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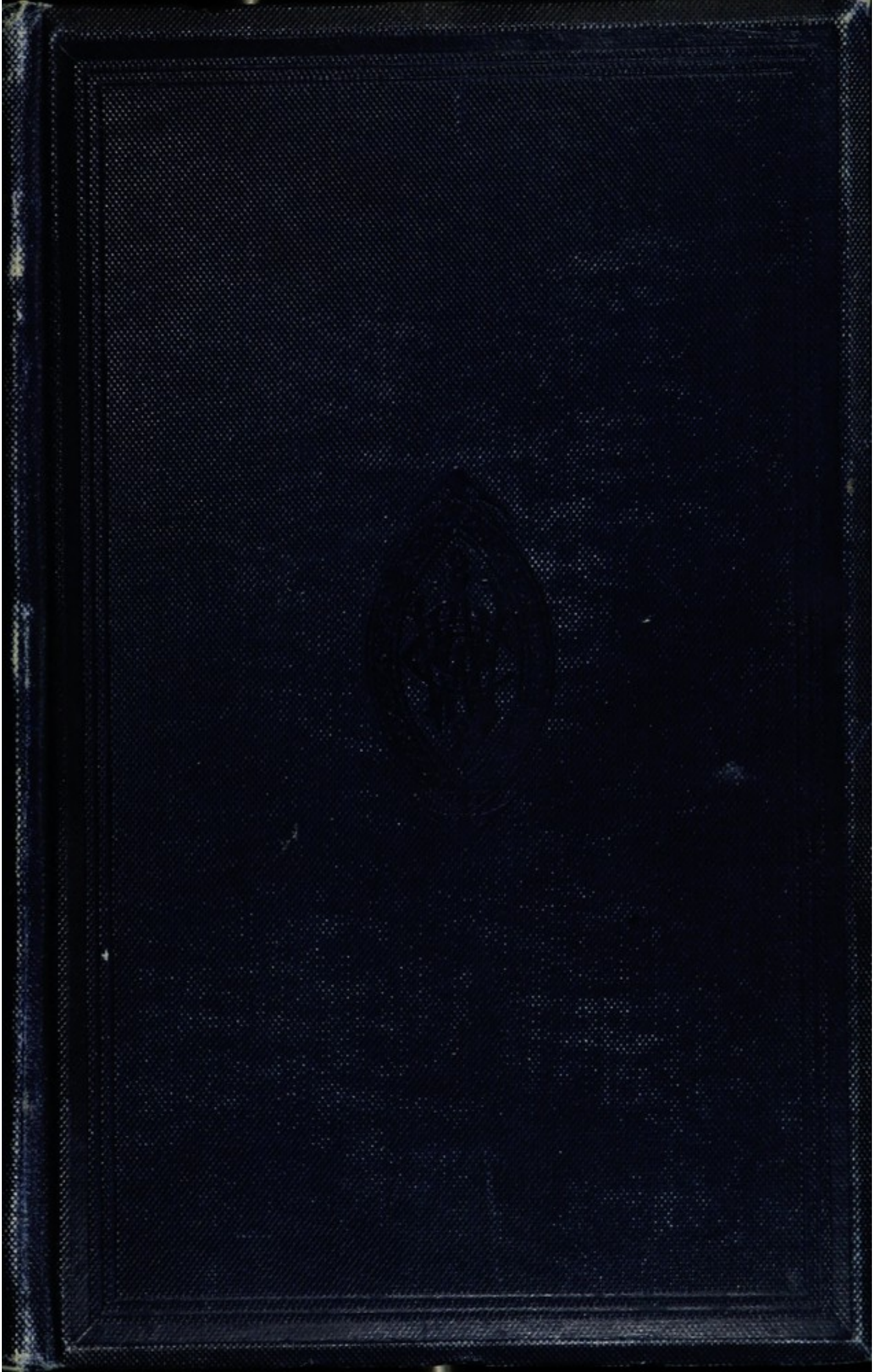

THE PRINCIPLES AND PRACTICE

OF

HYDROTHERAPY

A GUIDE TO

THE APPLICATION OF WATER IN DISEASE

FOR STUDENTS AND PRACTITIONERS OF MEDICINE

BY

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WITH NUMEROUS ILLUSTRATIONS

NEW YORK

WILLIAM WOOD AND COMPANY

1898

"Therapeutics developed by empiricism or clinical experience alone cannot rest upon a secure foundation. Experiments made upon the lower animals or upon healthy human beings are the only rational scientific groundwork for the treatment of disease."—HORATIO C. WOOD.

PREFACE.

DIFFERING from all other works on hydrotherapy, this book is written by a general practitioner for the guidance of his colleagues.

The following pages represent the observations of the author, who has labored in every branch of medicine, and who has gathered these data from a private and hospital practice extending over a third of a century, and more recently from special institution practice. The latter, extending over a period of seven years and furnishing the recorded details of over one hundred thousand hydriatic treatments, may be confidently offered as a trustworthy guide in the hydrotherapy of chronic diseases, while the former is regarded by the author as equally trustworthy as a guide in the management of acute diseases.

It is not the purpose of the author to write a panegyric upon Hydrotherapy, but to discuss water as a remedial agent precisely as medicinal remedies are discussed in the text-books on therapeutics.

The first part of the book deals with the physical properties of water and its mode of action in health; the laboratory experiments upon which the latter is based being freely discussed. The second part is devoted to the practice of hydrotherapy. The various methods of applying water in disease are minutely described and illustrated, the *rationale* of each procedure is discussed, and its special therapeutic indications are outlined.

Having mastered the technical details, the reader is introduced to the practical application of hydrotherapy in acute and chronic diseases, in order to familiarize him with the flexibility of this potent remedial agent. The clinical histories which are added to this part of the book are specially commended to the attention of the reader, inasmuch as they illustrate pratically how different hydriatric procedures may be adapted to varying conditions of the patient and his malady. That hydrotherapy differs materially in this respect from medicinal therapy will be made evident by a careful reading of these histories. Every statement of the author will be found supported not only by his personal observations, but also by the published testimony of acknowledged authorities in clinical medicine. The opinions of specialists in hydrotherapy have been avoided as far as possible, because these are often charged with unwarranted enthusiasm for their favorite remedy.

The author has adopted this judicial and dispassionate course, be-

cause he desires to disarm prejudice and to disseminate a more exact knowledge of the application of water in disease among medical men, many of whom appear to entertain vague ideas on the subject.

That hydrotherapy is an effective agent in acute diseases is beginning to be recognized by reason of the success attending it in typhoid fever. But the fallacious idea still prevails that chronic diseases must be sent away from home in order to obtain good results from hydrotherapy. While it is true that the treatment in institutions offers the best prospect in chronic cases, the reason lies not so much in the facilities offered by them as in the experience and consequent skill acquired by physicians from the large *clientèle* of such institutions. A considerable proportion of the most prevalent chronic diseases does not require institution treatment; nevertheless, they demand a careful adjustment of temperature, duration, and technique to each individual case. Such knowledge may be as readily acquired by the practitioner as is that of any other department of therapeutics.

Having mastered the technique and mode of action of hydriatric procedures, the educated physician will discover that he may often obtain as good results from the simplest methods as from those requiring more technical skill.

To afford this information in a concise and practical form is the object of this work; the author, himself a general practitioner, believes that he appreciates the needs of his colleagues.

The chapter on the hydriatric prescription is devoted to an exposition of the prevalent fallacy that water is so simple and innocuous a remedy that it may be applied with less regard for precision than the physician is wont to exercise in prescribing medicinal remedies. The author has endeavored to inculcate by striking examples the importance of exactness in prescribing and executing hydriatric procedures.

The concluding chapter points out the lessons derived from the history of hydrotherapy. It aims to show the need of instruction in hydrotherapy in our medical schools, in order that this valuable remedy may be wrested from the laymen and empirics, who have stolen it from medical men, and who alienate the latter by perverting it for their mercenary ends.

The addition of hydrotherapy to the curriculum of our medical schools, as is done in the universities of Vienna and Heidelberg, would arm the young practitioner with a much-neglected weapon, whose power is amply demonstrated in these pages.

The author would ask the earnest attention of teachers of clinical medicine to the concluding chapter of the book.

NEW YORK, 51 WEST SEVENTIETH STREET,
July 10th, 1898.

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THE

PRINCIPLES AND PRACTICE OF HYDROTHERAPY.

INTRODUCTION.

HYDROTHERAPY.

Definition.—Hydrotherapy, as its derivation from ὕδωρ, water, and θεραπεύω, to heal, indicates, may be defined as the method of applying water in disease. Some physicians have endeavored to restrict the term to the remedial use of cold water alone, and this is not an uncommon error. An excellent medical dictionary, now in considerable use, defines hydrotherapeutics to be the application of *cold* water to disease. If those who are familiar with the derivation of the term commit so serious an error, it is not surprising that erroneous views of the application of water in disease are general among the profession and lay people. The idea probably originated with the hydropaths, who claim Priessnitz, the apostle of *cold* water, as their leader. This empiric has doubtless given a strong impetus to the popularization of cold water in disease. Indeed, his life and labors form a remarkable chapter in the history of this subject, and will be referred to more fully in another part of this work.

It will surely inure to the progress and development of hydrotherapy, *i.e.*, the scientific application of water in disease, if this false conception of its being a cold-water treatment be removed from the minds of the profession and the people. There seems to exist in the human mind a strong feeling of repulsion against cold baths, wet packs, and other hydriatric procedures. The former conjure up in the mind of the timid practitioner vague apprehensions of shock and heart failure; the latter remind him of damp sheets bearing rheumatism and colds in their train. The reader who shall follow these pages will find in them ample illustrations of the untenability and the absurdity of such views.

Hydrotherapy includes the application of water in any form from the solid and fluid to vapor; from ice to steam, internally and externally. The recently discovered styptic action of steam, the well-known

aseptic effects of hot water in surgery; its resorbent use in gynæcology and surgery; its application in gastric, rheumatic, and intestinal troubles and in meningitis; its value in gastric catarrh, render hot water as important a hydriatric agent as is cold water.

Hydrotherapy does not, however, include the use of mineral waters when these depend upon their mineral constituents for therapeutic efficacy (which, by the way, is rarely the case). While these mineral waters are quite as valuable as is plain water in all the procedures of hydrotherapy, if they possess the proper temperature, etc., the mineral constituents do not often add to the effects produced, inasmuch as the latter are the result of the judicious adaptation of the mechanical and thermic influence of water alone.

A clear conception of this subject is important at the outset. It may, therefore, be stated that *hydrotherapy* depends upon the mechanical and thermic action of water in disease, irrespective of the source from which it may be obtained. *Balneology* depends upon the chemical and diluent action of mineral waters, the effects of which are greatly modified by and depend almost entirely upon the source from which they are derived.

Hydropathy is a method of practice adopted by certain empirics who base their results chiefly upon the effect of cold water. Other terms, referring to the subject in general, are the adjectives hydriatric and hydriatic. *Hydriatric* is derived from ὕδωρ, water, and ἰατρία, medical treatment; it is a short and equally expressive substitute for the adjective hydrotherapeutic. We may correctly speak of hydriatric procedures or hydriatric institutions, but the term cannot be applied to water applications made in physiological experiments.

Hydriatic is an adjective in common use, qualifying nouns connected with the use of water in medicine or for other purposes. Its correct derivation I have been unable to obtain. It may obviously be applied to procedures as hydriatic measures, or applications in health, but its use is incorrect when applied to institutions, etc. This word should be banished altogether when referring to the remedial application of water. The word hydriatric is more expressive and clearly indicates that water is used for remedial purposes. It is proper to use it in connection with measures, procedures, or prescriptions, but it would obviously be tautology to use it in connection with treatment.

CHAPTER I.

THE PHYSIOLOGICAL EFFECTS OF WATER.

As a basis for the proper understanding of the uses and effects of water in diseased conditions, it is important to study and thoroughly master its action in health. Wilhelm Winternitz, of Vienna, has made the expansion of hydrotherapy into a branch of scientific therapeutics the mission of his life. To his initiative may be traced almost all the advances that have been made in this important subject. Twenty years ago he endeavored to impress upon the medical profession the idea that methodical and physiological observation must be utilized as the basis of hydrotherapy. Deviating from the prevalent comments resorted to in balneological writings, he banished such expressions as "enhancement of activity of functions," "favorable changes in the gastric and pulmonary nerves," "agreeable stimulation of the circulation," "improvement of the blood." For these he proposed to substitute actual demonstrations by experimental processes of the effect of water in health and disease. Thus a grand impetus was given to the subject, an impetus whose influence will be long discernible. Indeed, no writer in this field of therapeutics can add much to the thorough and masterly presentation of the scientific side of this subject. We may, however, amplify the observations of Winternitz, and add confirmation by experiments and clinical results of the claims he has set forth for the remedial value of water. Differing from all writers who have preceded him, and from many who have followed him, the writings of Winternitz are not panegyrics upon the unfailing virtues of this remedial agent, but rather ingenious, at times classical, demonstrations, often mingled with confessions of defects in our knowledge, and strivings to amplify the latter by pointing them out in the clearest manner.

Since the chief, though not by any means all, effects of hydrotherapy concern the thermic and mechanical action of water upon the cutaneous surfaces of the body, it becomes necessary to study, 1, the anatomical construction and physiology of the skin, from a hydriatric standpoint; and, 2, the physical properties of water which render it capable of producing these effects.

Anatomy and Physiology of the Skin.

Although an intimate knowledge of this subject is important to the hydrotherapist, it is not my purpose to enter into so minute and detailed an account of the anatomy of the skin as would be required for the purposes of dermatology. *In connection with hydrotherapy* it is only necessary to study briefly the anatomical structure of the skin for purposes of furthering a correct understanding of its functions. Those portions of the skin which contain the blood and nerve supplies will, therefore, interest us most. Their distribution over enormous areas and their interdependence, direct and indirect, with almost every organ in the human body, lend to the subject of the nerves and blood-vessels of the skin paramount import to the student of hydrotherapy.

It appears to the author that a more careful and elaborate discussion of these structures than is usually accorded to them in the works on hydrotherapy would be of practical value.

The *epidermis* is so constructed anatomically that it serves as a protecting layer to the more delicate and sensitive structures lying immediately beneath it.

The *cutis vera* consists of the white fibrous and yellow elastic connecting tissue, forming bundles which, in the upper layers, are so thickly and closely aggregated that they appear like felt. This contains the papillæ, whose number is enormous. In the deeper layer, the stratum reticularis, the elastic fibres form a network which, by its disposition, lends itself to the special functions of the skin in the various parts of the body, and by its structure admits the blood vessels and nerves, which lend to the skin the most important functions connected with hydrotherapy. The muscular fibres of the skin are of the involuntary variety. They are regarded as a whole by Unna, who gives them the appellation of oblique tensors of the cutis, the real origin and ending of which are in the elastic tissue, and through the latter in the entire skin. *The tension of the skin produced by this muscular structure and elastic network, is really subject to and produced by temperature changes.* This may be observed very readily in the dartos of the scrotum. In the latter, medium tension is produced by a medium temperature, relaxation by a higher temperature, while a lower temperature produces contraction, which is evidenced by its being drawn up. In hairy parts this contraction produces the well-known cutis anserina. This anatomical construction, by reason of which the cutaneous muscles are surrounded in their entire extent by a woof of elastic fibres which are connected with each other and with the tendinous formations existing in the skin, renders it plain that a

shortening or tension of the muscular fibres always simultaneously contracts the elastic apparatus which is woven around their entire extent. *This explains the vital import of the contractility of the skin when exerted upon the small blood-vessels contained in it.* Inasmuch as the condition of tension of the skin may thus be readily varied in the most direct manner by reason of the universal presence of the elastic fibres, and inasmuch as muscular coats are either absent in the vessels of the skin or are feebly developed, these structures really perform the function of an inhibitory apparatus which distributes uniformly pressure and motion, and *enables the oblique muscular fibres which are embedded in the skin to regulate the secretion and circulation, the movement of lymph, and consequently the nutrition.* The functional interdependence of the muscular and elastic fibres in the skin, which has long been recognized, is evidenced here by the fact that those parts which, like the palms of the hands, the soles of the feet, the nose, show the smallest quantity of muscular fibres also possess the smallest elastic fibres. Both of these parts appear simultaneously in the first six or seven months of fœtal life (Unna).

It is evident that a recognition of the contractility with which the elastic and muscular apparatus of the skin is endowed furnishes the hydrotherapist a clew to most of the functions of the skin.

Blood-Vessels.—The papillæ contained in the upper layer of the cutis show fine capillary loops, or blood-vessels, which rise perpendicularly to the near vicinity of the epidermis, nourishing it and furthering exchange of gases and secretion of the aqueous portions of the perspiration. These capillary loops consist of an arterial and a venous portion, which combine a short distance below the point of the papillæ, and which run either straight or form loops, as they may be filled with blood or compressed by the papillæ. The loop may be so filled with blood that it may double and fold over in spiral windings until it occupies almost the entire space of the papilla. *This capacity for increasing or diminishing the size of the capillary loops furnishes an important agency by which hydrotherapy may affect the circulation.* The blood-vessels of the skin differ greatly with the locality and functions of the part. They run either in perpendicular or in radiating loops to the surface, as in the palms of the hands, ending in a circular arrangement of the numerous branches, or they are drawn into a flat arrangement by the densely contracted bundles of elastic fibres. The horizontal branching of these partly oblique and partly perpendicular vessel loops is found chiefly in two regions: at the border and between the true cutis and the subcutaneous tissue, or between the border of the former and the papillary body. The terminal branches of the capillaries which lie beneath the capillary body consist of numerous

tubules, forming a wide-meshed arterial network, whose long axis adapts itself to the direction of the folds of the epidermis. From this arises for each vessel papilla a rolled-up arterial capillary which is looped in order to form the more winding venous capillary. All the venous capillaries of the papillary body unite in a dense, narrow-meshed capillary network on a line with the arterial capillaries; from these the larger veins issue which pass through the cutis in the same direction as the arteries. All the vessels of the papillary tract, as also the larger branches which pass through the skin, consist of only an endothelial tube, to which are added a very insignificant media and adventitia in the vicinity of the subcutaneous tissue. Hence their character is chiefly capillary. The arteries are narrow, the veins relatively very wide, a difference which increases with the thickness of the epidermis (Unna).

The papillary blood tract enters the deeper layer of the cutis vera at several points, and supplies the follicles, glands, and oblique muscular fibres. Beneath the papillary layer is found an area the extent of which corresponds with the thickness of the cutis, and which is not well supplied with blood-vessels.

The fibrous layers of the corium have no capillaries, but at the border lines between the corium and the subcutaneous tissue the most abundant supply of blood-vessels is met. From the minute arterial trunks separate branches are seen to arise and pass to the whole papilla, surrounding the latter with a capillary loop. Every sebaceous gland, also, has a delicate capillary network, which forms a complete plexus where these canals are in close proximity. Branches from this plexus, forming delicate though dense capillary networks, also are seen within the small fat flaps. In the capillaries permeating the skin the elastic coat is absent, being supplied by the elastic fibres of the skin itself. Meissner* says that these elastic fibres form a frame structure around the vessels; they oppose the action of the vasomotors, and separate the vasodilators, whose power is much less. They also protect the vessels against pressure from the surrounding structures. When the coats of the cutaneous vessels become rigid, the elastic fibres disappear, even before atheromatous thickening is noticeable. A section under the microscope would thus enable us to detect changes in the vessels due to senile degeneration and alcoholism.

With the exception of the isolated branches supplying the whole papillæ, the horizontal distribution of the vascular branches may be said to keep chiefly within the two border lines of the cutis vera. The form of distribution of vessels in the adult depends upon the development of the thickness of the corium. As the subcutaneous fat in-

* Deutsche Medizinal-Zeitung, No. 4, 1896.

creases, the upper portion of the fat cushion is supplied by the cutaneous layer of the muscular fascial vessels. The papillæ containing tactile corpuscles have no blood-vessels.

The Physiology of the cutaneous circulation is a subject which has not received sufficient attention either from physiologists or from hydrotherapists. The author has long held that it would be impossible for the heart to propel a viscid fluid like the blood through the fine peripheral vessels, unless the latter were endowed with propulsive power which aids in furthering the flow of the blood onward. In explaining the *rationale* of the Brand bath in typhoid fever,* of the cold chest compresses in pneumonia,† and of the Nauheim baths,‡ the author has emphasized this view, which was derived from clinical observation entirely.

It is gratifying to the author to discover confirmation of this view by the studies of Dr. Woods Hutchinson, Professor of Comparative Physiology in the University of Buffalo, and to whom I am indebted for advance sheets of his article in the *Boston Medical and Surgical Journal*, November, 1897. The ingenuity of this author has coined a word which is expressive of the propulsive action of the cutaneous vessels. He writes of the "*skin heart*" as a factor in the human circulation as follows: "In tracing the pedigree of a mammalian vascular system from its earliest ancestral form, as well as through its embryonic stages, we are struck at once with the fact that we have to deal with the familiar process of division of labor and centralization of power. Beginning originally with the network of irregular interspaces between the cells, which become walled by a simple flattened protoplasmic tissue, and this, again, as the surrounding cells lose to some degree their powers of contraction, developing into circular bands of muscle cells, each ring of which drives the blood onward, vermicular-fashion, we find this contractile power gradually concentrating itself, as it were, in one or more regions, with the result of the formation of a heart or hearts in these localities. In the mammalian circulation we have the result of a large, thick-walled dilatation of the original tube, known as the heart, guarded by an elaborate series of valves, propelling the blood through an apparently comparatively passive system of blood tubes. We say 'apparently passive,' because even the briefest study reveals the fact that these tubes are highly elastic and to a degree which could be possessed only by living tissue, and that this elasticity plays a most important part in the circulatory mechanism. Secondly, that the calibre of the arteries and arterioles, particularly the latter, varies very

* "Uses of Water in Modern Medicine," 1890.

† Medical News, January, 1897.

‡ Hare's "System of Therapeutics," vol. iv., p. 34.

considerably from time to time, so as markedly to influence the flow of blood to the part supplied by them. These reactions are obviously carried out by the presence of the elastic coat, which forms the chief bulk of the wall in the aorta and gradually diminishes in importance down to the arterioles; and the changes of calibre are equally obviously brought about by the vital contraction or relaxation of the firm and powerful muscular wall, which extends from the largest arteries down to the mouths of the very capillaries themselves."

This much of actual vital contractility is unanimously granted by all physiologists to the muscular cells of the arterial walls; but here their power apparently abruptly stops. While modestly claiming that he is in a position little more than to raise the question, Dr. Hutchinson emphatically challenges this position and asserts not only the possibility, but also an apparent high probability, that these muscle cells are possessed of far wider powers than these with which they are usually credited. In the first place, no one questions the fact that they are as thoroughly alive and responsive and capable of vigorous action as is any other unstriped muscle cells in the body, and it certainly is against all the analogies of what we know of muscular action everywhere else that they should be capable only of such mechanical changes as will merely regulate the calibre of the tubes which they surround. We know of absolutely no form of muscle which is capable of such sustained and uniform contraction; everywhere else muscular action is rhythmical—very slowly so in some cases, it is true, but still emphatically rhythmical; and only in a few tetanic spasmodic conditions is it capable of maintaining a uniform contraction level for more than a very brief period of time, and yet this theory presupposes an extraordinary power on the part of the muscular cells of coming to a given point and retaining their contraction practically unchanged, not only for hours, but for days and even weeks. The position becomes still more untenable upon *a-priori* grounds when we remember the extraordinarily active part which is played by this very same muscular wall throughout the entire circulatory system of the higher invertebrates and the lower vertebrates, and that the heart is nothing under heaven but a simple localized aggregation of these very same muscular fibres; that this heart-forming tendency is not limited to any one locality, but may occur in two, four, six, or even eight places in the body; that we still have, even in some of the highest mammals, those circular, pulsating, spongy networks which are known as the *retia mirabilia*, such as are found upon the collateral branches of the carotids in some of the larger hoofed animals, and which unquestionably appear to act as local balance wheels of the circulation. It would also seem not improbable that our own elastic, muscular, and highly pulsat-

ing spleen performs some such pressure-regulating function for the portal circulation. In fact, we cannot resist the conviction that *this extraordinarily universal and vigorous muscle coat in our arteries and veins has a higher vital function than merely that of mechanically narrowing the calibre of the vessels.* As Wesley Mills aptly expresses it, "An inherent tendency to rhythmic contraction all through the vascular system, including the vessels, must be taken into account." *

"While this dissatisfaction with the usually accepted view of the human physiologists was manifesting itself at the comparative end of the line, upon the extreme opposite wing of the army of medical progress, among the clinicians and the therapeutists, a similar though less articulate feeling was developing itself. We have long been conscious of the utter inadequacy of most of the explanations of the extraordinarily tonic and beneficial effects of bathing or splashing the surface of the body with cold water. The familiar 'reaction theory' has been growing more threadbare every year; for, if it simply consists in throwing more work upon an already exhausted or overloaded organ, its ultimate effect would necessarily be that of the boyish attempts to lift one's self by one's boot-straps; not that this element does not play some part in the reaction, but that it is utterly inadequate to account for the general glow of satisfaction, the feeling of comfort and permanently tonic effect, which are brought about by this simple but wonderfully effective means. Why the blood should remain for not merely minutes, but even hours, in the superficial vessels with less effort than before the plunge or splashing is, of course, hardly to be accounted for simply by any tonic effect upon the heart or central nervous system. But when this remedy began to be systematically applied in therapeutics, the gap between the theory and the results became wider still. In the Brand treatment of typhoid fever, for instance, while we were at first inclined to regard almost the whole of its beneficial effect as due to a mere mechanical lowering of the temperature and quickened escape of abnormal bodily heat, one after another of our clinicians has come to the conclusions that this is one of the least of its beneficial effects, and that the singularly tonic effect which, as it has been expressed, is produced upon the heart and nervous system and the renal excretion is the central factor in its wonderful power. All the leading authorities upon this method of treatment —Baruch, Osler, Siehler, Stockton—have expressed themselves most definitely on this effect.

