phenomena by stimulating the peripheral ends of the cutaneous nerves; a reaction sets in, and the warm glow of vigorous health is felt, with increased nervous and muscular energy; thus "the vascular contraction of the blood-vessels causes temporary hyperæmia of the deeper viscera;" the balance of this condition, if a sufficiency of food and exercise is provided, is readjusted later by a general cutaneous vasodilatation and a diminution in visceral hyperæmia. The human body can bear a much lower temperature of atmospheric cold if the air is dry and still; for when it is in motion and laden with moisture, winds and currents of air intensify its chilling effect. Cold markedly increases the excretory function of the kidney, while the sudorific function of the skin is diminished. The secretion of bile is in some persons increased by the effect of cold, which also has a stimulating effect on the muscular tone of the intestinal tract.

3. Atmospheric humidity exerts an indirect influence on the bodily functions. It greatly affects the heat-removing properties of the air, moderating its temperature, and intensifying the chilling action of cold and the oppressive influence of heat. Humidity, in association with temperature, is an important factor in determining the relative proportions of water removed by the skin, the lungs, and the kidneys; a humid atmosphere lessens evaporation, thereby causing the skin to become moist. Huggard states that the influence of humidity on the nervous system is indirect. It increases the difficulty of getting rid of surplus heat, and thus tends to retard all vital actions which are accompanied by increased development of heat. It greatly diminishes the stimulus due to alternations of heat and cold. It modifies, in some hitherto unexplained manner, the electric conditions of the atmosphere.

Humidity also much influences the development of micro-organisms. One advantage of humidity in a climate is that it favours equability of temperature, although humidity in any locality has no definite relation to rainfall.

4. As a general rule, the density of the air has a definite

effect on the rate of the pulse and respiration. Increased barometric pressure lessens the pulse-rate, while it increases its strength and volume; the respirations are diminished in rate, but their depth is increased.

5. Decreased barometric pressure, as experienced at high altitudes, causes a diminution in the oxygen pressure; the blood is unable to extract sufficient oxygen, "because the oxygen pressure of the air is reduced below the required point" (Solly).

The climate of the British Isles (latitude 50° and 60° north) belongs to the moderate or insular type, which is mainly dependent upon the presence, the temperature, and the motion of the sea which washes our shores. The chief feature of our climate is the absence of marked extremes of heat and cold. The British climate is relatively equable, owing to the humidity and prevalence of south-west winds; our summers are cool and moist; our rainfall, usually lowest in April and highest in November, though considerable, is not altogether a really serious defect. Our southern sea-coast resorts are comparatively warm in winter and cool in summer; our mean maximum temperature is reached in July or August, and the mean minimum temperature in December or January; the latter is often the most stormy month.

Our inland resorts are warmest in summer and coldest in winter, and the relative humidity is, as a rule, highest at inland stations and lowest on the sea coast, which is also less cloudy on the whole than inland districts. April, on an average, has the least rainfall, October or November the heaviest. During spring, autumn, and winter there is more cloudiness, which entails sunlessness, in the south-western districts, while in the summer the least cloudy areas are to be found on the southern district and its coast-line. Here, in the "old country," the prevailing winds are from the south-west and west, but north-easterly winds are most prevalent in April, May, and June; the last month has the least number of rainy days. It is well to remember that in "the British Islands the greatest differences in local climates arise from differences in the rainfall" (Buchan), and "the direction of the rain-bearing winds in their relation to the physical configuration of the surface" is undoubtedly the key to the distribution of rainfall in the British Isles. Lastly, as regards the influence of soil on our climate, we find heavier rainfall areas in mountainous and upland districts, while the general geological structure and contour of the land surface have a local influence on temperature.

The chief geological formations which have an indirect relation to climate are, roughly, the dry pebble beds, the sands and sandstones, the cold, damp clay, and shaley soils, and the porous limestones. It must not be forgotten, also, that while soil influences climate, the latter produces certain marked effects on the rock formation and superficial soil as well as on the configuration of the land generally.

In selecting a climatic health resort we must remember that "no climate is perfect," and no climatic health resort is a cure-all, for human ills; also, at the majority of "stations climatériques" the climate is not equally suitable all the year round for the diseases most likely to benefit by its influence. Sir H. Weber states that "a climate with constant moderate variations in its principal factors is the best for the maintenance of health;" such is the climate of the British Isles, healthy and tonic, often rainy and windy.