"Still more recently, in a widely divergent realm of therapeutics, the method is equally marked and with even more surprising results, first, in the treatment of the toxæmic heart failure of pneumonia, and,

* "Animal Physiology."

second, in the so-called Schott method of the treatment of valvular heart disease. In the latter of these the effect upon the mechanism is the same simple one as before—the application of cold or cool water to the body surface, this, however, being rendered more stimulating, first, by the addition of considerable quantities of salts, chiefly such as will be found in sea water; and, second, in the later stages by the introduction of that unrivalled stimulant to involuntary unstriped muscle fibre—carbonic acid. In this last case we have obviously the temperature factor completely eliminated, and the nervous system as such almost equally so, for these patients are usually in a fairly good state of equilibrium with the one defect of the inadequacy of their great heart pump. So marked is the effect of this skin tonic that in severe cases of dilatation the almost incredible result is attained of causing the apex actually to retract three-quarters of an inch toward its normal position in a single treatment. Not only are the pulsations of the heart greatly lowered in frequency, but they are apparently increased proportionately in power, so that the work which was previously altogether too much for it is performed with comparative ease and comfort. In fact, the results obtained from this simple remedy sound almost too good to be true, and would hardly be believed if the repeated experience of competent clinicians did not almost unanimously verify them.

"Now, it seems to me that on no possible theory which regards the heart as the sole motive force of the circulation, and the heart muscle as the only muscle in the vascular system possessing powers of rhythmic, propulsive contraction, can more than the merest fraction of any of these three great classes of results be explained. But, suppose we recognize the power, already suggested, of constant rhythmic contraction upon the part of the muscular tissue wherever found in the vascular system—grant this, and it seems to us that the problem in all three cases is well-nigh solved. The voluminousness and functional importance of the great mesh of blood-vessels contained in the skin and subcutaneous tissue, its importance as a heat-regulating and excretory factor, have been insisted upon by all physiologists; and if, in addition, we have the right to regard this enormous mesh, capable of containing nearly thirty per cent. of the entire blood of the body, as endowed with the power of independent contraction in its muscular walls, we have at once a factor in the circulation which could be depended upon for the production of some most striking results. In fact, we venture to claim that in the blood-vessels of the skin and underlying tissues we have in the higher vertebrates, just as found everywhere in the lower forms of life, a great 'skin heart,' which plays an important part in the circulation, not only in health but also

in disease. For instance, in the effect of the Brand baths, the fact that the local stimulant effect upon the vessels of the skin is promptly followed by a rapid reactionary dilatation is as familiar as the alphabet; but just why this reaction should so immensely improve the quality of the heart's action and relieve the toxic condition of the whole nervous system is as yet hardly accurately explained. It was usually accounted for simply on the ground that it relieves the work of the heart by dilating the skin vessels and diminishing peripheral resistance.

"But Winternitz observes, what a glance at the flushed skin of the fever patient would immediately suggest to the eye, that we have already a distended condition of the peripheral blood channels due to paralysis of the vessel walls, and insists, in flat contradiction to the other explanation, that the heart's action is improved by the restoration of resistance in the peripheral circulation. But let us once admit that the fundamental element in this so-called 'improvement of the tone' in the superficial vessels, the appearance of which all investigators agree upon, is really an active and not a passive one, a local rather than a reflex change; in other words, that the normal condition of the muscles in the walls of the arterioles and the amœboid endothelium of the capillaries, as elsewhere, is not one of rest, either in contraction or in dilatation, but of constant rhythmic activity, and that the restoring of this active contractility in the vast mesh of vessels in the skin, by the contact of cold water and by friction, is the essential element in the improvement of the circulation. The heart itself is nothing but a special local aggregation of these same muscular fibres, and, like them, its action is intrinsic and merely *regulated* by the so-called cardiac nerves; and, when we recall that the great contractile mesh of the cutaneous vessels is capable of containing over thirty per cent. of the entire blood of the body, and that the whole of this surface is affected by the cold bath, it hardly seems impossible that the stimulation of this great diffuse 'skin heart' may be a factor of the greatest importance in improving the entire circulation.

"Now let us see of what assistance this hypothesis would be in explaining the remarkable effects of the Schott-Nauheim treatment. Upon what would these cool baths, with a high percentage of saline constituents in them, rendered still more stimulating by the addition of carbon dioxide, and prevented from depressing or chilling the system by subsequent passive movements and gentle friction, be most likely to act? Obviously, upon the great skin mesh. And, when we remember that we are practically plunging the cells of this entire heart into their old ancestral medium of sea-water, and adding to it the one remedy which most powerfully increases peristaltic action on the part of any

of the unstriped muscles of the body, as seen in animals poisoned by it (carbon dioxide), could we imagine anything which would be much more likely to stimulate to its highest degree of vigorous contraction, and restore to its molluscan and crustacean long-swinging, tireless rhythm, the great skin heart?

"The first shock of the cold stimulates the whole mesh to contract forcibly and drive on the stagnant blood, not merely through the arterioles, but, by acting upon the unquestionably contractile epithelial capillary wall, through the capillary system; by a similar stimulation of their linings and walls through the lymphatic and venous systems the lymph which has become poison instead of food to the tissues. This when thrown into the right side of the heart provides the greatest stimulus for contraction of the ventricular muscle—namely, active dilatation with an abundance of blood. The lungs do their part in purifying, and return it to the left side of the heart, from which it is driven in abundant flow through the kidneys, thus accounting for the marked increase of urinary secretion after this treatment. But if the action ended here, we should be only a little better off than before, for upon the principle usually accepted the superficial blood-vessels, having contracted, would remain for a considerable length of time in the same condition, and the heart would simply have to overcome on the arterial side precisely the same amount of force which had been added to it upon the venous. Suppose, however, that the contraction has been a rhythmic one, and that the vessels have dilated in readiness for this increased supply of purer blood. At the moment they have received it they again promptly, no matter how slowly, contract and drive it on again into the great veins (and that this rhythmical contraction, as evidenced by a healthy flush of the skin, is steadily increased by the continued restoration of ancestral conditions, the vigorous sea bath which the vessels are receiving, is evident), and it seems to me that we really have a new force added to the circulation, something like an adequate explanation of how the weak and distended ventricle can succeed in retracting its apex half or three-quarters of an inch toward the median line during a single session.

"We would again insist upon the fact that neither in typhoid nor in cardiac inadequacy can these effects, or anything like them, be produced by cold alone (for that has been thoroughly tried in both cases), by the temporary application of water alone, of whatever temperature, or by either dry saline or gaseous or mechanical irritants. It is absolutely necessary that not merely cold, but *cold water*, should be used; that the surface should be literally rubbed with this for a considerable length of time; that the activity of this should be markedly increased by the addition of the sea salts, and still further by carbonic acid, such

as would result from abundant processes of oxidation in the water. In fact, fanciful perhaps as the suggestion may seem, it is by a precise and accurate imitation of our most ancient ancestral surroundings, in cool sea water of high degree of salinity and a considerable percentage of carbon dioxide—in short, precisely the condition which we find in the shallow, sun-warmed lagoons in which life probably originated—that we reach the maximum of curative effect.

"Now let us see for a moment what basis of probability exists for the presence of this factor in the present state of our physiological knowledge. Although, as I confessed at the beginning, little more than suggestions of its possibility can be given, yet there are several of these. In the first place, all observers for the last thirty years have reported, from time to time, the appearance of rhythmic contractions in certain groups of the vessels of the lower forms, not merely in the invertebrates, but also in the lower vertebrates, even in mammals.

"The farther we go down the scale, the more frequent this becomes. In fact, in the invertebrates it may be regarded as the rule. Among the lower vertebrates the vessels in the wing of the bat, in the fin of the eel, in the fins of various fishes, and in the foot web and mesentery of the frog have been seen repeatedly to possess the power of constant though slow rhythmic contraction. In many cases this has been reported without any apparent suspicion of its real nature; as, for instance, when the arterioles of the frog are reported to seem to 'vary spontaneously,' and when, as Curtiss states, in watching the capillary area in a rabbit's ear, 'capillaries not noted before may suddenly spring into view' and shortly after disappear. Among mammals almost every observer has commented upon, with varying resultant opinions, the singular rhythmic contraction frequently observed in the ear of the rabbit, and occasionally in the mesentery of the same animal. Curtiss also admits that the capillary walls are evidently 'living cells and possibly contractile.' Porter declares that there has been much discussion over the rhythmic contractions present in some of the vascular areas of mammals; and these are but a few of dozens of admissions of the existence of such contractility (at least of occasional signs of it) in the mammalian blood-vessels.

"Of course it hardly needs to be said that it is only occasionally that the opportunity for observing this process in the mammalian tissues can be obtained; and with the single exception of the ear of the rabbit, in which *every* observer has noticed it, the placing of the tissues in a position to admit of this change being noted, if it occurred, would necessitate a very serious disturbance of the normal relations and even of their vitality. It is, to my mind, significant, to

say the least, that in the only places in the mammalian kingdom in which this phenomenon might readily be studied, with the parts in their normal condition—the wings of the bat and the ear of the rabbit—it has been noted, and in some cases quite extensively speculated upon, by almost every observer. In fact, as Mills sums up the discussion of this phenomenon: 'Such facts lend some color to the view that the return of vessels to their previous size after distention by the cardiac systole is aided by the rhythmical contractions of the muscle cells in their walls.' * But we must also admit that nearly every investigator who takes the trouble definitely to pronounce upon this question expresses himself practically in the words of Morrant Baker: 'There appears to be no reason for supposing that the muscular coat assists to more than a very small degree in propelling the onward current of the blood.' †

"Finally, are there problems in the physiological aspects of the circulation which remain conspicuously unsolved, and in which this factor might play a part? There are three at least. One of them is the much disputed question of the dicrotic wave in the pulse, which has usually been explained as a reaction wave upon the part of the elastic coat of the vessels, as an oscillation reflected from the periphery, as a percussion wave from the closing of the aortic valve, and upon a variety of other grounds. Upon closer examination, this wave is usually found in reality to consist of a low predicrotic and a higher dicrotic curve; and we cannot resist the suggestion that we have here precisely the condition which would be accounted for by supposing that the first step in the return of the blood-vessel to its normal calibre was carried out mechanically by the elastic tissue in its walls, producing the predicrotic oscillation, while its return was completed by the active muscular contraction of the muscular coat, producing the dicrotic wave proper. Moreover, this condition of affairs is exaggerated and retarded by the lowered arterial tone; by which is meant a relaxed condition of the muscular coat, and consequently a free and complete distention, followed by a slow contraction of wider range, corresponding to the degree of distention. In conditions which increase the arterial tone, in which the distention from yielding is slight, and the reaction so prompt as practically to coincide with the recoil of the elastic tissue, not only are the two waves merged in one, but their beginning is so nearly synchronous with the cessation of cardiac distention that the downward curve is practically uninterrupted, and the dicrotic wave almost disappears in high arterial tension.

"And, last of all, there are certain reactions in the wonderfully complex and interesting problem of the maintenance of the blood-

* "Animal Physiology." † Kirkes' "Physiology," p. 207.

pressure which still lack any satisfactory explanation upon the usually accepted hypothesis of the passive relation of the arterial walls; for instance, the familiar increase of arterial pressure where an increased amount of blood is being driven through a part, precisely the reversal of what would be expected by one, on *a-priori* grounds, from the action of the vessels were they mere passive conducting tubes. This has usually been lamely explained by calling into play that mythical power of the long-suffering heart of increasing the work done by it in direct proportion to the resistance offered to it; which, if true (except for a very limited period), would place it upon a perfectly abnormal pinnacle of biologic virtue. Suppose, however, that this increase of the arterial pressure is due to the active propulsive pressure which the muscle wall is exerting upon the blood, and that its contractions occur at the same rate with those of the heart, but in the intervals between them, and we can at once see how the blood pressure may be distinctly raised and yet the work of the heart not only not increased but distinctly diminished thereby.

"In fine, we would venture to submit the conclusions, simply as a basis for further investigation and discussion:

"First, that the existence of active contractility upon the part of the muscular wall of the arteries and arterioles, and in less degree of the veins and lymphatics, and of the capillary epithelium, is something which we have the strongest reason to expect upon ancestral grounds in even the highest mammals.

"Second, that the beneficial effects of cold water upon the circulation, particularly of a high degree of salinity and accompanied by friction, (first) in health, (second) in the Brand method in typhoid fever, and (third) in the Schott-Nauheim method in cardiac disease, are adequately to be explained only upon the ground of the persistence of such a power in our mammalian skin heart.

"Third, that the occurrence of this sort of contraction is almost uniform in invertebrates, and has been observed in the vascular area of many of the lower vertebrates—frogs and fishes; and in those positions in which it could be readily seen under normal conditions in the higher vertebrates—the wing of the bat and the ear of the rabbit; so that we have abundant grounds for the possibility and some even for the probability of its occurrence in our own species.

"Fourth, that in the behavior of the vessels in health, as noted by physiologic investigators, there are again conditions which are admittedly unexplained, and yet which may be accounted for on this supposition—the rhythmic pulsation of the vessels in the rabbit's ear, the restoration of normal tone on the part of the vessels of any area after recovery from section of the vasomotor nerves, the persistence

of contraction in the ventricle in lower vertebrates and auricle in all forms after the section of all the cardiac nerves, the phenomena of the dicrotic wave, and the anomaly of an increase in the rapidity of the circulation and amount of blood in a given part coinciding with the marked increase of the arterial resistance."

The author has reproduced Dr. Hutchinson's "skin-heart" theory, because it confirms his own views on the subject, reached independently on clinical grounds, and it affords the most rational explanation of most hydriatric procedures which has yet been presented. A correct appreciation and understanding of the anatomy and physiology of the cutaneous circulation are absolutely demanded for the comprehension of the varied and sometimes apparently inconsistent results obtained from the application of water in disease.

Nerves.—The nerve supply of the skin consists of medullary and non-medullated fibres. The sensory branches from the cerebral and spinal nerves (mixed with vasomotor nerves) and the motor nerves of the cutaneous muscular structure under the skin form, according to Unna, plexuses in much coarser bundles and more distinct arrangement than those seen in the blood vessels. In the subcutaneous tissues they present a more extensive horizontal course; they repeatedly break into thin branches before they finally penetrate the cutis vera in company with the vessels. At some points in the skin they give off within the subcutaneous tissue branches to the Pacinian corpuscles. After penetrating the cutis, the nerves again bend at the lower border of the papillary bodies, and assume a horizontal position in order to form a real nerve plexus just beneath the epidermis. Krause claims the presence of very fine ganglionic cells in those nerve fibres which still retain a medulla. The uppermost branches are very short, and losing their medulla terminate just under the epidermis in fine fibrillæ, which are distributed in great abundance, and furnish some branches to the endothelia of the papillary vessels. Others are found free in the connective tissue with fine, button-shaped ends. Another portion of these nerves which still contain a medullary centre rises into the papillæ in the direction of Meissner's bodies, which, as is well known, are abundantly distributed throughout the entire skin.

The nerve supply of the epidermis is very interesting. According to Unna, non-medullary branchlets of the subepidermal network arise perpendicularly between cylindrical basal cells, and give off fine branches in manifold netlike divisions as far as the horny layer. They bore through the plasma prickle cells, and arrange themselves in fine, button-like ends. The typical nerve ending in the epidermis is, therefore, in pairs, and intercellular.

The hair follicles and sebaceous gland tubules also receive nerve

fibres from branches which lie in close apposition to the lower layer of the epidermis.

All sensory nerves end, according to Krause and Unna, in non-medullary fibres, which terminate in small, button-like enlargements, most abundantly found in the cells of the epidermis, as far as the horny border.

The nerve fibres and endings here described furnish a clew to that remarkable sensitiveness of the epidermic layer which opens to hydrotherapy a free gateway to the central nervous system.

CHAPTER II.

FUNCTIONS OF THE SKIN.

In connection with hydrotherapy the functions of the skin may be considered chiefly in three aspects: first, as an organ of sense; second, as an organ of secretion; third, as an organ of heat regulation.

First, as an Organ of Sense.—Roehrig, whose work has been freely drawn upon, has well epitomized the importance of the skin as an organ of sense by the statement that, next to sight, the sense of touch is the most important of all the senses. Through this sense the human organism is made conscious of its contact with the outer world. The anatomical distribution of the nerves throughout the skin and their connection with the central nervous system are so perfect and complete that not the finest pin point may penetrate its uppermost layer without calling into action all those agencies by which the human organism protects itself against threatening dangers or deleterious influences. *The cutaneous nerve endings stand guard, as it were, over most of the functions of the human body.* They are constantly exposed to irritation by heat and cold, which they convey to the vasomotor, respiratory, and cardiac centres, and to the muscles, in order to arouse in them by reflex action such a degree of innervation as may be required to ward off any damaging influence that may approach from without. The nerve endings which fulfil this important function are the tactile corpuscles, and Pacinian bodies, and club-shaped terminals which compose the sense of touch. The latter is composed, according to Goldscheider,* of a large number of specific sensations, each of which is brought about by separate nerves. Goldscheider has sought for the terminals of these nerves and has established their separate positions and specific functions. There are points for cold and heat, which may be discovered by touching them with small hair or metal pencils moistened with ether. These points are arranged in chains and lines, which often radiate from a single point. It is very remarkable that these radiating points are in lines common for both cold and heat. Nevertheless, radiations and chains for cold do not unite with those for heat. The latter are smaller in number. *The sense of cold,* when aroused by irritating the cold points, is *lightning-like. The sense of heat,* when aroused by irritation of its points, on the contrary, *de-*

* Archiv für Physiologie, 1885.

velops more slowly. The temperature points may be excited mechanically and electrically. Indeed, we may discover their action very plainly by touching a "cold point" with a heated needle. A mild touch is not noticed at these points, but even the strongest touch does not produce pain in them. Irritation of the trunks of these nerves for cold produces an eccentric sense of cold, the same as when the terminals are irritated. For this reason we often find a temperature sensation following strong pressure which happens to strike upon temperature nerves.

Examination of the topography of the temperature sense shows that it depends upon the abundance of nerves in a part. For instance, in the palmar ends of the fingers, which are known to have excellent sense of touch, the number of temperature points is small, and therefore the sense of temperature is subordinate. The belief that the acuteness of the temperature sense depends upon the tenuity of the epidermis is erroneous, according to Goldscheider.

Separated from the temperature points are the pressure points, which furnish appreciation of touch and of locality. There are no specific points for the sense of pain, although at certain points even feeble irritation may produce a sense of pain. Frey, of Leipzig, regards it as probable that there are specific end organs in the skin for the pain sense, although there are no externally recognizable points for this sense.

Finally, there is a system of nervous sensation spread through the skin, not arranged in any recognizable type, which seems to enable us to "feel our skin." While the pressure nerves give information of those objects which touch us from without, the nerves of sensation are the carriers or conveyers of the so-called general sense.

A. Herzen holds that experiments made on limbs that felt "asleep" go to show that, while these are deficient in the sense of touch and the sense of cold is absent, the sense of heat is completely preserved, differing in this respect from Goldscheider's views. Herzen believes that the sense of cold is conveyed on separate tracts, like the sense of touch, through the posterior fibres of the cord, while the tracts for the sense of heat, like those for the sense of pain, pass through the gray substance. This remarkable fact was confirmed clinically in a case of myelitis of the posterior cord with complete tactile anæsthesia of the lower extremities, and it was also confirmed by experiments on animals.

According to Roehrig, the actual efficiency of the touch, pressure, and temperature senses depends upon the integrity of the part of the skin containing terminals of the nerves of touch. When cold and heat act directly upon the nerve trunks, there is neither a temperature sense nor localization. At the most, we may have a sense of pain following

intense injury, this being a common result of varied impressions. In a similar manner the ends of the nerves of touch lose their distinct pressure and heat sense when intensely irritated, because their perceptive capacity is blunted by the general sensation of pain. The portion of the skin thus affected loses for a time the capacity of further irritability, because the nerve endings are overstrained. Touch and pressure sensations may be regarded as due to direct compression of the tissue containing the nerve endings, and we judge the extent of the impression thus received by the intensity or extent of the pressure impact. The case of heat sense is similar, and depends upon that property of heat which produces an expansion or contraction of the fluid contents in the microscopical organs of touch. Hence there is also in the sense of heat a species of pressure effect upon the nerve endings.

Thus is explained the well-known observation that we often exchange impressions produced by touch and temperature irritants. For instance, we usually overestimate the weight of a cold body, because we cannot precisely separate pressure and temperature sensation, but preserve both as an intensified pressure sense.

Another condition which is important in the production of temperature sensation is the blood supply of the end organs of the nerves of temperature, this being subject to reflex action. Cold produces a contraction of the cutaneous arteries, and warmth causes their dilatation. This explains why electricity and certain chemical irritants of the skin, which produce similar effects upon the cutaneous circulation, are capable of exciting the temperature nerves and producing a feeling of warmth. The difference between the burning sensation produced by mustard plasters and by the interposition of a galvanic current can really not be distinguished from that produced by contact with a heated object.

Moreover, pressure and warmth arouse such decidedly different sensations in the central nervous system that it is impossible to regard them as modifications of the same organ of sense. We are, therefore, forced to conclude that, just as in the tongue there are nerves of touch and sense lying near each other, with entirely different endings, so is the skin the seat of separate organs for producing perspiration, heat, and touch.

There is no doubt that the impressions from the sensory and motor nerves are conducted in the same manner to and from the nerve centres.

Temperature sensations are divided into positive, or sensations of heat, and negative, or sensations of cold, according to the temperature of the object being higher or lower than that of the body. But, inas-

much as the temperature of the skin is constantly subjected to fluctuations, it is clear that a sharp distinction between these conceptions is not easily made. Generally the power to perceive cold and heat is subject to many fallacies. For instance, our judgment depends upon the size of the portion of the skin tonching the object, and consequently upon the number of the nerve endings which come in contact with it. Temperature impression is thus intensified by the number of nerve endings receiving it. In opposition to Goldscheider, Roehrig insists that much depends upon the greater or lesser thickness of the epidermis, which is a poor conductor of heat.

To sum up, we have in the nerve apparatus of the skin facilities for perceiving pain, temperature, and space, the aggregate of which endows it with all the intricate functions of an organ of sensation. The enormous importance of the skin as an organ of sensation is exemplified by the pathological conditions which accompany loss of reflex sensibility. In old hemiplegias the skin is shrivelled and dried, showing a lack of proper nutrition; in facial paralysis impairment of the nutrition is also evidenced by the wilted and emaciated condition of the skin of the face; in severe sciatica, pallor and coolness of the skin are not infrequent. Gangrene of the foot has been observed after section of the sciatic nerve.

Second, as an Organ of Excretion.—That the skin is important as an organ of excretion has been recognized so long ago as the time of Galen. But the idea which has until recent times prevailed, that the skin excretes so many deleterious elements that the suppression of the latter invariably and quickly becomes a lethal factor, is erroneous. The familiar example of the boy who, being gilded to represent an angel at one of the papal coronations, died under this manipulation, is no longer accepted as illustrating the danger of suppressing the excretory functions of the skin. Death by covering animals with impermeable substances is now known to be due to a disturbance of the heat regulation by which the inner temperature is finally reduced below a safe point. This is proved by the fact that when the temperature of animals thus subjected to an impermeable covering is maintained by surrounding them with warm air they do not so readily succumb. The effect of varnishing the skin, when not so counteracted, is a sudden rise of temperature with all the symptoms of a febrile condition, such as weariness, rapid pulse, and respiration; the latter gradually becomes slower, the temperature falls, the animal becomes dull, albuminuria and convulsions ensue, the exhalation of CO_2 is reduced to one-seventh of the normal, and the temperature falls to 80° F.

Although the suppression of the perspiration is not so imminently dangerous as was formerly supposed, the secretory function of the skin

is, nevertheless, of great importance in the maintenance of a healthy condition. Through its extensive glandular structure, an enormous discharge of water is produced from the cutaneous surfaces. Carbonic acid also is exhaled through the skin, as well as urea. According to Schierbach,* CO_2 is eliminated in moderate quantities from the skin when the temperature ranges from 29° to 33° C. A rise over 33° produces a sudden increase of CO_2, which may be doubled when 34° is reached. Watery excretion is not abundant under 33°; it increases simultaneously with the CO_2 excretion, both being probably produced by the activity of the gland cells. The quantity of water excreted through the naked skin, according to Schierbach, in a temperature of 36°, is about equal to that secreted by the covered skin in a temperature of 32°.

In various diseases of the lungs and heart also, in which other physiological functions of these organs are diminished, the exhalation of CO_2 by cutaneous excretion is usually enhanced. Witness the profuse perspiration attendant upon severe asthma; the walls of the cutaneous vessels are dilated; more water, aqueous vapor, and carbonic acid are excreted; and the dyspnœa is somewhat relieved. So, when the heart's action is embarrassed, the lumina of the cutaneous vessels become distended, affording some compensatory action to tide the patient over immediate danger. The clammy sweat, characteristic of cardiac inadequacy, is a commonly observed clinical phenomenon.

The similarity in the anatomical structure of the skin and the glomeruli of the kidneys, and the chemical resemblance of perspiration and urine, have often been pointed out. Many clinical observations go to show that the skin is one of the most important aids to the kidneys. That the perspiration and urine are secretions, to a certain extent vicarious, is proved by the fact that their relation in this respect is generally enhanced in disease. Thus is produced an increase in the perspiration of those constituents which the kidneys are incapable of eliminating. Urea has been found by Favre, Picard, and Funke, in the normal perspiration to the extent of 0.1 to 0.2 per cent. The elimination of the most dangerous chemical elements by the skin is generally enhanced in those diseased conditions in which the kidneys become inadequate. Schottein, who failed to discover urea in the normal perspiration, observed it when the kidneys became inadequate, as in the uræmia of cholera. In these cases he saw the whole body covered with a thin white crystalline layer of urea. Unna confirms this statement by observations made in cases of uræmia due to suppuration of the kidneys and in cholera typhoid, in which these deposits could be scraped off daily in large quantities.

* Archiv für Anatomie und Physiologie, 1893.

Conrad Brunner* has demonstrated in a man suffering from pyæmia, in whose blood the staphylococcus albus was present, that perspiration induced by wet packs contained the staphylococcus abundantly in six or eight examinations. To verify this observation, Brunner experimented upon two pigs, which were made pyæmic by injections of the staphylococcus aureus. In the sweat produced in these animals by pilocarpine, numerous cultures of these staphylococci were found. In a cat impregnated with bacilli of anthrax, sweat produced in the foot by faradization of the sciatic nerve showed the presence of these bacilli.

Tizzoni reports a case of septicæmia arising in the left knee, after a condition for which the knee was excised and disinfected without result on the general infection. During the illness, to which the patient succumbed after amputation of the limb, a miliary eruption appeared on the skin which, upon being opened after careful disinfection with sublimate and alcohol, was found to contain a pure culture of staphylococcus pyogenes aureus, proved by culture on gelatin and agar. The same micro-organism was found in the urine.

Bernabie describes a case of puerperal peritonitis, in which the secretion from the uterus contained streptococci. The latter were also found three times in miliary vesicles on the skin and in bedsores, and at points which had been inflamed by subcutaneous ether injections.

Gaertner also found, in a case of sepsis after turning for placenta prævia, the staphylococcus albus in the blood and in the perspiration, together with other diplococci. He reports two other cases of infection in which he found in the perspiration the same staphylococcus which existed in the blood.

These well-authenticated observations prove incontestably the importance of the skin as a secreting and excreting organ in health, and the vicarious utility of this function in disease.

It remains to be shown later how hydrotherapy may utilize its enormous influence upon this function of the skin in disease.

Third, the Skin as a Heat Regulator.—This is the most important function of the skin when considered in connection with hydrotherapy. It depends to a great extent upon the two functions discussed above. To the human organism the maintenance of the body temperature is of paramount importance, and the contribution of the skin to this process is indispensable. It is a trite physiological fact that the standard of the body temperature depends upon the maintenance of an equilibrium between heat production and heat loss. Without entering upon the theoretical questions involved, it may be stated that heat is produced by the combustion of non-nitrogenized substances, chiefly in the mus-

* "Ueber Ausscheidung pathogener Micro-Organismen durch den Schweiss." Berliner klinische Wochenschrift, 1891, No. 21.

cles, and that heat is given off by perspiration and radiation from the cutaneous surface. When heat loss exceeds production, the temperature is lowered until the processes of life are interrupted and cease.

The following physiological facts, trite though they be, are of interest in this connection. The temperature of the living human body is not governed by physical laws alone; it is supplied with a mechanism whose function it is to protect the body against serious heat loss by calling forth certain conditions before dangerous or low temperatures are reached. When the body is exposed to temperatures much below its own, the peripheral vessels in the skin are contracted. Their lumina are narrowed; the circulation of blood is gradually diminished in force. The loss of heat from the cutaneous surface being governed by the activity of its circulation, less heat is now lost. Besides, a collateral hyperæmia ensues in the underlying parts which offers a barrier to the penetration of cold. Inasmuch as cold inhibits the action of the vasomotor centre which governs the abdominal splanchnic nerve, the large vascular area which is under control of this nerve is greatly increased; the cold blood is thus drawn into this warmer locality for safe keeping, as it were. At the same time the muscular structures of the skin which surround the hair follicles, the action of which has been described in the physiological portion, react under the stimulus of cold by contraction, producing the well-known cutis anserina. This condition prevents cooling by radiation. By reason of the contracted condition of the cutaneous vessels, the force of the heart is intensified, according to the law of Marey; the blood circulates with more force through the muscles, and the heat-producing capacity of the latter is thus enhanced. In addition to this, the voluntary muscles usually respond to the demand for more heat by the desire for motion, which the influence of ordinary cold usually arouses. There is also a direct effect upon the nerve mechanism, conveyed probably from the sensory nerve endings which form the delicate temperature sense existing in the skin. The thermic intrusion upon the temperature-regulating machinery is neutralized by the central nervous system in the following manner: The spinal cord contains an excitory and moderating system, which, according to Senator, affords a latitude of 8° to 10° C. for regulating temperatures. When the body is suddenly exposed to cold, the excitory fibres are either stimulated to action or a paresis of the inhibiting fibres ensues. More heat is produced. The irritation is conveyed to motor tracts. A steady, mild contraction of the muscles takes place, which may even be intensified into distinct rigors. Thus a considerable quantity of heat may be developed, which counteracts the damaging effect of exposure to cold. M. Foster says: "Many considerations have long led physiologists to suspect the existence of a nervous

mechanism by which afferent impulses arising in the skin or elsewhere might, through the central nervous system, originate efferent impulses, whose effect would be to increase or diminish the amount of heat generated for the time being in the body."

When, on the other hand, the body is exposed to high temperatures, the sensory nerve endings which form the temperature sense convey the irritation to the vasodilator centre in the medulla oblongata. An increase of the large vascular area in the skin and in the lungs is produced in response to this irritation, resulting in increased exhalation of moisture. At the same time the large vascular area within the abdomen, which is under the control of the splanchnic nerve, becomes narrowed. Thus the circulation of superheated blood is not only limited, but evaporation, heat radiation, and perspiration, together with the constricted condition of interior vascular areas, combine to cool the inner part of the body, and thus to counteract the deleterious effect of external heat. If exposure to heat continues, or increases, the cutaneous vessels lose their tone, a congested state of the skin ensues, which prevents a too rapid flow of the heated blood to the interior by reason of the sluggishness of the circulation thus induced. The interior is not supplied with the quantity of blood which is necessary to produce the usual quantum of heat, and is thus protected against being superheated.

Adamkiewicz has demonstrated that perspiration may be induced by influences acting upon the innervation through the sensory nerve filaments, and that heat is a most powerful reflex irritant for arousing the perspiration, whether it be applied externally or be generated within the body. The blood cooled by the perspiration thus induced flows to the interior of the body, and aids in preventing an excessive rise in temperature.

It is not difficult to demonstrate by clinical observation that the temperature sense in the skin is the most important agency in the regulation of the body temperature. Burns covering over two-thirds of the body are fatal, because the terminal sensory fibres of the skin are destroyed. By reason of this intense effect upon the central nervous system, the vasomotor fibres are brought into the highest state of tension. Heat radiation from the skin is gradually interfered with, while at the same time tissue change is enhanced and production of heat is immensely increased. There being no regulating influence at the periphery, the vessels at the injured point, even if they are not destroyed, are contracted. Hyperæmia of some of the internal organs ensues, resulting in the well-known ulcers and inflammations which destroy life.

Again, large doses of narcotics which destroy the sensibility of the peripheral nerves and the conducting capacity of the sensory nerves

favor death from exposure to cold, because the heat-regulating centres do not receive the impressions to which in normal conditions their response is made by increase of heat production.

The effect of thermic irritations of the cutaneous surface upon the body heat has been investigated with exactness, and has been well demonstrated by Otto Pospischl as follows:

Driving of the blood from, and stoppage of the circulation in, a part diminishes the loss of heat as far as 70.6 per cent.

The interruption of the circulation by the production of passive hyperæmia diminishes loss of heat as far as 46.2 per cent.

Mechanical irritants may produce an increase of heat loss as far as 95 per cent.

Weaker chemical irritants may produce an increase of heat loss as far as 40 per cent; intense irritants, on the contrary, only to 8 per cent.

Thermic influences which produce cutis anserina diminish heat loss as far as 44.5 per cent.

A warm rain bath may by this means induce a reduction of heat loss as far as 38.7 per cent.

Partial cold wet rubbing may increase heat loss up to 80 per cent.

Cold rain baths, with subsequent rest, produce after a transitory diminution of temperature, an increase of 25 per cent.

Cold rain baths, with subsequent exercise, increase heat loss as far as 66.6 per cent.

Warm rain baths, with cold fanning and subsequent rest, increase heat loss 60 per cent.

In two cases of fever the heat loss during the rise of temperature was diminished 25.4 per cent.

If we accept as the result of these exact investigations the deduction that heat dissipation may be increased 70 per cent, or decreased 90 per cent, thus enabling us to induce compensatory fluctuations that may be three times the normal, we have a ready explanation why these compensatory agencies serve to maintain the constancy of the body heat. We must also accept the deduction that in this manner may be explained the rise of temperature in fevers, and its reduction by the hydriatric procedures described in another part of this work.

The influence of thermic agents, externally applied, upon heat production and heat loss, will be discusssed more fully in a future chapter. It is here referred to with a view to demonstrate the *great importance of the skin as a regulator of temperature by reason of its temperature sense*, which conveys to the central system those impressions which regulate heat loss in due proportion to heat production.

CHAPTER III.

PHYSICAL PROPERTIES OF WATER.

The application of water for remedial purposes upon the important organ which has been discussed above involves certain distinctive elements. The physical properties which render water capable to act as an agent for conveying those temperature impressions which are the essential elements in hydriatric procedures are:

1st. *Its capacity* for gathering, absorbing, and transmitting heat and cold.

That water possesses a remarkable capacity for absorbing heat without being itself much elevated, and giving off heat without losing itself very materially in temperature, has been frequently demonstrated by experiments. The quantity of heat required to raise the temperature of one pound of water 34° suffices to elevate to the same temperature two pounds of oil of turpentine, eight pounds of iron, or thirty-five pounds of mercury. Again, one gram of iron at 32° may be elevated to 130° F., by the same quantity of water at 140°, the latter losing only 43°, while one gram of iron at 140° F. elevates one gram of water at 32° only to 43°, with a loss of 130°.

2d. *Its flexibility.* The enormous physical changes which water is capable of accepting as the result of different temperatures enhance its value as a flexible thermic agent. At 32° F. water solidifies; at 212° F., under ordinary atmospheric pressure, it becomes elastic, increasing seventeen hundred times in volume. In the form of ice it evolves, as will be shown, valuable thermic indications which are impossible in other forms. In the volatile form of steam it is again a most useful agent.

By proper mechanical contrivances water may be obtained at any temperature demanded by the indications of cases. Its application is rendered more facile than that of any other remedial agent by the precision and methodical manner with which temperature and duration may be graded, as will be shown later.

An enormous range of effect is evidenced by our ability to apply water at a temperature equal to that of the body, which produces an indifferent effect, and at that of ice, which, by sufficiently long continuance, may destroy the life of the part, and in the other direction up to a temperature sufficiently *high* to produce the same destructive effect.

By remaining within the range of safety, we still have a large choice of temperature (say from 34° to 120° F.) which renders water a most flexible therapeutic agent.

3d. The perfect control which the chief physical property of water—its fluidity—affords for changing the size, form, and character of the stream, for directing it to any one or all portions of the body, for thus limiting the local and general effects with the utmost nicety and precision.

The various hydriatric procedures, full bath, half-bath, sitz bath, spinal douche, etc., derive their technique and application from this property of water.

4th. The capacity of water to be influenced by varying degrees of pressure endows it with power to produce mechanical effects upon the nerve and blood supply of the skin, which form one of the most interesting and *least appreciated* elements of hydrotherapy.

By proper mechanical contrivances, which will be described in a future chapter, water may be applied almost without pressure, as by a sponge, or by pouring from a vessel which is just above the level of the cutaneous surface; it may flow from a height with great force, or it may be driven upon the skin by compressed air. Thus may be produced a range of irritant mechanical effects which vary from the mildest to the most destructive. That a destructive effect may be produced cannot be denied. I have frequently demonstrated it with the filiform douche of Lauriat, by which a thread-like stream, propelled with great pressure, can be made to penetrate the skin, producing pain and bleeding.

Here again we find a range of action which enables the physician to produce varied effects adapted to the therapeutic indications which may present themselves.

CHAPTER IV.

RATIONALE OF THE ACTION OF WATER IN HEALTH.

Since water may be applied as a therapeutic agent externally to the cutaneous surfaces, internally to the cavities of the body by irrigation, and also with a view to absorption, its mode of action in health will be considered under these three heads.

The application of water to the cutaneous surface is the most important function of hydrotherapy. *It involves chiefly thermic and mechanical effects. The action of these, whether by cold, heat, or mechanical impact, is that of irritants to the peripheral sensory nerves.*

(*a*) This irritation may be conveyed to some portions of the central nervous system, and thence reflected by motor fibres to the various parts which we desire to influence.

(*b*) Changes of the local innervation of the part which receives the application may be produced by effects upon the ganglionic centres, which have been shown by Vulpian, Golz, and Heidenhain to exist in the nerve supply of the vessels, and which perform the function of nerve centres within their immediate sphere without depending upon reflex impulses from the brain or spinal cord.

The effect of these nerve irritants depends, like that of other irritants, upon their intensity, upon the extent of surface receiving their impact, upon the susceptibility of the entire organism or of the point of application, and also upon the suddenness of the impact.

The thermic and mechanical action of water upon the circulation, respiration, temperature, tissue change, and secretions, forms the basis of all those notable therapeutic results which hydrotherapy claims. If it can be established that these pronounced effects may be obtained in health, it becomes a logical deduction that they are useful in disease, because the same laws which govern the vital processes of the organism in health in order to maintain its functions also are at work in diseased conditions, with the object of restoring the lost equilibrium.

Just as in the study of medicinal agents, their physiological action forms at once an explanation of their therapeutic effect and a guide to their application.

Modern hydrotherapy does not ask acceptance of its clinical results unless it can furnish a fairly clear *rationale* of the action of its procedures. It is the aim of these pages to *lead the practitioner to the*

adoption of hydriatric methods in all those conditions in which they are therapeutically superior to medicinal agents, or in which they may become auxiliaries to the latter. This can be accomplished only by acquainting the practitioner with the principles which govern their action.

In order to obtain a clear idea of the real therapeutic capabilities of thermic and mechanical irritation applied to the cutaneous surfaces in disease, a somewhat detailed account of our present state of knowledge of their influence upon the most important functions of the organism is necessary.

To demonstrate the latter, positive experimentation upon animals and man has been made, which will be considered under the following divisions: Influence of water applications upon: (1) Circulation. (2) Respiration. (3) Temperature. (4) Tissue change. (5) Secretion.

Influence of Hydriatic Applications on the Circulation.

That system of animated hydraulics which in the living organism is comprised under the term "circulation of the blood" forms the great highway upon which the products for its maintenance and growth are conveyed, and by which the products of waste and repair incident to the performance of all functions are eliminated. It follows, therefore, that any agent which is capable of exercising even the slightest influence upon an apparatus which is destined for these important tasks must be capable of exercising in disease an analogous influence upon the organs and their functions which come under the domain of its action. The study of the mechanical and thermic action of water upon the circulation will consequently engage our deepest interest and attention. It is proposed to present under two distinct heads the physiological effects of hydriatric applications upon the circulation.

I. Effect upon the distribution of the blood and upon the blood pressure.

II. Effect upon the composition of the blood.

I. Effect of Hydriatric Applications upon the Distribution of the Blood.

The effect upon the distribution of the blood and the effect upon the blood pressure will be considered together for obvious reasons. They may be subdivided, however, for purposes of furthering a clear conception of this important subject into (*a*) vasomotor or reflex effects, (*b*) mechanical or hydrostatic effects.

(*a*) Reflex Effects.—The effects of hydriatric applications upon the distribution of blood have been studied by many physiologists.

Among these Roehrig, who, as a practising physician at Kreuznach, had acquired a large experience in hydrotherapy, furnishes* an elaborate and painstaking exposition of the influence of cutaneous irritants on the circulation, which, at once convincing and practical, is applicable to the various modes of applying water to the skin.

"When the cutaneous surface of an animal is exposed to the effect of an irritant, an immediate reddening at the point of application ensues, which may pass from a simple erythema to the complete death of the part. Changes in the blood-vessels ensue, which may be observed under the microscope in the transparent web or in the mesentery of the frog. When the back of the frog is pricked with a needle or pressed with a pair of pincers, a perceptible increase in the blood current is at once observed, accompanied by a feeble contraction of the arteries, and even of the veins, lasting a few seconds, when the normal rapidity of the circulation is restored, together with a return to the previous calibre of the vessel. If the irritation is more intense, the narrowing of the lumen of the vessel is more decided, only, however, yielding to an equally decided unnatural relaxation of the muscular walls of the vessel, accompanied by a positive slowing of the blood current. The normal condition following such irritation is much more slow in returning than it is after feeble irritation. The duration and intensity of these effects depend upon the intensity of the excitation. Such experiments demonstrate *that feeble cutaneous irritants enhance the normal tone of the circulatory muscular fibres of the vesssels, that intense irritants permit a relaxation of the muscular fibres to follow.* The calibre becomes narrowed either during the continuance of the irritation, or, as after intense irritation, responds at once by a pronounced dilatation without preceding contraction." The latter may be regarded, according to Roehrig, as the result of fatigue from overstimulation, because the intensity and duration of the relaxation of the circular fibres corresponds not only to the intensity of the sensory irritation, but also to the intensity of the preceding contraction of the artery. In short, the nervous supply of the vessel coats displays the same property which characterizes all other nerves; *i.e., they are stimulated by feeble irritants and paralyzed by intense irritants.*

"It has been clearly shown by experiments made upon frogs under the microscope that irritation of the cutaneous surface is conveyed upon reflex tracts to the vessel walls. The origin of the nervous supply of the peripheral vessels has been found in the vasomotor centre of the medulla oblongata. When the latter is irritated, the small arteries of the entire body are contracted, just as they are made to contract by simple excitation of the sensory nerves themselves. It is

* "Die Physiologie der Haut, experimentell und kritisch bearbeitet."

probable that all the sensory cutaneous nerves congregate in the vasomotor centre in the medulla, where they are connected with the vasomotors of all the arteries of the body. From this central point an incessant influence goes out, acting upon the contractility of all arteries and probably with greater intensity upon the peripheral vessels. A continued tonic action is thus maintained, which produces 'arterial tone,' and partly furnishes that resistance at the periphery which is so essential in maintaining the force of the heart, and in governing the blood pressure and blood distribution. That these important factors in the circulation may be readily affected by irritation of the sensory cutaneous nerves has been illustrated by experiment. But there are deeper and more far-reaching results traceable to action upon the external surface of the body, which are of great importance in explaining the effects of thermic cutaneous irritation, and consequently also the effects of many hydriatric procedures. Maximilian Schüller's experiments on trephined rabbits* demonstrate that the nerves supplying the vessels of the pia mater experience a steady 'tonic' excitation from the cutaneous sensory nerves. When Schüller severed single nerve trunks on one side of a trephined rabbit, he always observed an evanescent but very distinct dilatation of the pial vessels on the corresponding side. That this result was not due to pain was evident from the fact that the other side remained unchanged. This result proved clearly that the changes in the tonic excitation referred to above, produced by thermic or mechanical irritation of the cutaneous nerves, would disturb the vascular equilibrium in the brain. Not alone the nerves supplying the vessels experience, according to Schüller, this reflex excitation going out from the cutaneous sensory nerves, but he believes that the centres for heart and respiratory movements receive it perhaps to a greater degree. Clinical observation exemplifies this effect also on man."

Goltz, also, has shown† how the action of the heart may be influenced by excitation of the sensory nerves by means of reflex action. Mechanical irritation of the exposed intestines of a frog by a simple blow caused cessation of cardiac action in diastole, and this result did not follow when the reflex tracts were interrupted by destroying the medulla oblongata or by cutting the vagus nerves.

The action of the heart is, as is well known, decidedly increased in high atmospheric temperatures, while low temperatures diminish it. Roehrig has made numerous experiments of the effect produced upon cardiac activity by excitation of the sensory cutaneous nerves, all of which demonstrated that the heart muscles respond with great

* Deutches Archiv für klinische Medicin, No. 4, 1874.

† "Tonus der Gefässe," etc., in Virchow's Archiv, Bd. xviv.

sensitiveness to all kinds of stimulation applied to the cutaneous nerves. Feeble stimulants not only invariably modify the energy of cardiac contractions, but also increase their number, while intense cutaneous stimulants not only enhance the force of the contractions, but also reduce their frequency considerably. These effects depend not only upon the intensity of the excitation, but also upon the extent of the cutaneous surfaces irritated. Roehrig also experimented with thermic irritants. He applied a paper tube filled with ice for fifteen minutes to the inside of the ear of a rabbit, with the result that the intense cooling of the ear produced an increase of twelve to eighteen beats in the pulse. On the other hand, the application of water at 156° to 158° F. caused an immediate increase of ten to twelve beats, which was, however, followed by a decided fall, amounting to seventy beats below the normal (the normal heart beat being 150 to 170). The heart recovered slowly, after the expiration of two hours, in both experiments. Roehrig also ascertained by proper experiments that, *when intense cutaneous irritants produce considerable slowing of the heart, they also increase its force. These results are undoubtedly brought about by reflex action*, as experiments by cutting the sympathetic and vagus in different animals have demonstrated that the slowing of the pulse is due to an excitation of the pneumogastric nerve, which in extreme cases caused death by tetanic contraction of the heart. The animals died in convulsions, with gradual paling of the fundus oculi, as observed in albino rabbits, which died with open eyes. There was doubtless an interruption of the blood supply to the brain and to the spinal cord.

A direct effect upon the continuity of the vessels was formerly regarded as the only channel by which irritants produced local external hyperæmia. It was supposed that the accumulation of blood on the surface after blisters or rubefacients withdrew blood whose fluxion to internal organs was pathological, and thus proved antiphlogistic. This fallacy was exposed by the investigations of Naumann, which have become classical.

Naumann has demonstrated clearly that *the effects of external irritants upon the circulation within the body are really reflex.* He separated the head of a frog from the body, leaving them connected by the medulla oblongata only. He next severed one leg, after preventing loss of blood by tying the vessels, so as to leave it connected with the body by the sciatic nerve. Now he applied thermal, chemical, and electric stimuli to the foot of the partially severed leg, while he observed under the microscope the mesentery of the frog. Shortly after gentle irritation of the peripheral endings of the sciatic nerve in the foot, the circulation in the vascular network of the lungs

and mesentery was accelerated, and resumed the former condition slowly after the withdrawal of the irritant. A more severe irritation produced retardation of the flow, and even stasis occurred, as if the heart had become temporarily paralyzed. A strong irritant produced dilatation, a feeble one constriction of the vessels. The effect of these peripheral irritations upon the heart was also noted. A strong irritation of the skin weakened its circulation; a feeble irritant strengthened it. As there was no possible vascular or nerve channel from the part irritated to the part thus visibly affected, the conclusion is inevitable that the effect is entirely reflex. Hot water acted precisely in the same manner as other irritants. Naumann continued his investigations upon warm-blooded animals and upon man with the same results, and announced his conclusions as follows:

"The effect of epispastics is essentially due to reflex action through the central organ; they exert considerable influence upon the activity of the heart and vessels.

"In proportion to the irritability of the individual, powerful continuous stimuli lessen the activity of the heart vessels and weaken contraction, the vessels becoming dilated and the circulation slower; relatively weak stimulation increases the activity of the heart and vessels, strengthens cardiac contraction, narrows the vessels, and accelerates the circulation.

"The changes produced in the body by long-continued cutaneous stimulation last a considerable time after the conclusion of the same, as a general rule; the more enduring the stimulation applied, the longer they will last, and in a healthy person will often still be perceived after the lapse of from half to three-quarters of an hour from the conclusion of the stimulation.

"The relaxation of the pulse which follows a more powerful cutaneous stimulation often attains its maximum during the stimulation, but frequently only after the conclusion of the same.

"The excitant action of a relatively weak cutaneous stimulation likewise continues for a considerable time after it has been removed, but it is finally also followed by a relaxation, only this appears much later and in a less degree than after more powerful cutaneous stimulation.

"As a consequence of stronger cutaneous stimulation, there constantly appears, mostly after a longer or shorter period of warming, a cooling down of the body, which often does not terminate until half an hour after the cessation of the stimulus.

"This period of alteration in temperature is of varying duration; cooling ofttimes takes place during the stimulation, but as a rule only after its conclusion."

There are *two* modes of effecting *changes in the circulation, by re-*

flex excitation from the sensory nerves, namely, one influencing the calibre of the vessel and the other acting upon the propulsive power of the heart muscle. Without entering into the details of experiments made by Bezold, Ludwig, and Roehrig, it may be safely stated that the enhanced arterial pressure and rapidity of the blood stream following the narrowing of the vessels produced by weak cutaneous irritants is not induced by an increased propulsive power of the heart, because these effects are produced also when all the nerves leading to the heart are cut off. It is clear that a stasis of blood ensues in the arterioles as the result of the contraction of their terminals, and that increase of blood in them is really due to the prevention of the outflow of blood from these contracted vessels, and that this heightened pressure is not chargeable to increased activity of the heart, but secondarily to the increased resistance of the stream at the periphery.

To summarize with Roehrig and Naumann: "Weak cutaneous irritants produce a narrowing of the small arterioles, with a rise of pressure, in consequence of which, by the intensifying of the resistance at the periphery, the heart is made to contract more rapidly. On the contrary, intense cutaneous irritants fatigue and paralyze the normally existing innervation of the blood-vessels which emanates from the medulla oblongata. These produce a relaxation and dilatation of the peripheral arteries with diminution of pressure, but at the same time the inhibitory action of the pneumogastric is enhanced, producing a slowing and intensifying of cardiac contraction, which may, when excessive, produce death by vagus tetanus."

These important functions resulting from irritation of the sensory nerves in the skin should be carefully borne in mind, since they possess great practical significance in many hydriatric procedures, whose aim it really is to produce such sensory irritations in varying degrees. The degree of heat or cold in any hydriatric procedure, the amount of pressure with which it is delivered, the previous condition of the patient, whether, for instance, his skin is in an ordinary condition or has just emerged from an air bath of 150° F., or comes from a room containing air at the ordinary temperature; whether the temperature of the douche is suddenly or gradually lowered—all these are modifying influences which, it will be shown later, are of immense importance. The effects produced by them depend upon the principles demonstrated by the experiments of Roehrig and Naumann, here detailed, and which have been abundantly confirmed by others.

In the human body the impact of cold conveyed by any medium to the skin, as is matter of common observation, induces pallor and shrivelling of the skin. Many physiologists have demonstrated that this is due to contraction of the circular fibres of the cutaneous vessels,

or, in the case of the finer capillaries, of the muscular fibres existing in the skin, by which the blood is driven out. In accordance with the physiological law that striated muscular fibres contract and dilate slowly, the contraction of the muscular structure of the skin is followed by a deliberate relaxation. The vessels not only resume their normal size, but even are dilated beyond it, so that more blood is received by them.

Following the process more minutely, we find that by intensely low temperatures the circulation in the capillaries is at first accelerated and the number of blood corpuscles diminished, when the part becomes pale. Quickly following this acceleration there is a stasis in the capillaries, while in the smaller veins and arteries the slowing of the circulation is followed by brief and rapid oscillations, which become slower and more infrequent. Slowly the vessels become more pale, less transparent, and finally the movements cease, until the vessel is blocked and occluded.

When the cold is less intense and more prolonged, there ensues a retardation of the stream in the smaller capillaries, while it becomes more active in the larger vessels, which now dilate. If, however, the application is continued, the larger vessels are also contracted and blocked. A collateral hyperæmia in neighboring parts is the result, which produces more rapid circulation in them.

It is not difficult to deduce the most important physiological changes as the result of this energetic influence of cold upon the vessels, as will appear farther on.