Turning to the diseases in which climatic treatment is an important contributory factor, we have an extensive series of the chronic and functional type. For instance, taking some in alphabetical order, we have *albuminuria* (functional and nephritic): the former is usually benefited by mountain or moorland air (Hindhead, Crowborough, Ilkley, Moffat, and Church Stretton); the latter will be more fully considered under the climatic treatment of chronic nephritis and granular kidney.

In the treatment of *primary anæmia* and *chlorosis*, in addition to rest, medicinal, hygienic, and dietetic measures, additional benefit will usually accrue by a residence in summer at some inland hilly resort of moderate altitude (Braemar, Buxton, Church Stretton, Harrogate, Llandrindod Wells, Matlock and Matlock Bath, Trefriw Wells), or of seaside resorts such as Brighton, Broadstairs, Cromer, Eastbourne, or Newquay. At home we have in winter, for such cases, Bournemouth, Bexhill, Budleigh Salterton, Ventnor, and Salcombe ; while abroad, Montreux, Vevey, or Glion in Switzerland; and Arcachon, Biarritz, or Grasse, in France, are generally suitable.

In the involutionary form of *arteriosclerosis,* Sir Clifford Allbutt recommends a " mild and equable climate," to which we would add a low altitude and a dry soil, e.g., Leamington, Worthing, Sidmouth, Lyme Regis, Torquay, and Falmouth.

Asthma, whether of neurotic, bronchial, cardiac, or renal origin, is benefited, as a rule, by a comparatively low or moderate altitude, and it is well known that many asthmatics do as well in large towns provided that bronchial catarrh and emphysema do not specially require an equable, somewhat moist, and more sunny seaside resort in winter. For ordinary cases we may recommend, both in summer and winter, such resorts as Nairn and the Speyside (Grantown), Haslemere and Hindhead (800 feet) or Malvern for young subjects; and at the seaside, Broadstairs, Worthing Newquay, Sidmouth, Ventnor, Paignton, and Torquay. For chronic *winter cough,* or chronic *bronchial catarrh,* and for the so-called " nervous cough," or any similar cough occurring in neurasthenic conditions, one of the following resorts may be tried in summer ; Bexhill, Folkestone, Malvern, and Church Stretton. In winter, *chronic bronchitic* patients will find the best shelter inland at Bath, Cheltenham, or Leamington, and on the sea coast at Bournemouth, Worthing, Broadstairs, Ventnor, Sidmouth, Budleigh Salterton, Torquay, Falmouth, Tenby in South, and Llandudno in North Wales, and Rothesay in Bute. Abroad, such patients as can afford to do so, usually spend their winters on the Italian or French Riviera, Algiers (Mustapha), Biskra, Arcachon, Pau, Sicily (Taormina), or in Egypt (Assouan), Madeira, Teneriffe, or Las Palmas ; the last three have more moisture in their climate.

Diabetics, and some of the mild forms of alimentary glycosuria, derive benefit from health resorts like Leamington, West Kirby on the estuary of the Dee, Cheltenham, Bath, and Clifton ; abroad, they mostly visit Carlsbad, Neuenahr, Contrexéville, La Bourboule, Marienbad, Homburg, and Vichy.

Dyspeptics with gastric atony and chronic catarrh derive most benefit where, with climatic and mineral water treatment, physical exercise and a dietetic régime can be judiciously combined, e.g., at Harrogate, Llandrindod Wells, Leamington, Bridge of Allan, and Strathpeffer ; or they may try such types of marine climate as Fokestone, Bexhill, or St. Leonards in winter ; Cromer, Westgate, Peterhead, or Stonehaven in summer ; and of inland climatic resorts, Malvern, Church Stretton, Crowborough, and Hindhead.

In *chronic disease of the middle and internal ear*, especially in patients troubled with tinnitus, we have observed that a dry, bracing, inland and upland air does most good, the effect of which is enhanced by an outdoor life without over-exertion. Increased humidity, particularly at the sea coast, sometimes aggravates this distressing complaint, and we would advise, other things being considered, a residence among the Surrey Hills or in the Highlands of North Hampshire, or at Crowborough, and in Scotland at Nairn, Peebles, or Moffat.

Chronic eczema, in conjunction with balneary and other treatment, is benefited by such climates as that of Bridge of Allan, Buxton, Droitwich, Church Stretton, Leamington, Llanwrtyd Wells, Moffat, Strathpeffer, and Woodhall Spa.