(*b*) Hydrostatic Effects.—That the effect of hydriatric applications upon the distribution of blood is not reflex only but to a certain extent also hydrostatic is clearly demonstrated by the experiments of Maximilian Schüller,* who trephined rabbits, carefully exposing to view the vessels of the pia mater, without disturbing the dura, which by its transparency facilitated his observation. He carefully noted the normal circulation of these vessels, and ascertained that even simple pressure upon the belly produced dilatation of the veins, and sometimes also of the arteries, probably through mechanical interruption of the venous return flow. When he applied pieces of ice upon the dura mater, he observed very energetic contraction of the veins and arteries of the pia, which continued half a minute even after removal of the ice. The most interesting observation, however, was that when he placed cold wet compresses upon the belly of the rabbit the vessels of the pia mater invariably dilated, cerebral pulsation became more pronounced and slower, and respiration was deepened and slowed. These phenomena continued a short time after removal of the compresses, and

* Deutsches Archiv für klinische Medicin, xiv.

they were followed by transient narrowing and a return to the normal calibre. When warm compresses were applied, the arteries and veins of the pia mater contracted, the pulsations became less pronounced and more frequent, and respiration more shallow and rapid.

By changing the temperature of the compresses these changes were more or less rapidly produced. A very hot compress produced the same effect as a cold compress. These manifestations were also observed, but with more pronounced effect, after immersion of the entire body into cold or hot water; the effect being exactly in the proportion to the extent of surface immersed. After a prolonged immersion in cold water a narrowing of the vessels and sinking of the brain substance ensued, due, doubtless to the reduction of temperature in the circulating blood, which approximated in effect to that produced by local ice application. The vessels of the ear also participated in this effect. Immersion in warm water produced a transient dilatation, which was followed by a vigorous narrowing of the vessels and sinking of the brain substance. The cerebral movements became at first accelerated, afterward slower and more shallow, finally becoming more rapid, when the temperature of the water was elevated.

Immersion into very hot baths produced effects similar to hot compresses, but of greater intensity and duration.

Under either the cold or the warm *douche* the cerebral circulation did not vary greatly.

Cold rectal enemata always produced a moderate dilatation of the cerebral vessels.

Schüller has placed hydrotherapy under lasting obligations by the pains taken in his observations.

The great importance of his experiments and of his deductions warrants the writer in presenting them in detail, inasmuch as the clear expositions furnished by Schüller supply, if they are interpreted logically and without prejudice, a clew to many misapprehended phenomena in hydrotherapy.

From all his experiments, Schüller regards it as undoubtedly established that the changes referred to as taking place in the vessels of the pia and in the fulness of the brain during and in consequence of the varied applications of water, and which have been shown to be always constant in a very large number of animals, may be positively accepted as the true expression of changed physiological relations. The occurrence of the characteristic changes in curarized animals also must set aside every objection to their being accidental. Indeed, it may be regarded as proved that *a causal connection certainly exists between the various external applications of water and the typical changes in the vessels of the pia.*

In explaining these results, that is, the dilatation of the pial vessels by cold applications to the surface of the animal and their narrowing by warm-water applications, the first thought would be, according to the usual ideas, that they arise from an influence of the thermic irritation upon the nerves of the vessels or upon the vessels of the nerve centres. But Schüller's experiments in irritating the nerves themselves, have shown that such effects differ entirely from those obtained in the original experiment. When he placed a piece of sponge saturated in water of 9° R. (52° F.) upon the trunk of a cutaneous nerve a transient narrowing of the vessels of the pia occurred, while a compress of the same temperature placed upon the belly or back of the animal always produced a prolonged and decided dilatation. The application of water at 30° R. (99.5 F.) upon the cutaneous nerve trunk produced widening of the vessels, while the same applied upon the general skin produced narrowing. Therefore thermic irritation of the sensory cutaneous nerve trunks produced changes in the vessels of the pia directly opposite to those applied upon the skin in general. Hence the *typical changes of the vessels of the pia after applications of water to the periphery cannot be ascribed exclusively to reflex excitation from the cutaneous nerves.*

Moreover, compresses of varied temperatures always produced decided changes in the blood pressure; namely, cold water produced a strong rise of blood pressure in the carotid, warm-water applications a relative sinking of the same. This positively ascertained fact cannot be reconciled with the idea of an essentially reflex influencing of the pial vessels by water applications; for if the latter were accepted we should be forced to explain the widening of the pial vessels following cold-water application upon the skin by a reflex paralysis of the vasomotor nerves of the brain. Inasmuch, however, as paralysis of vasomotor nerves or of the vasomotor centre is always connected with a decided *fall* of pressure in the arteries, while on the other hand cold-water applications are constantly followed by a *rise* of blood pressure, this simultaneously occurring dilatation of the pial vessels can in no way be attributed to a reflex paralysis of the vasomotor nerves.

These apparently irreconcilable contradictions, that is, the dilating of the pial vessels under cold applications upon the skin and their narrowing when the applications are made upon the sensory nerve trunks, as also the rise of blood pressure with simultaneous dilatation of the pial vessels and of the vessels of the ear, may be very readily explained in a satisfactory manner if we assume that the cold-water application upon the skin produces contraction of its peripheral vessels in consequence of which the remaining vessels of the body are filled with more blood. Moreover, inasmuch as every interference with the blood flow

(in this instance the large area of capillaries in the skin) raises the tension of the arteries behind it, we have herein also an explanation of the rise of blood pressure. The fact that during the full bath the filling of the pial vessels increased according to the dimensions of the part of the animal which was dipped into cold water, and the fact that the vessels of the ear also filled more completely when the ears were kept out of the water, and, finally, that the dilatation of the pial vessels increased still more when the ears were also dipped into the water, taken in connection with the above-mentioned observations, point to but one explanation, namely, that the cause of the dilatation of the pial vessels under cold-water applications is to be found in a retrostasis of the blood into the interior consequent upon the narrowing of the vascular area of the skin. A similar explanation of the narrowing of the pial vessels under warm-water applications is justified, namely, that the relaxation and consequent filling of the cutaneous vessels are followed by a simultaneous diminution of fulness in the remaining vascular area, consequently also in the vessels of the brain. The relative reduction of the blood pressure agrees with this explanation, because the brief initial rise of pressure may be explained by the increased rapidity of the heart's action.

Schüller does not deny that there is an influence upon the nerves under these applications. On the contrary, he regards it as indubitable that the cutaneous nerve terminals are affected in the same way by thermic influences as the cutaneous vessels, and that it is very probable that these nerve filaments are affected in the same way as their trunks; namely, that cold applications arouse reflex narrowing, warm applications reflex dilatation of the pial vessels. This seemingly contradictory effect must undoubtedly limit the characteristic changes of the pial vessels when water is applied to the skin, and to it is probably attributable the rapidly changing alternation of calibre in the pial vessels observed *in the beginning* of the water application before the characteristic dilatation or narrowing ensues. In other words, Schüller believes that in the beginning of the application the pial vessels are affected by reflex irritation from the cutaneous nerves, and that the real effect upon the pial vessels occurs only when the thermic influence upon the cutaneous vessels has gained the ascendancy.

The fact that cutting the cervical portion of the spinal cord prevented the occurrence of any effect upon the pial vessels under water applications does not weigh against the assumption that we have here to deal with a hydrostatic effect. After the section of the cord not only is there an interruption of reflexes from peripheral thermic irritations upon the nerves supplying the pial vessels, but the tone of all the muscular coats of the vessels is essentially destroyed; consequently,

also, that of the cutaneous vessels. Under these conditions no effect whatever can be produced upon the distribution of the blood under water applications; indeed, the blood of the entire body remains in a positive equilibrium, because none of the vessels respond on account of loss of tone.

The action of the heart and the respiratory movements which influence the circulation of the brain more or less in ordinary conditions are of little importance in this connection. Schüller found that after section of the vagus, the pial vessels were not quite so full; but the typical changes resulting from water applications ensued just as plainly as when the vagus was intact.

Schüller summarizes the characteristic action upon the pial vessels by water applications as follows:

These changes are due essentially to the increased or diminished afflux of blood to the pial vessels in consequence of the narrowing or dilatation of the peripheral vessels in the skin.

The movements of the heart and respiration are only indirectly concerned; they sometimes further or limit these changes.

The reflex influences of the thermic irritation of the cutaneous nerves upon the pial vessels are of subordinate importance (in the procedure used by Schüller [*author*]); if they produce any effect they probably limit these manifestations.

Secondary Effects of Water Applications.—The experiments of Schüller further show that the effects described as arising from cold and warm external applications do not continue if the latter are prolonged. These effects last only two to three minutes after compresses, five to ten minutes after baths. In general they are of shorter duration after cold than after warm applications. Frequent repetition of the application does not change the effect. It occasionally increases it after cold applications, but shortens its duration. After the above period, whether the application be discontinued or prolonged, Schüller observed constant changes of the vessel calibre, *which are the reverse of the initial changes;* if the pial vessels were dilated by cold applications, they now became contracted, and *vice versa*. When the application is interrupted after short duration, the vessels assume their normal character; when the application is continued very long, the constriction mostly increases. Schüller's observations demonstrate without doubt that in these secondary changes in the pial vessels opposite conditions prevail in a minor degree; viz., that the cutaneous vessels fill after cessation of or upon continuation of the cold. Schüller claims that when the application is of long duration, the relatively intense cooling of the blood conduces to prolonged narrowing of the pial vessels; cooler blood circulating in the pial vessels causes

contraction of their coats, especially after full baths, which effect is more pronounced in rabbits because their surface is relatively larger than their mass. The secondary effect upon the pial vessels produced by warm-water application may be explained in a similar manner. When the bath is prolonged the blood flows, owing to diminished heat dissipation, at a relatively higher temperature to the pial vessels, and produces dilatation of the previously contracted vessels, by reason of paralysis of the vasomotor nerves of the cerebral vessels. If the warm application be discontinued, the cutaneous vessels are again narrowed, and the blood is again driven in larger quantities to the pial vessels; hence we have dilatation, which gradually ceases as the blood distribution becomes equalized. Schüller holds that this is the explanation of the dilatation ensuing upon cessation of the warm-water application, because, if cold water be applied immediately afterward, the dilatation is increased by reason of increase of the contraction of the cutaneous vessels, a larger quantity of blood being thus driven from the capillary area of the skin to the internal organs.

These explanations of the contrary secondary effects of water application, made by Schüller, do not appear quite satisfactory to the author. I believe that Schüller's original explanation that the primary effect is chiefly hydrostatic also holds in the *rationale* of these opposite secondary effects. After the cold application which has by contraction of the cutaneous vessels driven the blood to the interior vessels, including those of the pia, ceases, reaction ensues on the surface; the cutaneous vessels become dilated, as I have shown, in a tonic manner; that is, the arterioles and capillaries fill, so that in the healthy human subject the skin becomes decidedly reddened. Surely this demonstrates satisfactorily that the pial vessels become contracted *because the large cutaneous vascular area is filled to repletion.* If the cold application be continued, the cutaneous vessels become paralyzed and relaxed. This is especially true of the veins, which is evidenced by cyanosis. Moreover, the muscular arteries, as has been shown in the physiological portion, become abnormally full in their compensatory action for the protection to the interior. The blood is drawn into the arteries of the muscles and the veins of the skin, removing it from the brain.

When warm applications to the skin are followed by contraction of the pial vessels, and this ceases with cessation of the application, the vessels returning, as Schüller shows, to the normal, I believe that a rational explanation may be found in the fact that when the skin is exposed after the warm application to the temperature of the air, which is always much below that of a warm-water application, the cutaneous vessels contract by reason of this change of temperature until they reach a

normal calibre. Hence the pial vessels also assume a normal calibre. Schüller's observation that prolonged duration of the warm application produces an increasing constriction of the pial vessels may be explained by the complete relaxation of the arterial vessels, producing a passive condition which admits much more blood than it did at first.

Schüller justly claims that his investigations made by experiments on animals, must prove of great value in the practical conception of the effect of water applications in man, and that if they can be applied to the human organism they will tend to modify or overthrow certain indefinite ideas upon the subject, and substitute these more positive ones. That the results of these experiments are applicable to the human organism also admits of no doubt. Although the anatomical structure of the skin and the relation of the cutaneous nerves to the central nervous system in man differ from those of the rabbit, the effect of water applications is modified only to a slight extent. The principal effect is the same. Indeed, the conditions are even more favorable in man, because his skin and cellular tissue are supplied with more blood-vessels, a more active muscular structure, and more abundant lymph vessels with muscular walls. Moreover, the absence of hair enhances the local temperature effect, which is intensified by the presence of smooth muscular fibres in the corium, which enables the skin to respond more readily to cold applications. If the effect upon this large abundantly anastomosing network of cutaneous vessels is taken into consideration, it may be easily conceived how contractions by cold and relaxations by warmth conveyed by water may induce considerable fluctuations in the blood supply of the remaining vascular system. The effect of cold and hot baths upon the brain has too often been noted to require to be cited in evidence of this proposition.

The observations of Schüller detailed above have been confirmed in man by Dr. Vinaj, who utilized for this purpose a man who had lost a portion of his cranium through a severe injury. Vinaj presented his observations to the Fourth Italian Congress for Hydrology, held at Florence on the 21st of November, 1892, stating that they entirely corroborated the results obtained by Schüller in animals.

From these simple explanations, it becomes clearly evident, that, while the local influence of warmer or cooler blood upon the pial vessels themselves may have a share in the opposite secondary effects referred to, the hydraulic principle holds here also.

I have dwelt so fully upon this point *because the explanations here offered afford, as will be shown later, a clew to many obscure effects of hydriatric procedures.*

Increase of Volume Shown by the Plethysmograph.—By his original

and interesting experiments with the plethysmograph, Winternitz* has demonstrated the hydrostatic effect of hydriatric applications. He placed a man into an empty hip-bath tub, and covered him with a woolen blanket, his left arm being introduced into the glass cylinder of the instrument. The apparatus and manometer were filled with water of the body temperature, and connected with the registering apparatus. After the lapse of some time the tub was rapidly filled with water at 50° F. The cold water produced the usual effect upon the pulse and respiration. The curve produced (as shown in Fig. 1) was registered during the whole time without interruption. It showed an even outline so long as the tub was empty. So soon as the water was poured in, as shown at *a*, the curve rose perpendicularly. The volume of the arm must, therefore, have increased, because the water used must have been driven into the manometer. This effect continued for eighteen to twenty seconds, and the line dropped slightly during the following twenty to thirty seconds, but it did not reach the former level. The explanation of this result can be found only in the local excitation of the sensory nerve endings by the cold, and the reflex effects thus aroused in the vasomotors of the cutaneous vessels, which produced contraction in the entire area exposed to the cold. The blood was driven from this part, or an increase by afflux to it was prevented. Hence a large quantity of blood must have entered the remaining vas-

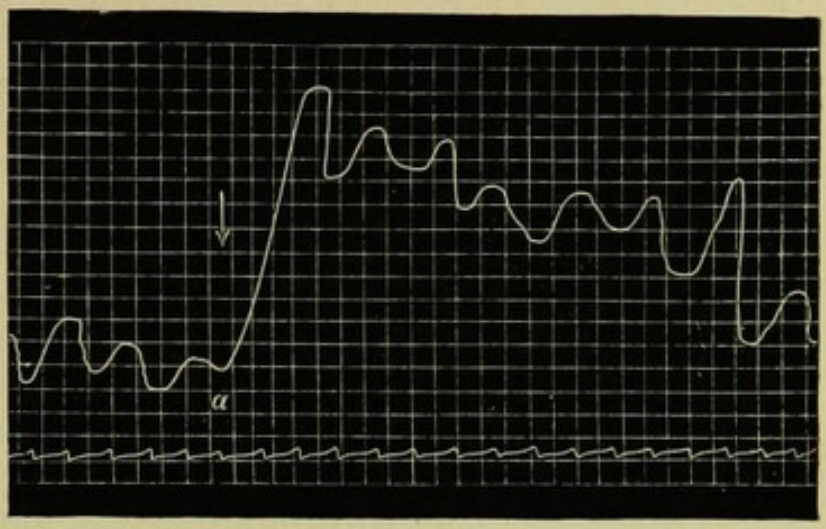


FIG. 1.—Volume Curve of the Right Arm before and after a Hip Bath of 50° F. (From Winternitz.)

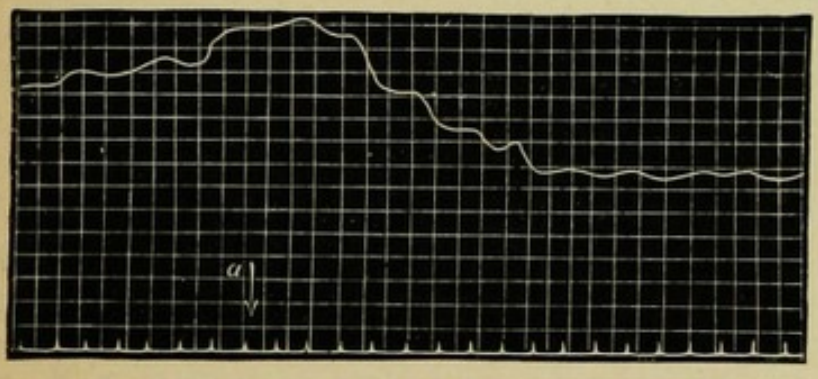


FIG. 2.—Volume Curve of the Right Arm before and during a Hip Bath of 110° F. (From Winternitz.) Duration, two seconds.

* "Die Hydrotherapie auf physiologischer und klinischer Grundlage," 1890.

cular areas of the body, *increasing their volume.* Winternitz claims that in the cold hip bath the vessels of the abdominal organs are chiefly contracted, and that the blood driven from them fills other parts of the body, including the arm.

In another observation on a man twenty years of age, the same experiment was made with water at 110° F., with the result shown in the curve (Fig. 2).

This experiment confirmed those of Schüller, who found a brief contraction of the cutaneous vessels, followed by their dilatation, evoked by the relaxing effect of the warm water. As a result, there was an afflux of blood to the part, compensated by diminished blood supply in other parts, which was demonstrated by increase in the volume of the arm.

That there is no contradiction involved in the conclusions of Naumann, Roehrig, and Schüller will be demonstrated by the effects of various procedures. Baths and other procedures without mechanical excitation, when applied to large portions of the body, doubtless act chiefly by hydrostatic effect, while *douches*, which impinge on limited portions, and are combined with mechanical effects, act chiefly by reflex influence. This demonstrates the great flexibility of water as a remedial agent.

Reaction.—This is the most important aim of the external application of water. The return of blood to the previously contracted arterioles is probably due, as is commonly supposed, to a relaxation of the coats of these vessels. When the vessels dilate after a brief application of intense cold, combined with decided mechanical impact derived from friction or from the pressure under which the stream of cold water strikes the part, the dilatation following the latter cannot be a passive process, but is more probably the result of an excitation of the inhibitory nerves, which overcomes the action of the vasoconstrictors. This is true of all vascular dilatation following the impact of cold, when not excessive in duration or intensity.

As has been mentioned above, blanching of the surface is the immediate effect of the application of cold. This is, however, quickly followed by an active congestion, and may eventuate in stagnation of the circulation. The superficial vessels receiving direct impact dilate most quickly after the primary contraction has passed. They become distended with blood, but, since the continued application of cold renders the capillary circulation sluggish in the parts subjected to it, the veins respond less actively to the excitant influence of cold, and, their contraction being more slow, their dilatation is correspondingly slow. Thus it comes about that the blood accumulates at the point of application of cold, which becomes turgid at first, and later cyanotic.

This effect, however, but slowly reaches the deeper-seated vessels, whose contraction would, as is well known, materially influence all vessels to which they are tributary. If this happens, or if cold is applied directly to the large vessels, their tributaries receive a smaller supply of blood, and they accommodate themselves to the change by diminishing their calibre. The result is an increase of resistance, viz., tone, which can be readily demonstrated by the sphygmograph—a tone in which every part of the arterial circulation participates if the entire periphery be subjected to the cold. The condition of the pulse indicates clearly that the *local hyperæmia resulting from the thermic irritation of cold* (*within reasonable limits*) *is not an evidence of exhaustion or paralysis, but points distinctly to a heightened tension in the vascular system.*

Blood Pressure.—An important result of thermic applications to the periphery is obtained in their effect upon parts not directly in contact with them. Since the impulse conveyed by the heart to the blood stream continues unabated, the contraction and subsequent dilatation of the parts in immediate contact induce certain changes by which vascular accommodation is accomplished.

If the blood is driven out of the narrowed vessels, it finds entrance into the collateral circulation. As a result we have collateral hyperæmia accompanied by increased tension and rise of temperature. The vessels of those parts, again, which receive this increased blood supply contract more vigorously, and force the blood which has, by reason of local or general pathological conditions, accumulated within them, to move on, giving rise to a more active current.

The *application of cold to the periphery*, like that of other irritants, even if it be followed by dilatation of the peripheral vessels, causes an *increase of blood pressure.* The contraction of the arterial capillaries induces primarily an acceleration of the blood stream from the arteries to the veins. The return of the blood into the venous system must be accelerated by this increased *vis a tergo.* The deepening of the respiration which also results from the external impact of cold, and which will be referred to below, increases the rapidity of the circulation of the small vessels, and induces an increased and accelerated return flow of blood into the left auricle, a slower and more vigorous systole, and more active filling of the arterial system; hence, a heightened blood pressure in it.

The sphygmograph demonstrates that *the dilatation of the peripheral vessels which ensues upon reaction is not accompanied by a loss of tone and is not passive, but is probably due to an excitation of the inhibitory nerves.* This is confirmed by the opposite effect which hot vapor baths produce upon sphygmographic tracings. These

show plainly a reduction of tone, diminished tension, and great dicrotism.

It may be accepted as a demonstrated fact that *cold enhances, while heat lowers, the tone of the vessel walls,* although both produce a primary contraction which is followed by dilatation of the surface vessels. In the former, however, we have an accelerated and increased passage of blood, with the vessels under high tension; while in the

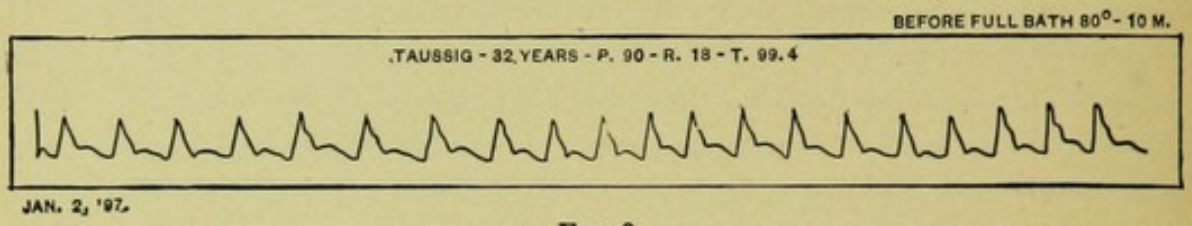


FIG. 3.

latter we have the vessels under low tension, and the walls relaxed and dilated, owing, probably, to a diminution in their elasticity. That these last must sooner or later produce a hyperæmia is evident. *It is important to distinguish these physiological differences between cold and warm applications, which primarily do not differ materially, bat eventually are totally at variance,* because we obtain quite distinct and differing effects from hyperæmia produced by heat and cold.

The subjoined tracings are offered as a graphic illustration of the effect of cold and heat upon the pulse in ordinary conditions.* The first tracing (Fig. 3) is from a nurse who had been smoking excessively all day and did not realize that he was in an abnormal condition. It represents a pulse of low tension, considerable dicrotism, small tidal wave showing feeble ventricular contraction, indicated by a slanting and low up stroke, and a somewhat obtuse percussion wave. Pulse, 90;

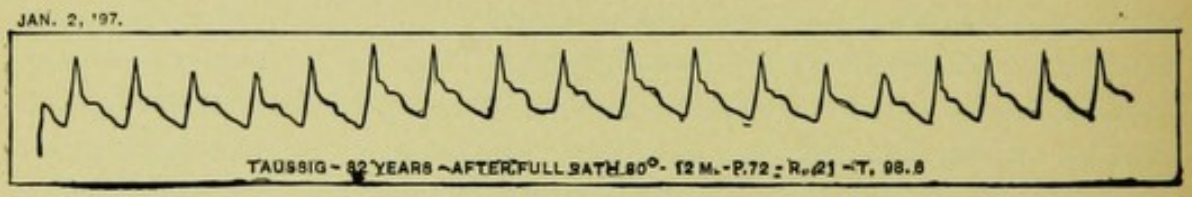


FIG. 4.

respiration, 18; temperature, 99.4° F. After being subjected to a full bath of 80° there is a pronounced change in this pulse, as shown in Fig. 4. We find now an improved tension, marked tidal wave, very moderate (normal) dicrotism, good ventricular contraction as indicated by the quick vertical up stroke and acute percussion wave. Pulse, 72; respiration, 21; temperature, 98.6° F.

* "The Practical Application of Hydrotherapy," Clinical lecture delivered at the German Hospital, Philadelphia, by Simon Baruch, M.D. "International Clinics," vol. ii., seventh series.

Fig. 5 shows the pulse tracings of the same man on the following day, he having not smoked at all. Pulse, 70; temperature, 98.4° F. He now received a perspiration bath.

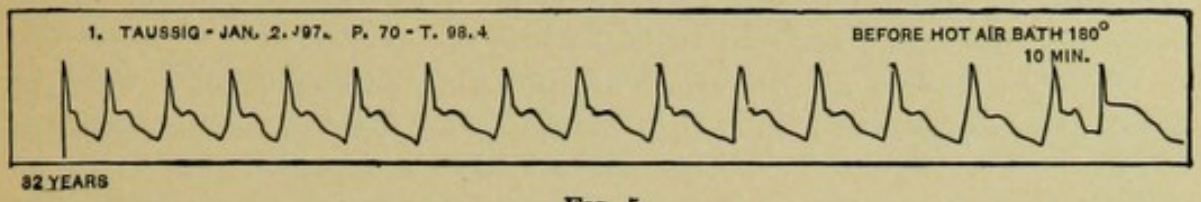


Fig. 5.

Fig. 6 shows pulse tracings of the same subject taken *while* he was perspiring in an air bath of 180° F. for ten minutes. Pulse, 100; temperature, 99.2° F.; respiration, 94. There is distinct evidence of weak-

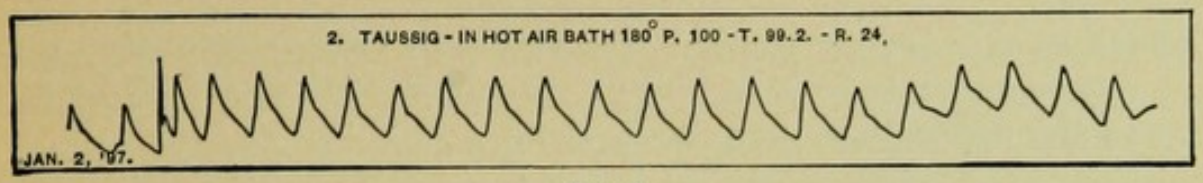


Fig. 6.

ened ventricular contraction, shown by absence of tidal wave and obtuse percussion wave. He is now subjected to a rain bath.

Fig. 7 shows pulse tracings of the same subject, taken after a rain

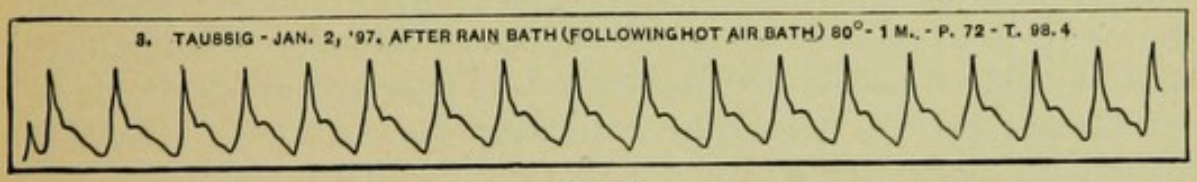


Fig. 7.

bath (following the above hot-air bath) of 80° F., one minute. Pulse is now 72; temperature, 98.4° F.

There is decided improvement in the ventricular contraction, evi-

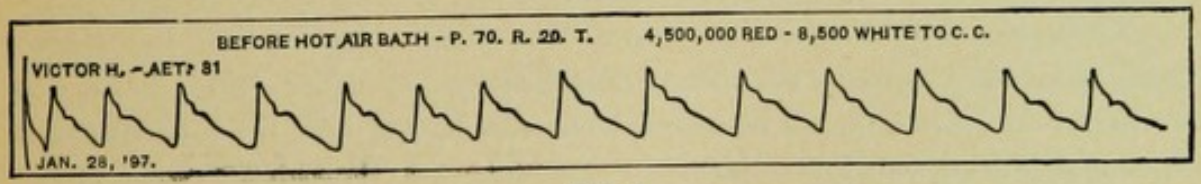


Fig. 8.

denced by high and quick up stroke, a very acute percussion wave, and marked tidal wave.

In another nurse, Victor H—— (Fig. 8), the same result is shown. (The blood-cell estimate made with Daland's hæmatokrit was, before the hot-air bath, with pulse of 70 and respiration of 20, 4,500,000 red and 8,500 white corpuscles). Immediately after the hot-air bath (ten

minutes) pulse was 86; respiration, 16; temperature, 99.5° F. (Figs. 8 and 9).

After the jet douche for five seconds, following this hot-air bath, the pulse was 72; respiration, 20 and deep; temperature, 99° F.; (blood estimate, 5,200,000 red and 10,000 white corpuscles).

Surely there is no medicinal agent which produces such changes when administered in ordinary medicinal doses, and none the effects of

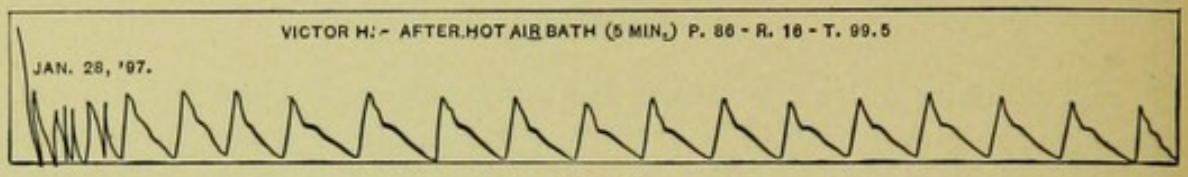


FIG. 9.

which have been more clearly and scientifically demonstrated than the simple experiments made on healthy individuals with absolutely harmless water applications here clearly show.

II. EFFECT OF HYDRIATIC APPLICATIONS UPON THE COMPOSITION OF THE BLOOD.

I. Changes in the Corpuscular Elements of the Blood.—The observations of Professor Winternitz * on this subject are of great interest. Dr. Winternitz investigated the number and relative proportions of red and white blood cells in the blood before and after cold applications, and found that there is a considerable change in their ratio after these procedures.

This change consists in the fact that while a white cell is accompanied by from four hundred to eight hundred red cells before a cold application, after such treatment the number of white cells is increased from two to three times. These observations were made in healthy as well as in diseased subjects.

These experiments are not conclusive in all directions. He states that this leucocytosis continues one-half hour after the bath. Its duration could not be ascertained with exactness, but in several cases it was observed two hours later.

Winternitz regarded this as the only observation of this kind until he learned that Professor Rovighi had presented the results of similar experiments to the International Congress at Rome. These were made upon rabbits and men, and demonstrated that heat diminished the number of the leucocytes in dogs two-thirds, and that cold *doubled* their number.

* Blätter für klinische Hydrotherapie, February, 1893.

The diminution in the size of the spleen and the increase in blood pressure and tone of vessels after cold application to the body surface have been proven for some time. Is it not possible, asks Winternitz, that the leucocytes may thus be driven forth into the blood current in increased number from spleen and liver and bone marrow?

Dr. William Sydney Thayer, of Johns Hopkins University at Baltimore, claims that these observations confirm his own results from experiments made upon himself. He took a bath of 70° F., of twenty minutes' duration, which was followed by pleasant reaction, without shivering, the skin being red and warm. The blood cells were counted immediately before the bath, and again fifteen minutes later, with the result of 10,333 leucocytes before and 12,333 after the bath.

A second bath, somewhat colder, produced shivering, the ears being cold, the skin livid. He shivered and did not react well. The count made just before the bath of twenty minutes showed only 3,250 (?) leucocytes, and two minutes after the bath showed 12,500, an enormous increase, which it is difficult to account for. The count after these two baths was not, as will be seen above, made under the same conditions; but a second count made fifteen minutes after the second bath, when Dr. Thayer was still shivering, still showed 10,250 leucocytes, threefold the original number.

Further investigations were made by Dr. Alois Strasser,* by request of Professor Winternitz. The blood was taken from individuals before rising, hence before taking food, and again at different periods following the hydriatic procedure. Examinations were made with care, and controlled so as to exclude error, as far as possible. Fleischl's hæmometer with 0.6 salt solution was used for hæmoglobin measurement, and the Thoma-Zeiss apparatus, 2.5 per cent bichromate-of-potassium solution for the red, and 0.1 per cent iced vinegar for the white corpuscles. The proportion of dilution of the blood was always 0.5 to 101. The individuals experimented on were healthy or slightly indisposed, and the countings were made by several assistants, and accepted only when they agreed. The result was (after all thermic and mechanical procedures acting upon the whole surface, as in cold sheet baths, plunges, half-baths, all kinds of douches, hot-air baths followed by cold procedures, alternating hot and cold [Scotch] douches, cold full baths with rare exceptions) an *increase of red blood cells* in blood taken from the point of the finger or lobe of the ear. The leucocytes, almost without exception, also increased, as did the hæmoglobin. The maximum increase of red blood cells amounted in fifty-six individuals to 1,860,000 in the cubic millimeter; the maximum leucocyte increase was almost threefold, the maximum increase of hæmoglobin fourteen per cent.

* Blätter für klinische Hydrotherapie, November, 1893.

The increase was not observed in all cases immediately after the procedure; often the count was made an hour afterward. It was remarkable that often an increase of leucocytes was observed, although the red blood cells had begun to diminish. Sometimes this increase could be observed two hours later, at which time, in most cases, diminution usually began. At what time the previous condition of the blood cells returns has not been determined. In isolated cases observed for a long time it did not return at all, but some increase of blood cells remained permanent.

Winternitz justly concluded that there can be no doubt of these changes occurring after all cold applications involving the entire body. Muscular exercise showed a somewhat similar effect.

After hot-air or steam baths "there was observed a diminution of the red cells in most cases, later followed in robust individuals by moderate increase.

Thermic applications upon parts of the body by cold foot baths, fan douches upon the thighs or knees, and sitz baths produced a diminution in red and white cells in the blood taken from the lobe of the ear, while in the parts struck by the cold water there was a decided increase of both.

That this increase of cells cannot be the result of recent or new formation is probable.

Error in these examinations is excluded by the fact that the same results were obtained almost constantly in sixty instances. Moreover, the increase is too great to be fallacious—1,800,000 red cells and 13,000 leucocytes to each cubic millimetre.

The fact that the number of cells gradually diminishes until the previous relation is established demonstrates conclusively that the effects are due to changes produced in the circulation, action of the heart, tone of the vessels and tissues. Under such favorable conditions as cold applications are known to bring about, blood cells are driven from organs in which stasis and accumulation of red and white blood cells have occurred.

That this increase in the cellular elements of the blood, which are the carriers of oxygen and carbonic oxide, may have a decided therapeutic effect is taught by these observations. They clearly explain the action of thermic influences applied to the surface of the body.

The vasomotor influence upon the composition and physical condition of the human blood has been recently made the subject of investigations by Knoepfelmacher.* These were undertaken in connection with the investigations of Professor Kraus in the second medical clinic of the university, on the vasomotor factors which are active in pyrexia

* Wiener klinische Rundschau, 1894.

and in their influence upon the blood. Dr. Knoepfelmacher examined the relation of the blood cells, hæmoglobin, and specific gravity resulting from such thermic influences applied to the cutaneous surface as produce pronounced contraction and dilatation of the vessels.

It is a well-known fact that section of the spinal cord above the origin of the sympathetic is followed by very intense and rapid changes in the circulation. Again, in animals thus treated irritation of the cord may produce contraction of the dilated vessels and raise the blood pressure above the normal. Section of the cord is followed in all cases by decided diminution of the number of blood cells; irritation of the nerves produces with the same promptness an increase of twenty-five per cent and over in the blood cells. According to Cohnstein and Zuntz, a similar effect is produced upon the leucocytes and the red blood cells. Contemporaneously with these changes in the blood cells there is a very decided change in the calibre of the smallest arteries and capillaries. Experiments with vagus irritation have shown that the change in the arterial pressure connected with these fluctuations is of relatively slight effect upon the blood cells.

Grawitz has studied the various results obtained from thermic irritants upon the vasomotors with a view to ascertain the fluctuations in the specific gravity of the blood. He found that sudden rapid temperature changes produced by cold douches, rubbings, or baths, caused an increase of the consistence of the blood, and that warm applications caused a diminution of the thickness of the blood. Grawitz believes that the contraction of the vessels produces a corresponding transudation of fluid from the vessels into the tissues, and thus concentrates the blood, while dilatation of the vessels induces the reverse process. Especially remarkable is the equalization of these fluctuations under the regulating activity of the vasomotor centre.

Knoepfelmacher endeavored to ascertain if these changes in the human blood, which have been shown to be due to mechanical conditions, alter our present conception of the physiological nature of leucocytosis.

For the purpose of obtaining decided narrowing and dilatation of the vessels, Knoepfelmacher also used the reflex excitation of the vascular nerves by warm and cold baths. It had already been established by experiment in animals that the cutaneous application of heat and cold is followed on reflex tracts by changes in the lumen of the vessel, even without change in cardiac activity. There are many drawbacks in applying these procedures to man, but Knoepfelmacher has made it very probable by comparative experiments that the changes in blood composition are at least not due to purely local changes in the blood concentration. He examined the blood drawn from the

finger points of normal individuals (always excluding digestion leucocytosis) half an hour before the bath, and again when relaxation was pronounced after the warm bath. The latter lasted eighteen to twenty minutes, the water having a temperature of 96° to 107° F. The cold baths were given from ten to twelve minutes at a temperature of 62° to 75°. The red blood cells were counted after Thoma Zeiss, the white after Thoma-Lyon; hæmoglobin by Fleischl's apparatus; and the specific gravity by Hammerschlag's method. The results of ten warm and cold baths seemed to be fairly constant; *after the cold baths the blood cells rapidly increased in number*, beginning two minutes after the bath was entered. The maximum increase was thirty per cent; a diminution ensued in half an hour; only in one instance the increase continued. The hæmoglobin and specific gravity of the blood were in agreement with this result. The white cells gave different results. In eight or ten separate trials *they increased eighty per cent more* than the red blood cells. This too, was transient; it ceased in half an hour. Very hot baths, with subsequent perspiration, were followed by an increase of blood cells, and a relatively greater one of leucocytes. Warm baths, which produced a decided dilatation of the visible vessels, caused in seven out of ten trials a reduction of red cells up to twenty-three per cent, combined with reduction of specific gravity. The leucocytes, on the contrary, showed a different result. Only in one observation did the number fall more than the red cells; otherwise there was a slight diminution.

E. Mangranti * made some experiments in the clinic of Professor Bozzole, in Turin, upon the changes produced in the blood cells by plunge baths and ice applications. His object was to verify the experiments of Thermes, Winternitz, Thayer, Rovighi, Murri, Pozzo, and Grawitz, because some of these seemed incomplete. Observations in thirty-six cases were made before and after application of water between 102° and 122°, and between 59° and 32°. The blood was counted by the Thoma-Zeiss method, the hæmoglobin ascertained by Fleischl's apparatus, and verified by the chromocytometer of Bizzen. Mangranti details the entire process, and gives his conclusion as follows:

a. The largest *increase of red blood cells*, often above two millions per cubic millimetre, during the period of largest dilatation of the cutaneous vessels, followed a protracted and intense application of cold as well as of heat, two opposing factors which closely unite in their final effect of congestion and stasis.

b. Reliable increase of erythrocytes during the period of vascular contraction ensued from application of cold.

* Giornale della Reale Accademia, October 10, 1895.

c. Diminution of erythrocytes, about one million to the cubic millimetre, ensued after brief application of heat.

d. The leucocytes shared the fate of the red cells only to a certain extent.

e. In many instances a diminution of hæmoglobin was found which did not correspond with the increase of the red blood cells.

Mangranti's results—increase of red blood cells, after hot as well as after cold applications, and the diminution of these cells after brief application of heat—prove conclusively that both heat and cold act as irritants, but that, the effect of heat being due to a relaxation of the vaso-constrictors, this fulness of the vessels ceases after brief applications; while, the plethora of the vessels resulting from cold applications, being due to a stimulation of the vaso-inhibitory fibres, reaction ensues which maintains the tone of the vessels.

II. Changes Produced in the Density of the Blood.—To demonstrate these changes Loewy * made experiments on rabbits. These were exposed in a roomy warming-box heated to from 30° to 36° C. (86° to 96.8° F.) for twenty-four hours. "The blood taken from the large vessels of the ears became more watery than is normal, despite the fact that evaporation by perspiration was great. The blood became thinner, as shown by the subjoined table:

TABLE OF BLOOD DENSITY UNDER BRIEF HEATING.

No.	Blood.		Blood Serum.		Remarks.
	Normal.	Heated.	Normal.	Heated.	
1	1047	1041	.....	.....	Heating lasted in Nos. 1 and 2, 10 minutes; in No. 3, 15 minutes; temperature, 140° F.
2	1052	1045.2	1025	1025.5	Number of erythrocytes, 6,231,000 to 5,446,000.
3	1050	1044.5	1025.5	1024	Number of erythrocytes, 5,660,000 to 4,820,000.
4	1044.5	1043.5	1020.5	1021.25	Heating for 5 minutes at 140°.
5	1046.5	1045.5	.....	.....	Heating for ¾ minute at 149°.
6*a*	1047	1045.5	.....	.....	Heating for ½ minute at 149°.
6*b*	.....	1042.5	.....	.... .	Heating for 2 minutes at 149°.
6*c*	.....	1044.5	.....	.....	Heating for ½ minute at 149°.
7	1043.5	1038.5	.....	.....	Heating for 2 minutes at 149°.

The body must have become poorer in water. In order to render this positive of proof, the quantity of water in the muscles was ascertained. In the majority of these experiments the muscles proved to be poorer in water, which Loewy regarded as due to the general removal of water from all the tissues. The plasma of the blood proved

* Berliner klinische Wochenschrift, No. 41, 1896.

to be increased. Warmth produces a widening of a large area of the circulatory system; the resistance offered to the movement of the blood, and consequently the blood pressure, is diminished. Thus a diminished transudation of plasma into the tissue and lymph spaces is brought about, resulting in an increase of the plasma in the blood. This, however, may not entirely explain it, because, although enlargement of the vessels causes a reduction of pressure in the smallest arteries, it does not necessarily follow that the pressure in the capillaries is also reduced, as is shown by Heidenhain and others. The extent of transudation of the blood plasma depends mostly upon pressure in the capillaries. Moreover, it may be that inasmuch as heat induces a greater giving off of water, chiefly from the lungs, this diminution of water reaches the arterial system, and the capillaries become poorer in water. Thus osmotic equalization processes may ensue, by reason of which fluid may transude from the lymph and tissue juices into the blood-vessels. But these osmotic processes, be they ever so extensive, cannot alone produce a thinning of the blood.

Although this thinning of the blood may not thus be absolutely proved, Loewy offers other evidence to demonstrate it. Eight rabbits were kept from one-half hour to fifteen minutes in a box whose temperature was between 148° and 150°. In each one there was a pronounced, often a very considerable, reduction of the density of the blood, which was quite as decided as after a retention for twenty-four hours in a box with a temperature of 86° to 91°. No difference in effect was perceptible between a warming of two hours and one of fifteen minutes. The number of red cells was diminished. The density of the serum was unchanged in these experiments. *Hence the influence of even very brief exposure to heat upon the composition of the circulating blood appears to be very considerable.* What processes account for these changes? There cannot be an absolute change in the quantity of corpuscular elements or of the plasma; the former cannot be absolutely diminished, and the latter cannot, in the brief time of the experiment, be so considerably increased. We must, therefore, accept these changes as occurring in the relative proportion of corpuscular elements and of water of the blood. Moreover, in these brief trials there cannot occur sufficient evaporation of water to increase the viscidity of the blood. No considerable stream of fluid can be made to flow by osmosis from the tissues into the capillaries; certainly not enough to increase the blood plasma. If this were the case even, it would not explain the impoverishment of the blood. Such osmotic processes have been shown by Cohnstein and Zuntz to occur very slowly; too slowly to accomplish the above purposes.

Loewy believes that the blood-thinning process may be best ex-

plained as follows: By reason of the increase of large areas of the capillary system, arising from dilatation of cutaneous vessels, a greater amount of corpuscular elements enters vessels which previously have been filled only with plasma (the vasa serosa) or which afforded room only for a small number of corpuscles. Those corpuscles only were withdrawn in large number from the larger vessels, the blood of which was used for the experiment; the blood thus lost formed elements; its density was diminished. The plasma displayed no change.

That changes in the tone of the vessels may produce such considerable and rapid changes in the composition of the blood as were shown by Loewy's experiments of a few minutes' duration, has been distinctly proven by the experiments of Cohnstein and Zuntz.

They found that the corpuscular contents of the larger blood-vessels depend upon the capillaries and upon the quantity of blood circulating in them; that conditions that narrow their lumina increase the corpuscles in the blood-vessels; and, reversely, that those conditions which dilate the capillaries produce a diminution of the blood corpuscles in the blood-vessels. For example, this effect is produced after section of the spinal cord during venous stasis and during muscular activity. Schoenburg and Zuntz ascribe the changes in the blood produced by high altitudes to changes in the tone of the blood-vessels, and the remarkable change produced by light upon the composition of the blood, as discovered by Fuller in Zuntz's laboratory, may also be attributed to the same cause.

All these factors are also connected with heat, which, in the same manner and with the same rapidity, induces a diminution of the corpuscular elements in the large vessels, and thus in the specific gravity of the blood.

There are many other investigations reported on the influence of thermic agencies upon blood composition, and they all refer to brief applications. Winternitz * reports that cold always concentrates the blood, which is condensed by increase of the number of red blood cells, while warmth produces in the majority of instances their diminution.

Knoepfelmacher † noted the same results. All three of these observers have always investigated the total blood in one part of the body. Despite the agreement in the results, their significance differs. All three of these authors ascribe them to the influence exerted by thermic agencies upon the muscular structure of the vessels—contraction of large segments of vessels by cold, relaxation by heat. Winternitz and Knoepfelmacher explain them by the theory that changes in the dimension of the vessels (besides changes in the circulation) produce changes of the cor-

* Centralblatt für innere Medicin, 1893.

† Wiener klinische Wochenschrift, 1893.

puscular elements, without regard to any changes in the fluidity of the blood. Winternitz further insists that the increase in the number of the corpuscular elements under the influence of cold is due to the fact that large masses of blood cells are driven into the general circulation from organs in which stasis or other accumulation of blood has taken place. In opposition to this view, Grawitz has repeatedly insisted that these results are due not to the condition of the corpuscular elements, but to that of the blood serum, inasmuch as the irritation of the vasomotors by cold and the resultant heightened blood pressure induce a transudation of water from the blood into the tissues, and thus the blood becomes more concentrated, the reverse being the case under warmth, which brings about a diminution of blood pressure and thus draws the water from the tissues into the vessels, inducing a thinning of the blood. This view cannot be accepted even under Cohnstein and Zuntz's observations, and Loewy's investigations in the density of the serum contradict it. He therefore agrees with Winternitz and Knoepfelmacher, who consider the chief agency in changing the density of the blood to be a changed distribution of corpuscular elements in the vascular system. That Winternitz's view that the inner organs take part in the process as well as the vessels of the skin is correct seems to be demonstrated by Breitenstein's investigation, which follows below. Loewy hopes to show by the publication of the results of these investigations the practical importance of those of Cohnstein and Zuntz, which have not been sufficiently recognized, but at the same time he emphasizes that for the purpose of clearing up the problems presented by the examination of the blood we should not limit ourselves to the determination of the relation of the blood at one or more points placed under the same conditions. In order to deduce conclusions of a general nature, we should, like Breitenstein, examine the blood of several vascular provinces, whose circulatory conditions are different, or we should examine, besides the total blood, at least one of the constituents, since the blood consists of water and cells.

Breitenstein * has published some observations which throw much light upon this interesting subject. He obtained the blood from healthy and sick individuals by a small incision into the lobe of the ear, gathering it without pressure. The individual lay on a sofa in an empty room, with body slightly elevated. After a rest of one-quarter of an hour the blood was obtained and examined with the most modern appliances. A bath of 77° F., of ten minutes' duration, was now applied, after which the individual again rested. The subjects were eleven healthy men and three chlorotic girls. In eight of these

* Archiv für experimentelle Pathologie und Pharmakologie, Bd. 32, 1896.

an increase of red blood cells was noted, in three an insignificant diminution, two of the latter being chlorotic girls. Thus was demonstrated the fact that cool baths produced an increase of red blood cells in the peripheral vessels. Winternitz had observed the same results, but these were from hydriatric procedures which produced energetic reaction in the skin. Breitenstein concludes that the slight reduction of the temperature plays no rôle, because in his experiments there was no relation to be noted between the lowering of the temperature and the increase of blood cells. This was confirmed by experiments with antipyrin, in which the largest temperature reduction was not always accompanied by the largest effect upon the red cells. Neither reduction of temperature, nor of respiration, nor of pulse furnishes any clew to the change in the corpuscles. New formation of the latter cannot be claimed, it being impossible that so large a number could be formed within an hour. According to Breitenstein, a change in the plasma, as argued by Grawitz, is scarcely to be thought of, because it is a well-known fact that it is very difficult to change the normal composition of the blood for any length of time. Where did these blood cells remain hidden? They could not be destroyed any more than they are destroyed in febrile conditions. There is no ground for claiming that the blood is thinned. They must have become lodged somewhere. Breitenstein sought for them *in the liver*, by taking the blood from the latter and from the ear at the same time, under all necessary precautions with regard to agitation, eating, etc., before and after the heating process. The blood cells were found to be equal in the ear and liver before the animals were subjected to the heating process; but after the latter there was an enormous increase of red blood cells in the liver, as is graphically shown in the following table.

EXPERIMENTS BY OVERHEATING THREE RABBITS.

No.	Weight in Grams.	Temp. of Rectum.	Number of Red Blood Cells in Millions.	Difference Between Blood from Veins of the Ear and Liver.	Hæmoglobin Per Cent Values.
I.	2,120	39.0° C.	Ear, 5,992	.....	11.84
	Temp. of hot box,		Liver, 5,840	− 152,000	12.12
	28–33° R.		Ear, 5,132	.....	10.72
	2,250	40.3	Liver, 6,250	+ 938,000	12.12
II.	1,880	38.9	Ear, 5,720	.....	12.40
	Temp. of hot box,		Liver, 5,896	+ 176,000	12.84
	28–30° R.		Ear, 5,996	.....	11.22
	1,900	40.5	Liver, 6,204	+ 908,000	13.28
III.	2,370	39.3	Ear, 5,440	.....	11.00
	Temp. of hot box,		Liver, 5,584	+ 144,000	11.32
	30–36° R.		Ear, 5,320	.....	11.32
	2,150	43.3	Liver, 6,112	+ 792,000	12.40

E. Tschlenoff * subjected six rabbits to a hot-air chamber of 42° C. (107.6) for five to six hours and found a loss of fifty per cent. in the leucocytes and no change in the hæmoglobin and red cells. This loss was compensated in twenty hours.

Experiments to Ascertain the Effect of Various Procedures upon the Blood Constituents in Health and Disease.

With a view to test the influence of various procedures in health and disease I instituted some experiments in the Hydriatric Institute, in which I was assisted by my son, Dr. H. B. Baruch, and in the Montefiore Home, which were conducted under my direction by Dr. Abramson, assisted by Dr. Talmey. The counts were made just before and within fifteen minutes after each procedure; with Deland's hæmatokrit in the Hydriatric Institute, and with the Thoma-Zeiss apparatus in the Montefiore Home.

In Hydriatric Institute.

Name.	Age.	Condition and Procedure.	Red Cells, Number to Cubic Millimetre.		White Cells, Number to Cubic Millimetre.		
			Before.	After.	Before.	After.	
Victor H. (masseur).	31	Healthy; hot-air bath. Followed by jet douche, at 80° F., 5 sec.	4,500,000	5,800,000	8,500	10,500	Blood from lobe of right ear measured with Deland's hæmatocrit.
Same.....	31	Healthy; jet douche, 80° F., 10 sec.	4,500,000	5,200,000	8,500	10,000	do.
T..... (doucheur)	32	Healthy; full bath, 80°F., 10 min.	5,000,000	5,800,000	9,000	10,500	do.