In convalescence after illness or operation, the choice of climate lies between inland or marine. Inland, we may recommend Hindhead, Crowborough, Ilkley, Ben Rhydding, Malvern, Church Stretton, Llandrindod Wells, Buxton, Harrogate, Braemar, Kingussie, or Peebles. For sea-coast resorts, among many others we may mention Margate (Cliftonville), Broadstairs, Cromer (in summer), Folkestone, Brighton, Eastbourne, Newquay, Felixstowe, Saltburn, Llandudno, Blackpool, and Portrush or Bundoran in Ireland.

Chronic gout and *arthritism* are essentially amenable to the " harmonized co-operation " of spa treatment, wherein the climatic factor plays a not unimportant part, at such British resorts as Buxton, Bath, Leamington, Harrogate, Cheltenham, Llandrindod Wells, and Strathpeffer ; while abroad, such Spas as Aix-les-Bains, Vittel, Gastein, Carlsbad, Ems, Kissingen, Neuenahr, Vichy, Baden-Baden, Royat, and Wiesbaden possess all that is required for the treatment of the various forms and many phases of gouty trouble. Some intractable and obscure forms of *headache* are favourably influenced by a change of climate, generally to one of the moderately bracing inland type, e.g., Hindhead, Crowborough, Matlock, Malvern, Chagford (Devon), Moffat, Peebles, and Bridge of Allan.

In chronic *compensated valvular disease of the heart*, in addition to such therapeutic factors as rest, regulated exercise, diet, the Oertel and Nauheim special methods, mental suggestion, and medicinal measures, the choice of a climate will have to be made. Inland, we have suitable resorts, such as Leamington, Bridge of Allan, Ballater, Aboyne, and the Lower Deeside, Buxton (1000 ft.), Church Stretton (613 ft.), Llangammarch Wells (600 ft.), Matlock, Matlock Bath (500 to 1000 ft.), and Strathpeffer; among seaside resorts a choice may be made between Rothesay, Southport, Broadstairs, Seaton, Sidmouth, or Falmouth. In the *chronic neuralgia* which often follows an attack of herpes zoster, a complete change of air is one of the most efficacious of remedies. Here such climates as those of Ilkley or Ben Rhydding, Llandrindod Wells, Blackpool, Braemar, Cromer (in summer), Hindhead, and Church Stretton are invaluable.

Cases of intrinsic *insomnia* are favourably influenced, *cæteris paribus*, by such climates as those of inland resorts of moderate altitude, e.g., Malvern, Moffat, Peebles, Church Stretton, and Hindhead; or at such seaside resorts as Bexhill, Hastings, Folkestone, Bournemouth, Torquay, Sidmouth, Nairn, and North Berwick.

For *malarial cachexia*, and in some cases of chronic *liver trouble*, the following British resorts are suitable in the summer: Buxton, Harrogate, Matlock and Matlock Bath, Strathpeffer, Church Stretton, and for the *anæmia* of post-malarial cachexia, Trefriw Wells in Carnarvonshire.

In chronic *parenchymatous nephritis*, as well as in early *granular kidney*, if the patient is not obliged to winter in Egypt or Madeira, the Canaries, West Indies, or Algiers (Mustapha), we may select one of the following British winter resorts: Ventnor, Sidmouth, Falmouth, Tenby, Southport, West Kirby, Ramsey, Worthing, Folkestone, Rothesay, and Glengariff in Ireland. In summer, the climate of Malvern, Buxton, Llanwrtyd Wells, Matlock, Matlock Bath, and Church Stretton is both suitable and beneficial.

Cases of *neuralgia* which "have for a long time hung fire" often do well by a change of air to a dry and warm climate, which is also favourable to a greater improvement of general health. At home we may try Buxton, Leamington, Woodhall Spa, or Hastings; abroad, among many other health resorts, may be mentioned Aix-les-Bains, Wildbad-Gastein, Baden-Baden, Schlangenbad, Badenweiler, and Wildbad in Würtemburg.