In Montefiore Home.

Name.	Age.	Disease and Procedure.	Red Cells—Number to Cubic Millimetre.		White Cells—Number to Cubic Millimetre.		Per Cent. of Hæmoglobin.	
			Before.	After.	Before.	After.	Before.	After.
William H.	24	Paralysis agitans; full bath, 95° F., 30 min.	6,491,666	5,444,444	6,000	11,600	120	110
Bertha D.	67	Paralysis agitans; full bath, 95° F., 30 min.	4,250,000	5,666,666	5,100	5,200	105	105

* Wratsch, 9 and 10, 1893.

In Montefiore Home.—Continued.

Name.	Age.	Condition and Procedure.	Red Cells, Number to Cubic Millimetre.		White Cells, Number to Cubic Millimetre.		Per Cent of Hæmoglobin.	
			Before.	After.	Before.	After.	Before.	After.
Nanette G.	..	Basedow's disease; wet pack, 60° F., 1 hour.	4,875,000	4,091,666	5,131	11,400	75	90
Matilda G.	16	Phthisis pulmonalis; hot-air bath until warm, followed by rain bath, 60° F., 30 lbs. pr. 1 min.	4,833,000	4,933,355	8,000	10,400	76	75
Mollie M.	58	Chronic nephritis; hot-air bath.	2,166,666	3,055,555	9,500	10,400	50	45
Augusta P.	31	Arthritis deformans; perspired in a hot-air bath 10 min.	4,450,000	4,980,335	6,400	9,400	80	80
Jenny L.	21	Hysteria; rain bath, 60° F., 30 lbs. pr. 1 min.	3,718,752	4,125,000	6,800	8,200	70	90
Lena D.	12	Chronic bronchitis; rain bath. 80° F., 30 lbs. pr, 1 min.	5,325,000	5,590,000	7,500	10,500	75	90
Annie S.	9	Rickets; circular (needle) bath, 60° F., 15 lbs. pr. 1 min.	3,321,666	3,575,000	7,500	11,000	83	80
Lizzie B.	30	Chronic gastritis; circular bath, 80° F., 15 lbs. pr. 1 min.	4,112,500	5,366,666	8,000	8,000	90	95
Nathan B.	28	Neurasthenia; jet douche, 60° F., 15 lbs. pr. 20 sec.	4,525,000	5,683,333	8,600	8,600	100	105
Julius D.	38	Friedreich's ataxia; jet douche, 80° F., 15 lbs. pr. 20 sec.	4,691,666	5,375,000	9,600	8,600	105	105
Joseph B.	40	Dilatatio ventriculi et neurasthenia; jet douche, 45° F., 15 lbs. pr. 10 sec.	4,133,333	4,658,333	8,200	8,200	100	100
Rosa G.	42	Locomotor ataxia; jet douche, 95° F., 30 lbs. pr. 20 sec.	4,683,300	4,641,000	14,375	9,400	100	95
Minnie G.	44	Multiple sclerosis; jet douche, 95° F., 30 lbs. pr. 20 sec.	4,783,300	4,958,333	5,419	6,800	85	85
Lillie F.	29	Tabes; jet douche; 110° F., 20 lbs. pr. 30 sec.	5,262,000	4,216,666	4,500	8,400	80	90

Changes in the Chemical Constituents of the Blood.

Alois Strasser has undertaken to study the chemical reaction of the blood under thermic applications. The experiments made upon himself and Dr. Kuthy are detailed in the *Deutsche Medizinal-Zeitung*, June 15th, 1896. The results are briefly summarized as follows: After all *warm or hot hydriatic procedures* (chiefly baths of about 110° F.), an increase of the relative quantity of acid phosphate was invariably noticed; most often it was considerable (once over one hundred per cent).

After cold procedures the relative quantity of acid phosphate was diminished, the greatest diminution was after half-baths (about fifty per cent.); small diminution followed the douche, cold sheet, or plunge in a bath of about 48° F. The blood was taken under anæsthesia from one femoral artery before and from the other after the experiment. The result showed a diminution of blood alkalinity after hot baths, and an increased alkalinity of the blood after cold baths.

Pokrowsky* demonstrated by his experiments that the assimilation of nitrogen-containing foods is increased by *hot-air baths*, the quantity of fæces and of nitrogen contained in it is diminished, and the body weight is increased (?).

Gussero† claims also an enhancement of nitrogen change *after hot baths.*

Conclusions.

From all these experiments and observations upon the influence of hydriatic procedures in health, made under fairly reliable conditions and precautions, by different investigators, it may be gathered, despite some difference of opinion and deductions, that the *changes produced by the thermic and mechanical stimulation arising from hydriatic procedures are very intense and far reaching.* The inference is as clear as day *that an enormous influence must be exercised by procedures which impress such changes upon the calibre of the vessels, the action of the heart, and the composition of the blood in health; and that its effect in disease must be equally pronounced.*

To guide and direct this effect into the proper channel and evoke such changes in the circulation as would remove stasis, fill certain vascular areas, and deplete others—are the aim of judicious hydrotherapy.

The enormous power for good or evil with which the physician is thus armed has, we trust, been made evident by the experiments detailed above.

* Wratsch, No. 9, 1893. † Wratsch, No. 39, 1893.

Influence of Hydriatic Applications upon the Respiration.

It has been clearly shown that all water applications considerably below or above the body temperature act as thermic irritants. Physiologists agree that the respiratory centre is most easily affected by nervous impulses conveyed to it from various parts of the living organism. Impulses from almost every sentient surface or passing along almost every sensory nerve may modify respiration. Weak stimuli tend to augment the action of the vagus, and strong stimuli to inhibit it. The influence of stimuli applied to the skin is peculiarly intense, as is evidenced by the universal use of cold and heat applied to the skin for purposes of resuscitation of the newly born.

There are probably two sensory tracts of nerve fibres passing from the cutaneous surface to the respiratory centre; viz., fibres for inhibition and for excitation.

When a very cold or a very hot bath is entered, a deep inspiration is initiated, which is interrupted by spasmodic efforts. If the bath is continued, compensatory agencies regulate the respiratory movements and the circulation adapts itself to the changed condition in the blood distribution. The greatest irritation of the respiratory centre is produced by cold applications, especially upon the chest and abdomen. The phrenic nerve probably is irritated in these cases, giving rise to spasmodic action of the diaphragm, which seems to threaten cessation of breathing. As soon, however, as more arterial blood reaches the respiratory centre, as the result of the increased flow of blood from the periphery, this spasmodic action ceases nd the respiratory efforts adjust themselves to the changed conditions. The respiration remains deeper for a considerable time. As a result, Winternitz and Pospischl have shown an unmistakable increase of CO_2 elimination. *

Exposure of the naked body to cold produces, according to Friedrich, † a decided increase of oxygen consumption, in proportion to the intensity of the cold. The projection of cold water upon the body also produces an increase of oxygen consumption and CO_2 excretion in warm-blooded animals.

According to Wick, ‡ who experimented upon himself, the hot bath influences the respiration peculiarly. Even at 102° F. the frequency of respiration was diminished; it became deeper, and remained partially so in the subsequent packs. In baths of 107.5° F. to

* "Neue Untersuchungen über den respiratorischen Gaswechsel unter thermischen und mechanischen Einflüssen," 1893.

† Hayem: "Leçons de Thérapeutique," vol. i., 1894.

‡ "Ueber die physiologische Wirkung verschiedener warmer Bäder," Wien: Wilhelm Braumüller, 1894, p. 150.

111° F. a sense of constriction occurred, connected with a feeling of tightening of the larnyx, which ceased at once when the neck was raised out of the water.

Hot baths regularly produced a marked retraction of the abdomen, which increased with the heat. This seemed to be a reflex manifestation, like the slowing of the respiration. The latter may be due to the influence of changed blood upon the respiratory centre. But the reflex theory is more probable, as the retraction is brought about by the dipping of the peripheral nerves into the hot water, without the other symptoms occurring. The phenomenon is remarkable, because, under the influence of heated blood upon the respiratory centres, there is usually rapid and shallow breathing. Probably both causes are at work, for prolonged response to the hot bath may weaken the reflex and allow the heat alone to operate. Topp found the respiration decidedly quickened and staccato fashion in a bath of 113° F. to 115° F.

Baelz, who has written fully upon the Japanese hot baths, says that the respiration is at first little affected, but becomes more frequent and shallow, an experience which I have frequently verified. The dyspnœa produced by heat has been shown by Claude Bernard to be due to reflex action exerted by the heated blood upon the respiratory centre. Frick and Goldstein produced dyspnœa by allowing water at 158° F. to circulate around the carotid arteries of animals.

Prolonged hot baths, which tend to raise the body temperature, also accelerate the respiration and render it more shallow. Numerous experiments made in the Hydriatric Institute upon the healthy male attendants, and upon patients under treatment for various diseases which did not preclude their following their vocations, showed the author that the impingement of water at ten or more degrees below the normal body temperature produces sudden spasmodic inspiratory efforts, which seem to be checked immediately after being initiated and often alarm the person exposed to it. Very soon, however, if mental agitation subsides and equilibrium is established, the inspiration becomes deeper and the expiration proportionately more active. The respirations are increased in number during the bath if it be very cold, unless shivering is induced, which produces staccato breathing. After the cold bath or douche respiration is affected by the extent to which reaction ensues. If the latter be good the respirations become much deeper, the patient feels that more air enters the lungs. For this reason *all cold hydriatric applications should be followed by moderate exercise in fresh pure air.*

If the mechanical influences of certain hydriatic procedures are added to the thermic, as in douches, for instance, the effect upon the respiratory centre becomes enhanced. The same influences are exerted

by thermic and mechanical irritants upon the respiration, which have been more fully referred to in connection with the circulation; the chief difference to be observed lies in the greater sensitiveness of the respiratory centre, and its more ready response to excitation from the periphery. The latter offers a fertile field for further experimentation for the purpose of ascertaining the precise influence of moderate and gradually increased hydriatric applications to the periphery, upon the respiration and its functional dependencies. In disease, the results of such experimentation would be extremely useful. We have a crude exemplification of these virtues in the application of hot or cold plunges and in affusion in the broncho-pneumonia of children, in which, perhaps, the chief effect arises from the stimulus conveyed through the sensory filaments from the skin to the respiratory centre, which, being overwhelmed by the disease, fails to respond to the increasing demands made by accumulation of CO_2 in the blood. Deepened inspiration and forcible expiration produce expulsion of retained secretions. The more precise adaptation of definite temperature to such and to similar conditions may be learned from extended experimentation on the influence of thermic and mechanical irritants upon the respiration, which it shall be my aim to study at some future time.

Influence of Hydriatric Procedures upon the Muscular System.

This interesting subject has until recently received insufficient attention. It has been well worked out by two Italian physicians, Vinaj and Maggiori.* These experiments are regarded by all who have felt interested in the scientific development of hydrotherapy so valuable a contribution that a detailed account of them must add to the explanation of the *rationale* of various hydriatric procedures. They are cited *in extenso*, at this point, because they lend greater force to the true explanation of the action of the douche. The authors gave an account of the experiments in an open letter to Professor Mosso, the well-known Italian physiologist. They undertook a series of investigations with the ergograph, invented by Mosso, in order positively to establish the effect of the most important hydro-therapeutic procedures upon the resistance of the muscles to fatigue. At the present time exact investigations upon this subject, which is important from a hygienic as well as from a therapeutic standpoint, are wanting. The stimulating or depressing effect on the muscular system produced by many of

* Blätter für klinische Hydrotherapie, 1892, vol. ii., No. 15, and vol. iii., No. 7.

the most commonly used hydriatic applications has not entirely escaped the great masters of medicine, but the little which is known up to the present time is the result of the simple subjective and direct observation of the manifestations without any experimental proof to demonstrate the correctness of this subjective observation. Experiments made with the dynamometer cannot be regarded as scientifically exact, because of the numerous sources of error connected with this instrument. The following diagrams represent graphically the results of these experiments with Mosso's ergograph. The normal "fatigue curve" was ascertained by several applications of the ergograph upon the flexor muscles of the middle fingers of both hands, the instrument

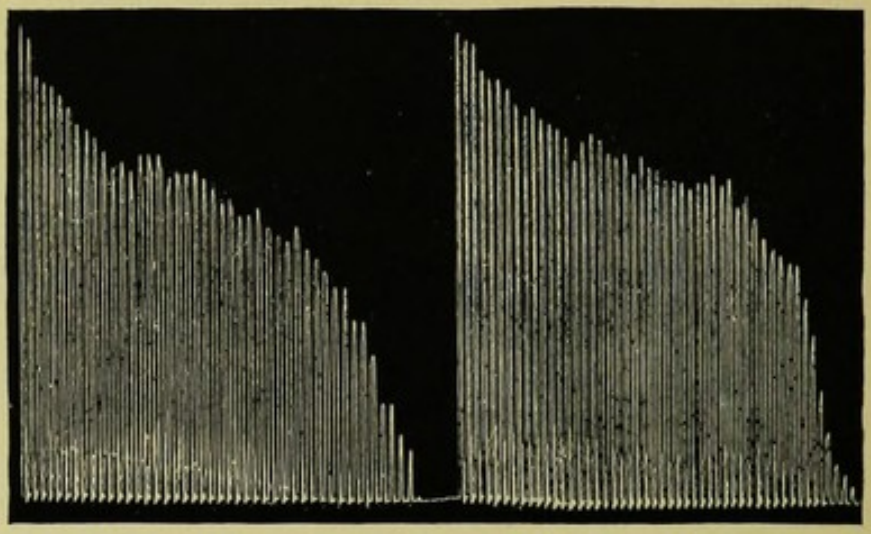


FIG. 10.—Normal Fatigue Curve, Left Hand.

FIG. 11.—Normal Fatigue Curve, Right Hand.

carrying a weight of three kilograms, and registering the contractions every two seconds. The same conditions were observed in all subsequent observations. Two and a half hours after this "fatigue curve" had been registered, the individual was placed in a tub containing water of 50° F. (10° C.) for fifteen seconds. He was now dried, wrapped in a woollen cloth, and the "fatigue curve" of the right and left middle finger taken. This experiment was repeated three times during the day; out of eight "fatigue curves" thus obtained the following are selected (Figs. 10 and 11). These curves indicate (the figures given are here omitted) the extent of the work furnished by these muscles. The middle finger of the right hand, contracting with the greatest exertion until completely fatigued in order to raise a weight of three kilograms every two seconds, was capable under normal conditions of completing fifty contractions, corresponding to mechanical work of 5,139 kgm.; while after the cold bath the same muscle could complete seventy-four contractions before it was fatigued, which cor-

responds to a mechanical work of 9,126 kgm. This simple and exact experiment demonstrates that the cold bath produces a considerable increase of the working capacity of the muscles.

The diagram indicates that in the normal fatigue curve (Fig. 12) there is a gradual lowering of the lines, each line showing the extent of the contraction. A gradual weakening of the muscles is evident, at first followed by a rapid diminution of strength. It will be seen that the "fatigue curve" after the cold baths differs decidedly from this normal curve, as it shows the continuation of muscular power for nearly one-half of the period, and its very gradual diminution to the end.

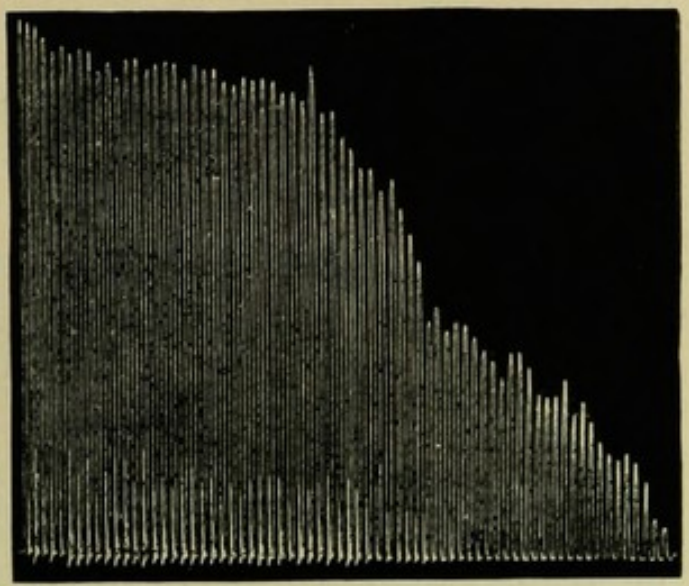
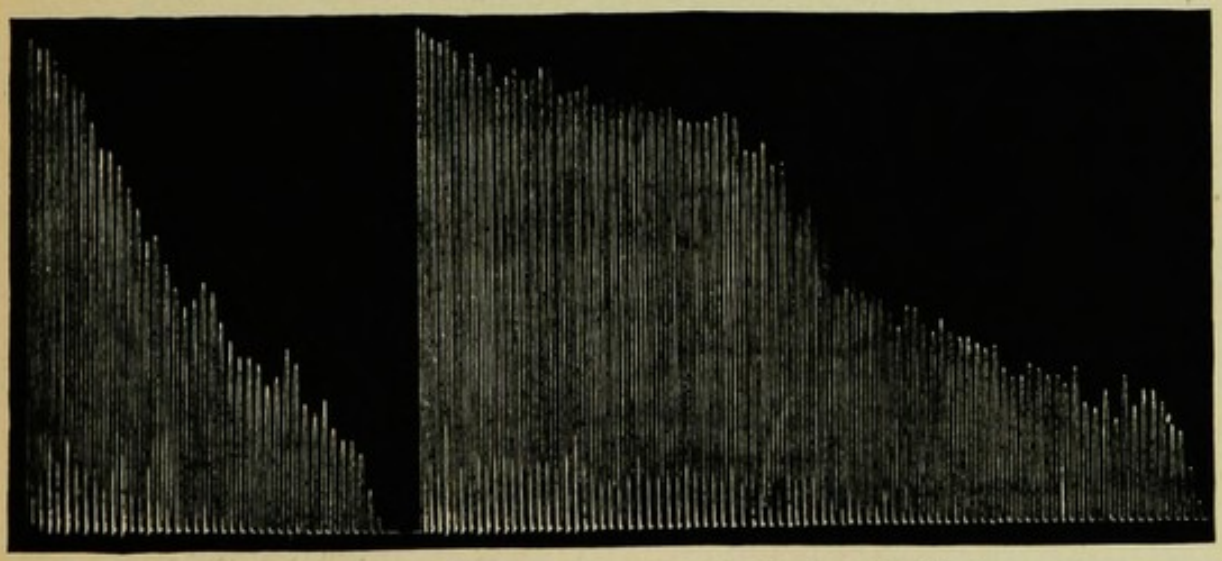


FIG. 12.—Fatigue Curve, Right Hand, after bath, 50°, for 15 seconds.

The gradually cooled bath furnished an interesting "fatigue curve." The water had a temperature of 96.5° F. when the individual, a student of medicine, twenty-seven years of age, entered it after his "fatigue curve" had been noted. Five minutes elapsed, when the outflow



FIGS. 13 and 14.—Fatigue Curves after Gradually Cooled Bath.

was opened and cold water was admitted, until the temperature of the water was 68° F., and the man felt slight chilliness. Upon emerging from the bath the fatigue curve was again taken. The above diagrams represent the effect of this bath (Figs. 13 and 14).

The average result of several trials shows that the flexor of the left middle finger, which before the bath was capable of making thirty-nine contractions, corresponding to 3,603 kgm. of work, yielded under the same conditions after the gradually cooled bath (96° to 68°) eighty-seven contractions, equal to 9,349 kgm. of work. This plain enhancement of working capacity is shown clearly also by the change in the form of the "fatigue curve." Before the bath the curve 8 shows high contraction, which fell regularly and slowly toward the middle; slight fluctuations in the raising capacity then ensues, indicating change in the contracting capacity; then the latter sinks regularly but much more slowly. After the bath the lines show a nearly even height for a long period; then a slow lowering ensues, gradually ceasing. The studies of Vinaj upon the cooled bath have shown that it increases the tone of the vessels. The present experiment demonstrates how powerfully the resistance to fatigue is enhanced in the muscles, and that this effect depends upon the thermic as well as upon the mechanical action of the procedure. So far as the former is concerned, cold increases the muscular working capacity, while warmth, when not combined with a mechanical effect, diminishes muscular power, as is well known. When, however, warm procedures are combined with mechanical effects, as in ablution, douches, and rubbings, there ensues a distinct elevation of the muscular capacity, which is always less than that observed after cool and still less than that observed after cold or alternating procedures. These effects will be more clearly delineated by diagrams when the *rationale* of douches is reached.

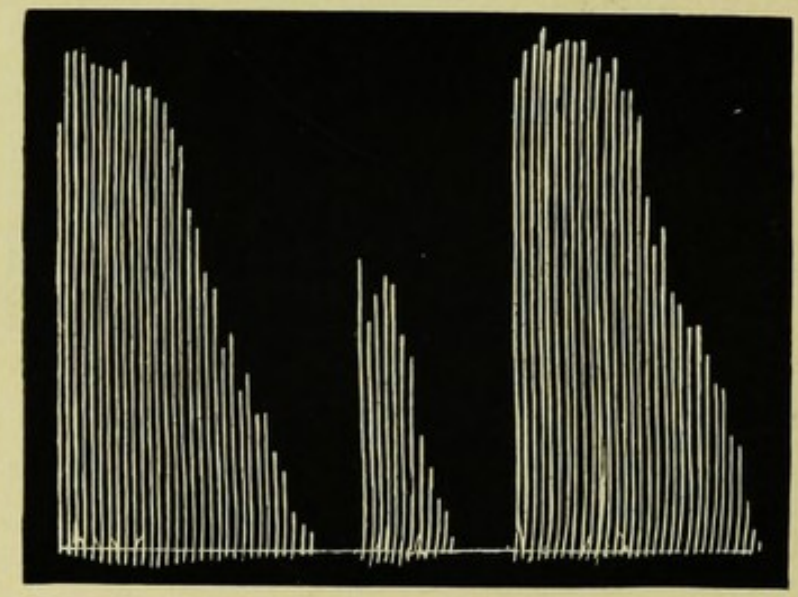


FIG. 15 FIG 16 FIG. 17

FIGS. 15, 16, and 17.—Effect of Gradually Cooled Bath upon the Fatigue Curve. Fig. 15, normal curve; Fig. 16, after active work; Fig. 17, after active work and bath.

A complete separation of the purely thermic action from the mechanical is not reached by these experiments; it appears, however, that the maximum effect may be reached by cold applications. Not alone do certain hydriatic procedures increase the working capacity of

the muscles; they also restore the latter when it has been used up by exercise or labor.

The effect of hydriatic procedures upon *muscles which have been fatigued* is well brought out by later experiments of Vinaj and Maggiora.* Their diagram shows the effect of a general cold bath upon the flexor muscles of the right middle finger with a weight of four kilograms and a rhythm of two seconds similar to Figs. 15, 16, 17, and demonstrates that the effect of fatigue is entirely removed by the cold bath.

The effect of rubbing with a cold sheet, upon the capacity of work of a muscle which has been fatigued, is graphically shown in the subjoined diagram by Vinaj and Maggiora (Figs. 18, 19, 20).

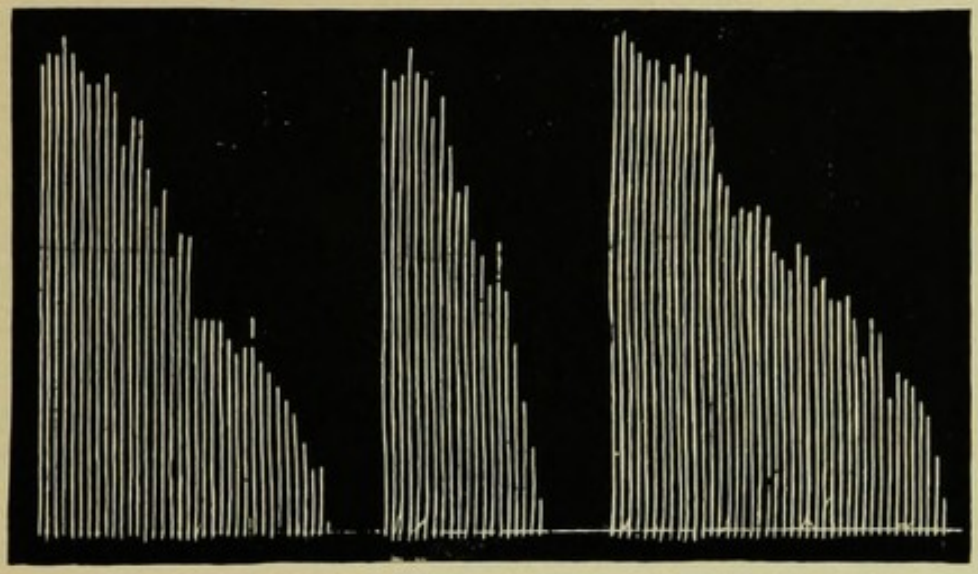


FIG. 18.—Normal Fatigue Curve. FIG. 19.—After Labor. FIG. 20.—After Wet Sheet.

This diagram shows not only a removal of the fatigue but the establishment of a muscular capacity superior to that shown by the diagram representing the normal "fatigue curve."

INFLUENCE OF HYDRIATIC PROCEDURES UPON TISSUE CHANGE.

The influence of hydriatic procedures upon the circulation, respiration, and temperature has been fully detailed. It has been shown that the effect of these procedures is far reaching; that not only the quantity of blood but its composition also in various organs and parts of the body are controlled and that muscular activity is enhanced. Since functional activity is the chief agency in producing tissue change, and this functional activity depends upon the blood supply in the organs,

* Blätter für klinische Hydrotherapie, July, 1893.

we may by influencing the latter readily exercise a powerful effect upon the former.

That thermic and mechanical irritation applied by means of water upon the cutaneous surface does arouse cell activity and does affect tissue change has been very generally accepted. Proof is not wanting that this well-recognized fact is based upon substantial experimental data. Many laboratory experiments have been made with a view of furnishing actual demonstrations of the influence of hydriatic procedures upon tissue change. Among these may be mentioned the classical experiments of Liebermeister and Goldmeister, showing a constant increase of CO_2 production after the application of cold. These deductions have been confirmed by Roehrig and Zuntz,* by their careful experiments in the Bonn Laboratory. Not only was Liebermeister's idea found correct, but it was clearly shown that the consumption of oxygen was subject to changes depending upon the temperature of the surrounding medium. Roehrig and Zuntz found that changes in the intensity of tissue metamorphosis appeared to be traceable to certain cutaneous nerve fibrils, which were excited by cold. These nerve fibrils could also be aroused by other stimuli, such as strong salt baths, with the same effect of increasing tissue change. An interesting point in connection with these experiments was that these increased oxidation processes seemed to be located in the muscles, through their nerve supply, and that the muscles need not, for this purpose, be aroused sufficiently to produce visible contractions. This was made evident by experiments made upon animals in which the innervation of the muscles was placed in abeyance by arrow poison. In such animals tissue change was not only not increased by cold but was even reduced one-half.

Roehrig and Zuntz concluded that the source of tissue changes in the animal economy when affected by cold lies in the innervation of the muscles, and this is confirmed by the trite physiological fact that the larger part of all combustion processes occurring in the animal body may be traced to the muscles.

The most recent conscientious and painstaking contribution to this subject is the excellent monograph on the behavior of tissue changes in hydriatic therapeutics by Dr. Alois Strasser, the intelligent and learned assistant of Professor Winternitz in the Allgemeine Poliklinik of Vienna, whose views I propose to reproduce as fully as space will permit.

Strasser refers to the fact which I have elsewhere insisted upon, that the action of all thermic irritants is reflex. The contraction of the peripheral vessels followed by the elevation of the tone of the vessels

* Pflüger's Archiv, 1871.

in the muscular tissues; the increase of cardiac activity by the reflex invigoration of the heart muscle through the increase of resistance in the circulation; the deepening and increased frequency of the respiration—all these are, as he correctly states, reflex processes, by reason of which a powerful change is produced in the biochemical functions of the organism.

"The entire exchange of products in the organism produced by the building up and destruction of its component elements is the effect of the vital activity of the cell, whose function we may trace in its various changes and gradations by means of more or less complicated methods, chiefly by investigating the end products arising from the destruction of tissues. These methods were also necessary in order to determine the changes produced by thermic irritants throughout the entire course pursued by the processes involved in tissue change. Winternitz and Pospischl have shown the influence of thermic irritants upon the respiratory exchange of gases; they found in the very decided increase of oxygen consumption and CO_2 elimination evidence that the oxidation processes in the body were powerfully enhanced by these influences.

"Bartels was the first to ascertain the behavior of urea under the influence of vapor baths. He increased the temperature of a man by exposing him from twenty minutes to an hour and a half to a hot vapor bath, to a point beyond 40° C. During the first days of this artificial heat retention there was a pronounced diminution of urine down to 600 c.c.; the excretion of urea appeared to be increased; but on the fourth day, when the urine had gone down to 400 c.c., the first diminution was noticed in the urea excretion; on the fifth day, however, after the bath had been discontinued, the urine again increased up to 1,900 c.c., which was accompanied by an increased excretion of urea. Every rise of body temperature must be accompanied by an increased destruction of the elements of the organism, oxidation processes having, according to Naunyn, great similarity to fermentation processes, whose activity is in accordance with the height of the temperature. The result of Bartels' experiments confirmed this, inasmuch as the urea fluctuated between 21.9 and 24.9 gm. between the beginning and the termination of the bath period, while the largest amount of urea during the bath days was 34.6 gm. Naunyn confirmed Bartels' findings by a demonstration of the effect of simple heat retention in a poodle weighing 17.8 kgm., which produced a decided increase of urea (about fifty per cent). The same results were obtained by Schleich, who experimented on himself and two other individuals with warm baths of 39° to 42° C.; he discovered an increase of the entire nitrogen and urea excretions, which was followed after a time by diminu-

tion of nitrogen excretion in the effort to restore the disturbed nitrogen equilibrium. Kosturin, Godlewsky, and Richter confirmed these results. Senator and Makowiecky reached opposite results.

"Formanek made some positive experiments to settle this question. He increased the temperature of the body by a hot-air bath of 65° C. for twenty minutes, followed by a vapor bath of 41° for fifteen minutes and terminated by a lukewarm douche. He ascertained that one hot-air bath or vapor bath scarcely changed the nitrogen, but that after two such baths had been taken on successive days a decided increase of nitrogen elimination was observed on the second bath day, which continued to the following day. Five hot vapor baths, taken during three days had a similar effect. It would seem, therefore, that much depends on the duration and intensity of the temperature elevation produced by the bath, which would explain the somewhat differing observations previously made by others. The urea excretion kept pace with the movement of nitrogen; that is, when nitrogen was increased the uric acid was excreted in greater quantity. The examination of the blood showed each time diminished leucocytosis. (This result is in accordance with experiments of Lowey and Breitenstein, p. 56.)

"Experiments with cold baths upon the influence of tissue change are not so numerous, but the results almost completely agree.

"Dommer found an increase of nitrogen elimination after a bath of 8° to 10° R., lasting half an hour; the same result was obtained by Flavard and Lepine in starving dogs, in which a very considerable increase of nitrogen elimination was produced by a bath of 4° to 2.5° C., lasting fifteen minutes.

"Formanek made some exact observations on this point also on a medical student. The results of these examinations, made with great care in order to eliminate errors, were as follows. After a single cold bath the excretion of nitrogen was scarcely changed, but when two cold baths daily were given on three successive days, so that a more decided abstraction of heat took place, the elimination of nitrogen in the urine increased markedly on the bath days—from 13.43 to 14.51 gm. The sum of all the nitrogen excreted by urine and fæces was nearly 1.5 gm. larger than on the normal days, but it exceeded the quantity of the nitrogen taken in, so that during the six bath days an average of 0.59 gm. of nitrogen taken from the body albumin was excreted. The excretion of uric acid generally kept pace with the excretion of nitrogen. These experiments of Formanek are the only ones which reliably represent the influence of heat abstraction upon tissue change."

Strasser correctly insists that "all these experiments had for their object only the heating and cooling of the body, and, therefore, can

have weight only as purely experimental physiological or pathological observations. They represent only partially those conditions which are in operation when thermic procedures are used for therapeutic purposes. The differentiation between brief and longer thermic irritations is lacking in these observations. Such, however, is imperatively necessary in judging their physiological action. A short application of cold must certainly act differently from a longer one; the former is followed by reaction, contraction of the cutaneous capillaries, and an active hyperæmia, while after a longer application, such as after cold baths of three-quarters of an hour, a veritable spasm of the cutaneous vessels ensues; after which the circulation in the periphery is restored much more slowly and tissue change is probably influenced not only quantitatively, but also qualitatively in a quite different manner. Therefore these experiments which energetically abstract or increase heat are not calculated to explain the effect of the usual hydriatric procedures. Our therapeutic procedures have a more or less combined effect, as douches, in which it is impossible to judge each of its component elements—duration, force of impact, etc., upon the tissue changes. Just as in the douche the chief effect is a thermic massage, we have in other procedures, as in half-baths, the co-operation of a second individual, who, by a mechanical effect, adapted to the case, contributes to the reaction obtained from the peripheral irritation."

With true scientific insight into all the elements of this problem, Strasser made some investigations for the purpose of obtaining a correct idea of the total effect of the various factors involved in the water treatment. He subjected two individuals to cool and cold procedures such as are usually applied in hydrotherapeutic institutions. Without paying regard to the changes of temperature produced by them, he confined himself to ascertaining their effects upon tissue metamorphosis. He refers to similar investigations made by Russian physicians upon the effect of temperate (33° C.), cold (15° C.), warm (40° C.), and Scotch douches (45° to 15° C.), of four minutes' duration. These showed an increase of nitrogen change, principally after the Scotch douche and the cold douche. The N assimilation was increased about 1.84 per cent in four cases reported by one of these observers, after cold douches (17° to 25° C.).

Strasser subjected two young men, eighteen and twenty-eight years old, to an experiment, measuring the daily amount of nutriment, the urine, the fæces, etc. The principal procedure used was the half-bath, which abstracts most heat because the surface of the body is longest in contact with the cold water and the mechanical action is comparatively slight as compared with douches, etc. As is usual, the

patient was dried after each procedure and exhibited a good reaction at once.

Without entering into the detailed results of each examination, and omitting the tables accompanying the report, which seemed to have been compiled with the greatest care and skill, we will relate the results.

"The *excretion of nitrogen was decidedly increased during the bath period.* The organism did not respond to the first attack of the peripheral thermic and mechanical irritation with the largest excretion of nitrogen; only on the second day did the greatest reaction occur and the irritation reach its highest point of effect. In the other case there was at once a rapid and powerful rise of N excretion. The maximum increase amounted on the first day to 32.2, the minimum on the third day to 11.33, the average being 16.43 per cent.

"This increased N excretion must be ascribed directly to increased activity of the organism—a more active change of nitrogen in the sense of the better utilization of the food. The promptness with which this effect occurred is evidence of this fact, as is also the circumstance that the fæcal nitrogen was diminished at the same time that the urine nitrogen was increased—a condition which was uniform in both trials."

In a second series of observations made to confirm or reject the findings of the experiments referred to, Strasser* formulates his results as follows: "Hydriatic procedures constantly increase the assimilation of nitrogen, the increase differing in intensity in different individuals; a diminution of body albumin does not necessarily occur if the nutrition is sufficient, but on the contrary even during the procedure albumin may be added. Reaction does not seem, in the majority of cases, after a duration of three days' treatment to exceed the effect of this stimulation. Nevertheless a larger number of clinical observations have established the fact indubitably that assimilation is decidedly and enduringly enhanced by water treatment, provided the latter is sufficiently prolonged."

Urea.—The most important final product of N tissue change is urea, being the result of vital activity of the cells in general. As the largest ultimate ingredient of the urine, urea is subjected to all the coarse fluctuations of N excretion; hence the absolute quantity of urea in Strasser's cases was decidedly higher on the days of large N excretion. The largest increase in the first case was 18 per cent, the aver-

* "Fortschritte der Hydrotherapie. Festschrift zum vierzigjährigen Doctorjubiläum des Prof. Dr. W. Winternitz," herausgegeben von Dr. A. Strasser und Dr. B. Buxbaum. Wien: Urban und Schwarzenberg, 1897, p. 249.

age 10 per cent; the largest in the second case was 25 per cent, the average 21.1 per cent.

The rise of urea during the bath period is explained by Strasser by the increased supply to the organs concerned in preparing urea, brought about by the more active circulation arising from reflex irritation; the fact that the relatively increased urea production lasts beyond the N increase he regards as evidence that the increased capacity of the organs and cells concerned in preparing urea, which is aroused by the thermic and mechanical irritation of the skin, continues as a kind of heightened tone even after the original irritation has ceased.

Uric Acid.—Our views of the nature of uric-acid formation and excretion have recently been modified. While formerly uric-acid formation was regarded as standing in a causal relation to the quality of the food, and it was regarded in the same light as urea, as an end product of albuminous tissue change, the doctrine of the formation of uric acid from the nuclein bases has become more prominent recently. The absolute quantity of uric acid was increased, in the first case, during the bath period as much as 30.6 per cent, the average increase being 20 per cent, and on the day after the bath period there was a further increase of 6.8 per cent; a total, therefore, of 35.4 per cent. In the second case we have a very considerable absolute increase of uric-acid excretion without any changes of relation to the total nitrogen.

The largest absolute increase during the bath period was 27.5 per cent, the average 19.1 per cent; in the after-period it fell 11 per cent, so that there was still a plus of 8.2 per cent over the period before the bath. The relative proportion to the total nitrogen remains about the same in all periods, which points to a parallel course and therefore to a similar reaction of the applied irritant.

According to Horbaczewski, we must regard the formation of uric acid as directly depending upon the breaking up of white blood corpuscles. It is therefore not difficult to account for it by the breaking up of the leucocytes which follows the abundant leucocytosis produced by peripheral irritations through cold (as has been demonstrated in hundreds of cases).

Phosphoric Acid.—This constituent of the urine is derived under normal conditions chiefly from the food; the equilibrium of phosphorus may be easily maintained in man by a regular supply of it.

We may obtain a key to the physiological progress of digestion and of the processes of destruction of certain albuminoid body elements during the period of excretion from the relative proportion of P_2O_5 to the total nitrogen. In both cases the large absolute and relative increase of phosphoric acid during the bath period on the one hand, and

the sudden rise of the relative P_2O_5 quantity on the other hand, are striking. In the first case the largest increase occurred on the first day, reaching one gram (about 44 per cent), the average quantity during the bath period being increased by 35.5 per cent; and the plus increase after the bath period still was 15.5 per cent. The absolute increase of elimination in the second case was on the second day, amounting to 26.3 per cent; the average increase during the bath period was 23.8 per cent; in the after-period the quantity excreted was still 14.4 greater than before the bath period.

Strasser claims that the relative increase of P_2O_5 after hydriatic procedures is due to the increased breaking up of phosphorus-containing organisms, and he regards the blood cells, which are rich in nuclein or lecithin, as the source of the excessive phosphoric acid; in other words, the breaking up of blood cells furnishes the P_2O_5.

According to the investigations of Winternitz and other observers, it has been positively ascertained that thermic irritants, especially cold, acting upon the periphery, produce a very pronounced increase of cells, whether this takes place in the liver or elsewhere, and thus the increase of the products arising from the destruction of the blood cells may ensue. Uric acid and phosphoric acid may originate in the nuclein arising from the nuclei of the leucocytes; phosphoric acid may also arise from the lecithin of the red blood cells. Thus may be explained the greater increase of phosphoric acid over that of uric acid, inasmuch as the former can be produced only by the comparatively few leucocytes, while the latter comes from both kinds of cells.

Moreover, it is possible that red blood cells may break up, even in the circulatory tract, as has been shown by numerous investigations on paroxysmal hæmoglobinuria, in which all authors agree that the blood cells are directly destroyed under the influence of cold.

In the last experiments* Strasser discovered that only a small proportion of the increased phosphorus excretion originates in destruction of tissues. It appeared from these that a considerable increase of this excretion is to be ascribed to a greatly enhanced absorption of nutritive phosphorus from the intestinal canal, and that only a small amount (averaging 0.018 gm.) is derived from the tissue elements. Strasser extended his observations in order to ascertain the character of phosphorus increase, and discovered the peculiar fact that the entire increase is in the alkaline phosphates and that the earthy phosphates remain unchanged even during the bath period. It remains therefore established that the absorption of phosphoric acid is intensely enhanced by hydriatic procedures. That this increase concerns only the alkalies does not controvert this fact. Indeed, it becomes valuable

* *Loc. cit.*

in ascertaining the source of the small remnant of phosphorus which does not seem to be covered by its diminution in the fæces. As the remainder consists only of alkaline phosphates, it cannot come from the bones, but, as shown by the first experiments, its source is in the destruction of blood cells.

Ammonia.—This constituent of the urine is a product of general albumin changes. In these experiments there was an absolute as well as a relative increase of the excretion of ammonia, but the relative increase, which has great significance, was, especially in the second case, much less than might be expected after the great increase of the total tissue change, and especially of the phosphoric acid.

Its absolute increase is indeed very large, amounting in the first case during the bath period to 52.5 per cent, the average being about 42 per cent; in the second case the largest increase was 42 per cent, the average 36 per cent. In the after-period the quantity of ammonia fell so rapidly that it was 33 per cent less than before the bath period in the first case; and in the second case it remained 30 per cent higher.

Strasser expected a larger ammonia excretion after thermic procedures, because under increased decomposition of albumin more organic acids are formed which require ammonia for their neutralization. It is a well-known fact that only those acids contribute to acidification in the organism which do not burn up into carbonic acid and water, and nothing is more plausible than that these organic acids, being burnt up by the powerfully increased oxidation of the tissues due to thermic procedure, are no longer capable of exerting an acidifying action upon the organism.

In his second series of experiments* Strasser found a complete confirmation of this view. He says that there is no escape from the idea that under hydriatic procedures acidifying materials are removed or at least destroyed. Inasmuch as inorganic acids not only are not decreased, but are even increased, only such acids can be destroyed, a result which seems quite plausible under the powerful excitation of oxidation induced by hydriatic procedures.

Extractives.—Under this heading Strasser calculated a number of elements containing nitrogen (kreatin, xanthin, etc.), which in the normal condition make up seven-eighths of the entire N quantity.

The quantity of these extractives sank after the bath period to 1.5 per cent, showing that the largest portion of the nitrogen was used up for the formation of the normal end products of tissue change, thus leaving but a small portion for these extractives.

Strasser concludes his valuable observations with the statement that

* *Loc. cit.*

the effect of hydrotherapy upon tissue change is to be explained by the influence of these procedures upon the activity of the living organism.

Ziegelholts* offers the following demonstrations of the effect of cold hydriatic procedures upon cellular oxidation. "If a tub filled with one-hundred litres of water at 18° R. is placed in a room of 15° R., for ten minutes, the water loses during this time two-tenths of a degree R. If a normal adult, weighing seventy-two kilograms and having a mouth temperature of 36.7° C., be placed for ten minutes in another tub of water at 18° R., the latter temperature will rise 0.8° R.; *i.e.*, the hundred litres of water has been raised nearly $\frac{5}{4}$° C. by the individual who has lain quietly in it. In order to raise one hundred litres of water $\frac{5}{4}$° C., 125 calories are necessary. Hence the individual bathing has given off in ten minutes 125 calories without any reduction of his own temperature. On the contrary, the thermometer shows a sudden increase of 0.2° C. at the moment the individual is placed into the cool water, and his temperature remains elevated as long as he lies in the bath. Only changes in the circulation can account for this effect. As the individual has given off 125 calories without losing anything at all, it follows that his organism has produced these calories. Increase in heat production is equivalent to increase of intra-organic combustion." Whatever is lacking in positiveness in this primitive experiment is completed by the well-known observations of Liebermeister, Ludwig, and Pflüger, who prove definitely that cooling of the surrounding medium, as in the dipping of rabbits into cold water, increases the consumption of oxygen and the elimination of CO_2. The significance of the loss of these calories is enhanced when we consider that this is about one-twentieth of the entire number of calories furnished by the normal organism in twenty-four hours. The experiments of Frankland and Rubner have shown that one gram of albumin furnishes about four calories; 125 calories therefore correspond to thirty grams of albumin. That this is an enormous enhancement of tissue change resulting from a rather mild bath is self-evident. Lower temperatures, which are usually resorted to when an enhancement of tissue metamophosis is aimed at by hydriatric procedures, must insure such a result without a reasonable doubt.

Thus is it mathematically demonstrated that the physician holds a powerful therapeutic weapon in these cold procedures, which, rightly used, may furnish results beyond those obtainable from any other known agent.

* Deutsche Medizinal-Zeitung, 53, 1897.

Influence of Hydriatic Procedures on Temperature.

Physiologists are in accord in maintaining that the temperature of a living part or organ depends upon the amount of arterial blood circulating within its tissue. The fact that venous blood returning from an organ in a high state of functional activity is warmer than the arterial blood passing into it, is alone sufficient evidence of the proposition that the arterial circulation is an important element in the equalization of the body temperature. All tissue change, all organic action, is in direct ratio to the quantity of arterial blood circulating in an organ, and therefore depends upon vascular activity, by means of which excretory and secretory elements are carried to and from it. The accumulated heat in the organs is equalized by the streams of blood which constantly pass through them. Hence the flow of arterial blood controls temperature variations, to some extent. The effects of hydriatic procedures upon the circulation, respiration, and tissue change have been fully enlarged upon. It remains now to demonstrate how, by utilizing this powerful influence, we may reduce or elevate the temperature in the human economy. That the application of baths of various kinds is potent in this direction has been accepted since the primitive days of medical investigation. Indeed, the idea *that reduction of temperature is the chief if not the sole attribute of the bath has so strongly rooted itself in the professional mind that it is difficult to dislodge it to-day*, when we have come to realize that this is only one of its valuable manifestations.

It has been shown ("The Skin as a Heat Regulator," page 24) that there is no evidence to prove that the influence exerted by external thermic agents is traceable to the heat-generating centres. There is abundant evidence, however, to prove that this influence is directly exerted upon that most important heat-regulating agency, the peripheral cutaneous circulation. The mode of action in this direction is twofold.

I have referred to the well-known fact in physical science that two bodies of different temperatures, by coming in contact, will at once make an effort to equalize their respective temperatures. This law applies to inanimate bodies, however, and is only applicable to the living body up to a certain point, because the latter is endowed with compensatory powers which enable it to resist dangerous encroachments from external temperature agencies, and which have been illustrated fully in the chapter on temperature regulation.

The utilization of these compensatory powers enables us, as will be shown, to influence the temperature of the body powerfully in diseased

conditions, in which the comfort and safety of the patient are jeopardized by long continuance of elevated temperatures.

I have referred to the important fact that the temperature of any portion of the body surface may be reduced or elevated by its contact with media of different temperatures, until the death of the part by freezing or scalding occurs, and that the inner parts are protected against further destructive invasion by the intervention of the dead part. I have also endeavored to emphasize the fact that temperatures whose effects fall short of destroying parts, are prevented from penetrating to the deeper tissues to any extent, because the collateral circulation is enhanced in the muscular structures, endowing the parts invaded with increased vitality and resisting-capacity. The well-known fact that the muscular tissues are bad conductors, and that the tonic contractions of the muscles aroused by the application of cold tend to create more heat, has also been dwelt upon.

Inasmuch, therefore, as the external parts of the body are well defended against the direct injurious invasion of thermic agencies, our means of reducing or of elevating the temperature of the body by hydriatic procedures are very meagre in health, although in disease their action is more pronounced. These effects upon temperature may be obtained for comparatively brief periods only, demonstrating that the antithermic uses of water are far less valuable than its other qualities.

The sooner this important point is mastered by the profession the better; for, as just stated, the fallacious idea that cold baths, for instance, reduce temperature by the direct effect of the cold is still so firmly fixed in the minds of many otherwise well-informed men that it is regarded as axiomatic. This is the cause of the misinterpretation of the *rationale* of the cold bath in fevers, which has been a serious obstacle to the popularization of this life-saving measure. *The truth is that the colder the bath the less active is its power of reducing internal temperature.* The temperature taken in the mouth is fallacious. The mouth is but a continuation of the external surface, the heat of which cannot be accumulated except by prolonged closure; yet mouth temperatures are commonly accepted as correct. This is the cause of the fact not being appreciated that we cannot reduce the internal temperature of the body very materially by means of very cold baths. I have often seen the mouth temperature after a fifteen-minutes' bath of 65° in typhoid fever reduced to 99°, when the rectal temperature indicated two degrees higher, although both were carefully taken for five minutes.

This point had never been referred to before the appearance of my book on "The Uses of Water in Medicine." It being a clinical fact,

however, which admits of no doubt, I must insist upon it here, as I shall do elsewhere, also, in order that the unreasoning prejudice against the cold bath, which had its origin in the *idea that its antithermic effect is in proportion to the low temperature of the bath, may be removed.* The fact is, as shown by Liebermeister,* that, during the action of extraordinary heat abstraction from the external surface, if its intensity does not exceed certain limits, the inner temperature of the body does not fall, but even rises a little. This observation is confirmed by Aubert, Corette, and others quoted by Hayem in his "Leçons de Thérapeutique."

The most important temperature effect of thermic agencies, externally applied, lies in the immense power the latter affords over the cutaneous circulation. The investigations of several physiologists referred to show that when a portion of the skin is moderately heated the temperature of neighboring portions is lowered, and that when cutaneous surfaces are moderately cooled, the neighboring structures present a proportionally higher temperature. This effect is traceable to the collateral anæmia produced by afflux of blood to the surface to which warmth is applied, and by the driving of blood from the surface to the inner structure when cold is applied.

Reaction follows both of these conditions, either restoring the equilibrium or disturbing it in an opposite direction. Fleury, who has done so much in France towards explaining hydriatic procedures upon physiological principles, offers the following results deduced from careful experiment: "Dipping the body into moderately cool water (48° to 58° F.) for thirty minutes reduced the temperature of the surface, while the inner temperature did not change at all. The more brief the application the colder it was made, and the higher the surrounding temperature the more rapid and complete was the reaction. The reaction entailing the re-establishment, and even the increase, of the previously existing temperature depended upon the conduct of the patient after the applications, it being more rapid and complete after active and passive exercise of the parts, especially in a warmer surrounding medium.

Another important deduction made by Fleury is the fact that reaction depends upon the individuality of the patient and conditions of the circulation and innervation at the time, as is illustrated by the ease with which a man under the influence of alcohol or of narcotics may be frost bitten, while one in a normal condition would be stimulated and invigorated by similar exposure, especially when kept in active motion.

These simple facts have again and again been verified by numerous

* "Handbuch der Pathologie und Therapie des Fiebers," p. 102.

reliable authorities, and may if properly grasped lead to a correct understanding of many seeming paradoxes in hydrotherapy.

In health the effect of hydriatic applications upon the temperature of the body is almost *nil*, because the compensatory agencies referred to are constantly on guard to maintain the normal equilibrium.

While the circulation and respiration may be readily affected in health by thermic and mechanical irritation conveyed by the application of water to the cutaneous surface, the internal temperature responds to its influence only to a very slight extent.

The temperature effect of hydriatic procedures is in health mainly perceptible on the cutaneous surface, *i.e.*, externally only. Even in disease much depends upon the individual pathological conditions which give rise to temperature elevation. It will be shown, for example, that clinical observation has demonstrated a great resistance of the high temperature in the early days of typhoid fever to hydriatric procedures. Rarely, if ever, will any cold bath reduce the temperature more than two degrees in the first week of the disease, while in croupous pneumonia even a moderately cold bath (85° to 80°) may reduce the temperature from two to four degrees.

It is well, at the outset, therefore, to realize that *the long-prevalent idea that in its capacity of reducing temperature lies the chief strength of hydrotherapy is fallacious.*

It has been shown that the influence of hydriatic procedures in health is less pronounced upon heat regulation than it is upon any other function of the human organism, and the clinical part of this work will make evident the fact that *temperature reduction is perhaps the least potent factor in the therapeutic effects to be expected from the application of water.*

PART II.

CHAPTER V.

THE PRACTICE OF HYDROTHERAPY.

The preceding chapters have been devoted to an exposition of the theory or principles underlying the application of water. The effects of the latter upon the various systemic functions have been explained as succinctly as is consistent with their correct conception. Mere theoretical quibbling and far-fetched pseudo-scientific data have been avoided, it being my aim to lay down definite physiological data, obtained by experimentation of reliable observers, as a foundation for the subsequent chapters which shall deal with the *practice of hydrotherapy.*

The latter will be divided into technical and clinical chapters. The reader shall be fully familiarized with the most useful methods of applying water in disease; their technique shall be clearly outlined, their *rationale* explained, and the chief clinical application of each procedure shall be set forth, at the risk of repetition, in subsequent chapters which will be devoted to a discussion of some of the diseases in which hydrotherapy has demonstrated its value most distinctly.