The climatic factor in the treatment of *neurasthenia* is an important one, and the following British inland resorts are recommended, especially during the summer months: Ilkley, Harrogate, Llandrindod Wells, Malvern, Hindhead, Church Stretton, Crowborough, Moffat, Peebles, Bridge of Allan, Braemar, and Strathpeffer. Among our marine resorts which are suitable in summer for neurasthenics, are Cromer, Felixstowe, Broadstairs, Eastbourne, Hunstanton, Saltburn, Ilfracombe, and Newquay; in winter, St. Leonards, Jersey, Ventnor, Bexhill, Tenby, Worthing, Sidmouth, and Bournemouth. Abroad, most neurasthenics are likely to derive benefit from such resorts as Abbazia, Arcachon, Grasse, Château-d'Oex, Gastein, Ischl, Langen-Schwalbach, Montreux, Neuenahr, Pau, Néris, Schlangenbad, St. Raphael, San Remo, St. Sauveur, Divonne, Le Fayet-St. Gervais, Badenweiler, and Wildbad among many others.

The treatment of the milder forms of *obesity* can be more easily carried out at some climatic resorts and spas than in the patient's own home. A well-planned "terrain cure," in addition to dietetic régime and baths at such resorts as Harrogate, Cheltenham, Leamington, Malvern, Peebles, or Church Stretton in this country; or at Carlsbad, Homburg, or Marienbad abroad, will effect a lasting reduction in weight and a markedly improved metabolism.

The climatic factor in the treatment of *pulmonary tuberculosis* is too extensive a subject for our incomplete chapter, and we can only roughly outline the types of climate recommended ; the choice must be made in accordance with the merits and requirements of each individual patient. If a sea-coast climate is indicated, among British resorts we we may select Folkestone, Hastings, Ventnor, Nairn, Bournemouth, Tenby, Falmouth, and Sidmouth ; while abroad, the climate of Arcachon or Biarritz, Madeira, the Canaries, or the West Indies is most likely to be beneficial. For desert climates we naturally turn to Egypt (Helouan, Assouan, and Luxor), or to Algeria (Biskra). In the choice of forest and woodland climates, we have the Highlands of Scotland, the Black Forest, the Austrian Tyrol (Dolomites), resorts like Pau, Allevard, Grasse, and Le Vernet in France, as well as the climate of the Italian Lakes. In selecting a mountain climate (1,500 to 10,000 ft. altitude), the best examples are found in Switzerland, e.g., Arosa, St. Moritz, Leysin, or Davos Platz. Further afield, in South Africa, we have such places as Bloemfontein, Cradock, and Pretoria, or Denver and Colorado Springs in North America.

In chronic *rheumatoid arthritis* we must select a bright, sunny, and dry climate, in a resort of moderate elevation, with a sandy or gravelly soil and very efficient subsoil drainage. In this country a few resorts are available in summer only, e.g., Buxton, Droitwich, Harrogate, Nantwich ; and if a marine climate can be borne, Broadstairs or Hunstanton. In winter, the rheumatic individual is climatically better off in a sunnier, drier, and warmer atmosphere than ours ; if he can have the necessary good food, proper sanitary conditions, and home comforts, a sojourn in Egypt (Assouan), or Algeria (Biskra), or the Portuguese Riviera (Mont Estoril), or Seville, in Spain, will do much to alleviate his aches and pains.

Climatic treatment plays an important part in an " after-cure " (Nachkur). Following on a course of the Schott-Nauheim treatment, or any Spa " cure," some inland climatic resorts of moderate altitude are very suitable, for instance, Buxton, Hindhead, Crowborough, Malvern, Church Stretton, Ilkley, and Ben Rhydding.

In patients whose *arterial system is extensively sclerosed,* and who, in addition, suffer from chronic bronchitis, emphysema, considerable myocardial atony, and possibly asthma, such South Coast resorts as Hastings, St. Leonards, Bexhill, Worthing, Bournemouth, Sidmouth, or Falmouth will be more suitable. Sufferers from *sciatica* do best as a rule in a warm dry climate. At home, Bath and Droitwich suit most elderly patients; others do well at Buxton or Harrogate in summer, and at Moffat or Peebles, Woodhall Spa, or Sidmouth.

In cases of primary or atonic *dilatation of the stomach*, if we can give the patient complete relief from work and worry, combined with suitable food, a change of air to some bracing climate like that of Buxton, Braemar, Llandrindod Wells, Church Stretton, Hindhead, Crowborough, or Ilkley will sometimes do more to improve the general health than any special attention to local digestive treatment.

Space forbids us trespassing any further on the indulgence of the reader. Many other diseases might be mentioned that are benefited by the climatic factor in their treatment; such are tabes dorsalis, various chronic gastric disorders, chronic pleurisy, dysentery, Graves' disease, the sequelæ of influenza and of whooping-cough, some chronic skin affections, tropical diseases, and chronic laryngeal, nasal, and pharyngeal catarrh.

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