The reader is urged to follow as closely as possible the technique described, and to observe the effect of each procedure in order that he may be enabled to modify it upon the principles indicated, whenever individual cases require changes in technique.

Familiarity with technical details is as important to the skilful and effective application of water in disease as it is in the technique of surgical procedures.

The aim of this work being to render accessible to the general practitioner a therapeutic method of which he has usually the most vague and imperfect idea, the author proposes to simplify this part of the subject, the technique, by *describing only such procedures as his personal experience as a general practitioner and hospital physician sanctions as useful.*

The writings of the hydropaths abound in minute subdivisions of the technique, *e.g.*, wrist baths, arm baths, head baths, etc., which

will be ignored in these pages, because their therapeutic effect is not established. The procedures described in the following pages will enable the practitioner to execute every useful hydrotherapeutic indication, provided the technique is followed with precision and the *rationale* upon which it is based is thoroughly mastered.

Each procedure will be described in detail and illustrated by drawings. The *rationale* will be next presented in its true light, in order that the practitioner may, by fully acquainting himself with it, execute the procedure with intelligent regard for the therapeutic indications of each case and adapt it by modification, if need be, to all exigencies.

Finally, the therapeutic indications for each procedure will be enumerated. The entire subject of practical hydrotherapy will thus be presented precisely in the same manner as are our medicinal agents in the text-books on therapeutics.

ABLUTION.

This procedure is the simplest and most universally applicable hydriatric application. The ablution is not only useful in many diseased conditions, but it also serves as an introduction to more active measures. It consists of the application of water by the hand, either unarmed, or covered with a bath glove, or holding a gauze or linen wash cloth. The sponge is to be avoided, because it does not produce sufficient friction and thus prevents reaction. The sponge is usually squeezed out of water and then passed by stroking over the cutaneous surface. In febrile conditions this would produce cooling by evaporation, but very little irritation of the nerve terminals, and consequently very little if any effect upon the central nervous system, which, as has been shown, is the chief aim of hydriatric procedures. The method and the temperature of the water vary with the object in view. Several vessels filled with water of proper temperatures should be within reach. In acute febrile affections, with temperature above 101° F., an oilcloth or rubber sheet is laid upon one side of the bed covered with a blanket, and upon this a linen sheet or tablecloth is spread, one half reaching over the edge of the bed, the other rolled up on the other side of the latter. The patient is now placed upon the sheet. His face is first bathed with water of from 65° to 50°, beginning with the higher temperature and on each application reducing it two or more degrees. The chest, the arms down to the elbow, the back, the abdomen, and the lower extremities down to the knees, are successively bathed by *freely* throwing water from the hollow of the hand or by saturating a crumpled piece of gauze with the water and gently rubbing successive parts, frequently dipping the cloth and squeezing it out of the water over the parts.

This is far superior to sponging, which chills by evaporation, while the gentle shock of the impact of the water applied by these methods, accompanied and followed by gentle friction, arouses the peripheral nerves and thus refreshes the entire system by its reflex effect. The difference of refreshing effect arising from adding friction is made evident by comparing in the ordinary morning toilet what would be the effect of wiping the face with a cold wet sponge with that of the usual method of dashing handfuls of cold water against the face, and using friction.

The refreshing and antifebrile effect may be enhanced in vigorous individuals with high temperatures by not drying the body until the ablution is complete, or by simply wrapping it in a dry sheet which has been kept in readiness on the other side of the bed and allowing the patient to dry spontaneously. Judgment, however, must be exercised to avoid chilling, and it must be borne in mind that gentle friction is aimed at, in accordance with the principles enunciated, and which it will be unnecessary to reiterate in the description of each procedure.

Another method for enhancing the antifebrile effect is placing a thin wet linen towel (always without fringes, to prevent dripping) successively over the chest, abdomen, back, and the upper parts of the extremities, and throwing water upon them by the hand, or from a pitcher, or by squeezing it from a sponge, followed by friction with the flat hand and patting over the wet towel. This procedure approximates a bath, and often accomplishes quite as good results in reduction of temperature and refreshing effect as the full or half bath. By modifying the temperature of the water and length of time, the antifebrile effect may be modified. After the ablution, which may be repeated by going over the body twice or oftener, the patient is dried. It may be repeated when the symptoms again demand it. In the early stages of all febrile affections, except pulmonary and bronchial, this method will found of value.

In chronic affections, too, the ablution is a useful preliminary to the more active hydriatric procedures. It has long been my custom, learned in treating the desperately depreciated patients presenting themselves at the Montefiore Home, many of whom have been utter strangers to cold water in health, to pursue the following course: The patient receives a thorough, warm, cleansing bath with soap and flesh brush. On the following day he is wrapped, nude, in two long-haired woollen blankets. One blanket is spread on the bed, the patient is laid upon it with arms above his head, and the blanket is snugly wrapped about the body and between the legs. The arms are now placed alongside the body, and the second blanket is tucked around him, so that the upper corners are firmly fastened under

his neck and the lower edge is folded under his feet. He now lies like a mummy in the warm room, more covers being laid upon him. Sipping a glass or two of ice water will promote the action of the skin. After he has lain from half an hour to an hour and has thus accumulated heat upon the surface, the face is bathed in water of 50°. The blankets are wrapped about the chest, abdomen, back, lower extremities, and arms, and these are successively bathed with water at 80° dashed from the hand. Each part is immediately dried and replaced under cover. The water temperature is lowered two degrees daily until 60° is reached. A general dry rubbing with a cloth or the hand follows, and he then is made to take some exercise, if he is able to do so. Otherwise he remains in bed and receives a cup of warm liquid food. This application is best made in the early morning hours, but it may be made at any time, and repeated as the reactive power demands, for several days. During the first days the water is applied by simply passing the hand, frequently dipped in the water, over the successive parts of the body. Every day a little more water may be applied, the hollow of the hands or a pitcher being used for the purpose, and larger quantities are applied in order to educate or train the patient. His reactive capacity is so gradually raised by this method that all shock is avoided.

The next step in the hydriatric training of the patient is a *general ablution*. The patient stands in twelve inches of water at 95° to 100°, and is rapidly washed down with the hands, having water at 50° to 80° poured upon him with the hand or from a vessel, followed by gentle friction just as described above. The temperature is lowered each day. This simplification of the methods adopted by special hydrotherapists, like Fleury, Winternitz, and Duval, has served me so well that I cannot commend it too highly in health and disease, but I must also insist upon an exact technique. It will not suffice to tell the patient, "You must bathe in cold water every day." The importance of the shock from the brief impact of cold water must be impressed upon him, and the physician should prescribe the temperature of the water and the method of using it as he would in ordering medicine. In the early summer months, when the water is from 70° to 75° F., and the air not much warmer, the shock will be slight. Ice must be added to a basinful of water, or several basinfuls should be precipitated over the shoulders and the body from a height, in order to compensate by the mechanical effect for the absence of temperature difference. But, aside from their therapeutic effect, ablutions are most valuable as introductory to other and more heroic hydriatric procedures, in acute as well as in chronic disease, inasmuch as they furnish a clew to the reactive power of the patient. If, for instance, the skin remains cool and pale or becomes cyanotic after

ablution and friction, we are warned to proceed cautiously to more intense procedures. In such cases only small portions of the body should be attacked each day, or twice a day, good friction being added. Each day the surface receiving ablution should be enlarged.

This cautious proceeding enables me to assert that I have never seen a patient too feeble to accept some form of hydrotherapy. The reactive condition of the patient is by this gradually advancing method disclosed in chronic diseases, the degree of heat retention is indicated, and the physician is enabled to adapt his subsequent hydriatric procedures in accordance with observations thus made.

The *rationale* of the action of ablutions may be found in the peripheral shock and subsequent stimulus, which are refreshing because

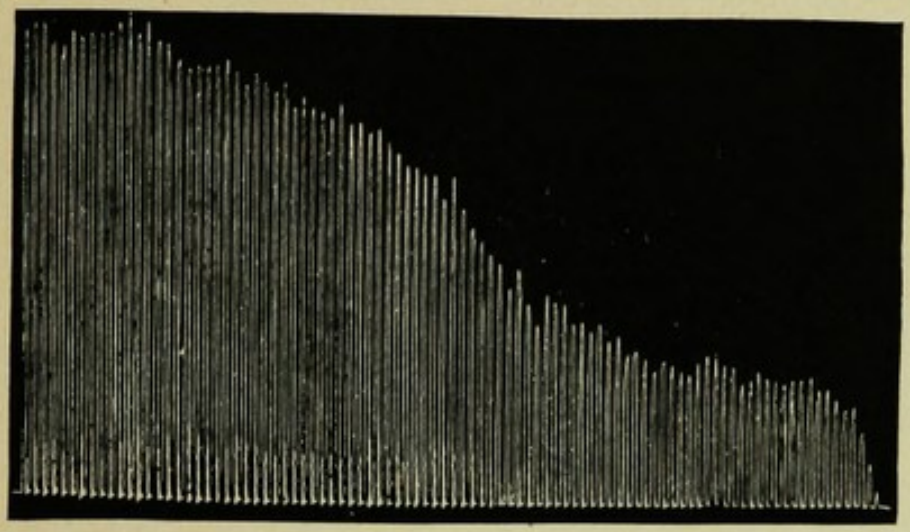


FIG. 21.—Fatigue Curve of Right Hand after a Cold Ablution. (See Normal Curve, Fig. 11.)

they are conveyed to the nerve centres, and in the dilatation of the superficial vessels by the friction, which, according to Weyrich, increases the evaporation from the skin fifty per cent. The latter must be of great value in fever, because, according to Leyden and others, retention of water is one of the chief elements in the febrile process.

Added to this effect, we have the dilatation of the superficial capillaries, as evidenced by the rosy hue of the skin following ablution with friction. We also have the deepening of the inspiration produced by the impinging of cold water upon successive parts, which improves the circulation. If the heart's action is feeble, we may thus enhance the tone in the peripheral vessels and facilitate its work by removing the impediment to the flow of blood in the correspondingly feeble cutaneous vessels. The *vis a fronte*, due to the enhanced contractility of the vessels, diminishes the need of a strong *vis a tergo* upon the part of the heart. This explains the reason why ablutions are a most valuable initiatory procedure, which the feeblest subjects may

bear with impunity, and which do not alarm the patient and friends, as do other more heroic measures.

Upon the muscular system ablutions also exercise a striking effect. The latter has been beautifully brought out by Vinaj and Maggiora, as noted on p. 85. The individual was sponged with water at 50° F. twice a day, and the "fatigue curves" were taken before and afterward. The latter are represented in Fig. 21. This diagram graphically shows a decided increase of muscular capacity after the cold ablution, demonstrating that its "tonic" effect is very pronounced.

Therapeutic Indications.—The ablution si indicated in acute febrile diseases as an antifebrile and antithermic agent. In mild cases of the infectious fevers it may suffice to carry them through their entire course. I have so treated cases of typhoid fever the temperature of which did not reach 102.5°. If the latter is afterwards exceeded, the ablution manifests its value as a measure preparatory to the full cold bath.

In chronic cases the ablution is of great value in anæmia, chlorosis, phthisis, etc.

In all those neurasthenic cases which do not require more heroic measures, the ablution may be applied with good effect; in the more severe cases it offers a gradual introduction to the douche and other more active procedures.

The Half-Bath.

Technique.—A sufficient quantity of water to reach above the pelvis of the patient is poured into an ordinary bathtub; the temperature of the water, adapted to each case, ranging from 70° to 85° F. After having a wet towel wrapped around his head, the patient is placed, or if not too weak he seats himself, in the tub, which contains water at 85° F. The attendant bathes his face, and begins at once to rub his back with the left hand, while with the right he dashes water from a small long-handled pail (like a milking-pail) over the shoulders of the patient. The latter at the same time rubs the front of his body with both hands. Colder water is added from vessels prepared for the purpose, until the patient shivers. If the teeth chatter the patient should be removed. The continuously renewed application of the water and the successive shocks imparted to the body by the moving streams of water, accompanied by friction, stimulate the peripheral nerves and dilate the superficial vessels. Thus the entire organism is refreshed, the effect being more intense than that described under "Ablutions." Especially important is the absence of pressure from the water, which characterizes the full bath, and which would not

further the dilatation of the surface vessels so much as is done by the ever-recurring changes of surface temperature produced by the temporary and repeated impacts of cold water. Friction, too, is more readily applied when the body is not submerged. Hence the mechanical effect, which has been shown to bear an important share in most hydriatric procedures, is enhanced. If the patient is too weak, he may lie in the bath and refrain from washing himself, or he may change from the recumbent to the sitting position, being subjected to general friction in the former and to drenchings with the pail in the latter. The temperature of the water should be reduced with each bath in order to avoid needless shock. It will rarely require to be reduced below 70°. Indeed, colder water would in subacute cases produce painful sensations in the feet, which would necessitate removal of the patient.

Therapeutics.—If the technique of the half-bath is thoroughly mastered, it may be utilized as the most universal hydriatric procedure we have. In cases of acute fever, without organic lesion, it may follow or take the place of the ablutions above described. The small body of water does not inspire the patient with apprehension; the gradual and even rapid lowering of the temperature of the water is scarcely perceived, because the agitation counteracts the sudden cooling and friction promotes immediate reaction of each portion of the body treated. As in most fevers, especially those of infectious origin, the rise of temperature is connected with and partly due to a spasmodic contraction of the superficial vessels, which intercepts heat diffusion from the skin, we accomplish one of the chief indications for temperature reduction and nerve stimulation by the widening of the vessels which surely follows friction after the forcible application of cold water. The more slowly heat is abstracted, the more enduring will be the lowering of the bodily temperature. In this half-bath we may graduate the rapidity of heat abstraction by properly gauging the temperature of the water and the frictions. But the half-bath is not so applicable for these purposes as are other procedures to be presently mentioned. It is rather as an introduction to other and more effective baths that the bath here described is useful as an antifebrile measure.

In *chronic diseases*, after the wet pack or other and procedure, to be referred to below, has produced dilatation of the superficial cutaneous vessels, the half-bath is a necessary sequel for the purpose of maintaining the tone of those vessels. In these cases a tub should be filled to one-fourth its depth, say ten inches, with water of from 90° to 85° F., which should be actively set in motion by the hands of the patient and attendant, as directed in the opening lines describing this procedure; the duration should be from six to ten minutes.

When the patient arises from the half-bath, a coarse linen sheet, previously warmed and kept in readiness, should be thrown around him, and with this he should be rapidly dried. In acute fevers the drying should be done in bed, a blanket and sheet having been previously prepared, as directed above in the case of general ablutions.

AFFUSION.

Affusion is a procedure by which the patient, sitting or standing in an empty tub, or lying upon a rubber cot, receives upon his head, shoulders, and body a stream of water issuing from a bucket, pitcher, or basin, preferably the former, because the stream may be broader. According to the height from which the water is poured and the low temperature (50° to 65°) will be the stimulating effect. With feeble patients it is well to begin with higher temperatures and short distances. The whole procedure should be rapidly executed, the patient being in a sitting or semirecumbent posture in acute conditions, standing in chronic cases. It is a more energetic treatment than the ablution, because of its briefer duration, the increased force of the water impingement, and the larger surface treated. This is the form of cold-water treatment which was practised by Currie with so much success.

Rationale of Affusion.—The action of affusions is simple. The sudden impingement of a considerable volume of cold water, propelled with decided force upon a large surface of the body, must produce an intensification of those mechanical and thermic influences upon the sensory cutaneous nerves which have been discussed in detail above. Being conveyed to the central nervous system, the reflex effects upon respiration, cardiac action, assimilation, and nutrition are decided and unmistakable. The intermittent character of the thermic and mechanical irritation impresses a distinct effect upon this procedure. It really presents a decided enhancement of all those effects which have been referred to under the head of ablutions (page 83).

We are indebted to several Russian investigators for creditably precise investigations of these effects. Omitting the details, which demonstrate how carefully these observations were made, a brief *résumé* may suffice.

Blagowetschensky studied in 1888 the effect of affusions upon healthy prisoners in solitary confinement at St. Petersburg. Affusions were given morning and evening, from three buckets of water of from 52° to 75°.

Food and drink being carefully weighed and regulated, it was found that the assimilation of nitrogen was increased in all cases, it being

1.43° after affusion of 52° F., and 2.44° after affusion of 75° F. General assimilation was similarly increased. Weight increased in seven cases—in a few very considerably—it decreased in one case. Loss by cutaneous and pulmonary excretion was increased twenty-four per cent. The pulse was decidedly slowed in eighty-three trials, and increased four beats after two affusions of 60° F. Respiration was slowed as a whole. Blood pressure was more decidedly increased after the colder affusions. Temperature was but slightly reduced in healthy persons. The colder the affusion, the more the pulse, respiration, and temperature were affected.

*Therapeutic Indications.**—There are certain conditions occurring in acute diseases in which the *affusion* is a most important adjunct. When the patient is unconscious or delirious, muttering or otherwise; when he presents evidences of depreciated nerve force and general adynamia; when the superficial vessels react feebly, as manifested by more or less cyanosis, and the heart is laboring to compensate for the loss of elasticity in the capillaries, which greatly aid the propulsion of the blood in normal conditions; when the bronchi are loaded with mucus and the air vesicles clogged by hypostatic congestion, no remedy will arouse the failing powers like an affusion properly administered. The patient may be placed or held in a semirecumbent position in water at a temperature of 100° F., while the upper part of the body is douched and dried with friction, with water at 50° to 65° F. The refreshing effect of such a bath judiciously given will never be forgotten by any one who has once witnessed it. The patient who entered the tub with muttering delirium is often aroused to consciousness, the eye brightening and the countenance losing its apathetic appearance. Others, whose respirations were shallow before the bath, are often made to breathe deeply, cough, and expectorate freely, and return to bed with lungs freed from threatening hypostasis. In others, again, whose cyanotic or marbled skin indicated heart failure, the surface becomes ruddier, a more active cutaneous circulation ensues, and

* Dr. Leopoldt Senfelder (Wiener klinische Rundschau, 1897) presents a summary of the uses to which Hippocrates put this procedure, which has historical interest. Hippocrates used cold general affusions in syncope and collapse, and in tetanus; warm affusions in childbed fever (instead of baths) and in dropsy. Partial affusions were applied—warm to the head in inflammations of the eye; cold to the head in fever for producing perspiration, in insomnia and delirium, wounds of the head with delirium, bleeding wounds elsewhere, inflammation of the throat. Hippocrates also applied warm affusions to dislocated or otherwise injured joints for anodyne effect, in fractures, in uterine displacements, in rectal fistula for cleansing, in pains of the thigh, hips, and loins. He applied cold affusions in diarrhœa and collapse, in pains and swellings of joints, uterine displacements, poured on the thigh as a stimulant, in uterine inflammation for cooling, and in uterine hemorrhage as a styptic and anodyne.

the pulse gains in force and diminishes in frequency. The reflex effect upon the vagus deepens the inspiration, a fresh supply of oxygen is carried to the feebly expanding lungs, the heart is aroused, and hypostatic embarrassment is overcome. The whole aspect of the case is often changed by these brief applications of cold to the surface, followed by rapid drying. Now stimulants which had failed to arouse the flagging powers act more efficiently, their effect being more enduring. The testimony of that experienced clinician, Winternitz, which has been confirmed repeatedly, should be borne in mind, when this terrible collapse condition menaces life. "Collapse," says he, "is almost universally regarded as a contraindication to every application of cold. I would again express the opinion that I know no more powerful or effective agent for combating threatening or existing collapse than the intense and intelligently applied excitation by cold. How often have I seen, in advanced fever processes, in degenerated typhoids, a rapidly favorable change wrought in the corpse-like coldness of the extremities in the most serious manifestations of nerve adynamia, in the hypostatic congestion of lungs, by one dipping into a very cold bath, or one cold application. I am firmly convinced that very often these manifestations are not due to heart feebleness, but to a collapse of the vessels, and here an evanescent but energetic excitation by cold is the only reliable remedy, as I have repeatedly proved."

Henoch * speaks highly of cold as a stimulant in collapse of children's maladies. He advises a warm half-bath (91° F.), with cold affusion over the neck and chest. Affusion is also the method by which Currie made his remarkable cures in typhus fever, using chiefly sea water on board ship. He placed the patient upon the deck and poured bucket after bucket of sea water upon his burning body, with the result of completely changing the aspect of the cases.

Professor Hoffmann, of Leipzig,† says: "The greatest benefit has been obtained from the use of cold rubbings and douches in diseases of the lungs. No injurious results have ensued from their intelligent application. It is well known how cold affusions over the chest and neck produce quite peculiarly energetic inspiratory movements. Hence they have long been used to deepen the breathing in somnolent patients. Fever patients, who respire superficially and thus favor the production of hypostasis, may be protected against a dangerous complication. Deeper respiration is produced, which furthers the circulation from the right to the left heart, and which results in a dilatation of the cutaneous vessels and in a proportional anæmia of the inner organs."

* Deutsche Medizinal-Zeitung, September 1st, 1890.

† "Vorlesungen über allgemeine Therapie," Leipzig, 1892.

In *scarlatina*, when the system is overwhelmed by the poison, the circulation embarrassed, the skin pale or marbled or cyanotic, the respiration shallow, the temperature high, the pulse rapid and feeble, truly marvellous results may be obtained by the judicious use of brief affusions. Reaction occurs rapidly, and with it comes an improved peripheral and general circulation, deepened inspiration, brightened countenance, and roseate skin. *Let not the fear of cold deter any one from resorting to cold affusions* (70° to 60° F.) in these desperate cases. They are the hydriatric substitute for digitalis and alcohol; from them the enfeebled heart will obtain vigor and refreshment, sending the life blood in joyous currents through the sluggish arteries, removing hypostasis, delirium, stupor, and preventing fatal issues in the most desperate conditions. I say this from conviction, born of clinical observation. But judgment is required in adapting temperature, duration, quantity of water, and force of impact to the condition of the patient.

Meningitis and Other Cerebral Disturbances.—Rohrer* reports fifteen noteworthy because desperate cases in which cold affusions demonstrated their life-saving value. After remonstrating against the tendency of physicians to yield to lay prejudice when they are themselves convinced of the therapeutic value of cold water in fevers, he states that he found cold affusions of great service: "1. In cerebral manifestations consequent upon high temperatures in infectious diseases (five cases). 2. In meningitis; disturbance of cerebral functions by pathological changes in the central nervous system; hyperæmia, exudation, infiltrations by neoplasms; insolation; simple and tuberculous meningitis (six cases). 3. In meningeal symptoms in acute non-infectious diseases, especially pneumonia cerebralis (four cases)." The histories, given in complete form, illustrate the correctness of this author's views, which he summarizes as follows:

"These cold affusions act:

"1. As temperature-reducing agents, when they are made very cold and prolonged up to ten buckets.

"2. Antispasmodic, calming in tonic and clonic convulsive conditions resulting from cerebral irritation.

"3. Derivate, poured upon the skin of the head and neck; the skin is always reddened intensely.

"4. Irritant to the peripheral nerve endings, producing deep inspirations.

"These affusions are applicable:

"(*a*) In all febrile conditions accompanied by manifestations of cerebral hyperæmia or irritation.

"(*b*) In meningitis, regardless of its etiology.

* Deutsches Archiv für klinische Medicin, 1874, No. 13.

"(*c*) In very high temperatures with cerebral disturbance.

"(*d*) In infections with sopor, coma, furibund delirium.

"(*e*) In disturbance of circulation in the left ventricle, as a sequel of insufficient respiration, hypostasis, croupous pneumonia."

This practical physician's clearly stated views, being sustained by full clinical histories, are entitled to careful consideration. They are here recited, in order that his observations may serve the reader in an emergency in these almost hopeless cases.

In *chronic diseases* the affusion is an excellent substitute for the douche, if it is administered with care and precision as to temperature and the patient's reactive capacity. It is therefore a valuable agent in domestic practice.

The prejudice existing in the lay mind against pouring a basin or bucket, or pitcher of cold water over a fever patient will disappear very quickly if the friends or relatives be not permitted to witness the procedure, but allowed only to observe the change wrought by it in the delirious or unconscious patient.

THE SHEET BATH.

Technique.—The bed or cot is protected by a rubber sheet. A blanket is spread upon the latter. Several linen sheets, coarse or fine, according to the effect desired (see *Rationale*), a basin, a tub of water of the required temperature, a cup, and a sponge are placed upon a chair. The patient, being undressed, is wrapped in a woollen gown or blanket, and held in readiness. The attendant drops one of the linen sheets, holding it so that he may easily remove it into water of from 50° F. to 80° F., according to the effect aimed at. The sheet is now partly wrung out, so as to be more easily handled; it is thus spread upon the bed as rapidly as possible to prevent a change of its temperature. The head and face of the patient having been bathed with ice water and a wet turban wrapped around his head, he is laid upon the wet sheet and is wrapped with it in the following manner: The patient is directed to hold both arms above his head. The upper left border of the sheet is now brought close under the left axilla and laid across the front of the chest, reaching beyond the axillary line of the right side; the lower portion is placed over the pelvis and the edge tucked in between the lower extremities. The arms are brought down and placed alongside the body, from which they are separated by the intervening sheet. Now the right portion of the sheet is carried across the body above and below, enveloping the arms and shoulders as well as the lower extremities. The right upper border of the sheet is firmly drawn over the left shoulder and securely tucked under the

latter; the lower end is tucked underneath the heels. In this manner the patient is snugly enveloped in the wet sheet and no uncovered parts of the body lie in apposition. The arms may, in feeble patients, be left out altogether, and simply bathed during the process. This will also facilitate the application of the sheet. The first impression will be a shock to the peripheral nerves, caused by the sudden contact with the cold wet sheet. A deep gasping inspiration and a little shivering follow. These are readily overcome by the patient's own high temperature, and their removal is now aided by the manipulations of the bath nurse, who, with outstretched hands, gently but firmly and gradually sweeps over the wet sheet, passing over the entire body successively. Small portions of the body should be rubbed in this manner until they warm up. So soon as any part of the body becomes thoroughly warmed, water from 50° to 60°, according to the condition of the patient, is poured from a cup or squeezed from a sponge over it, and rubbing is resumed. These gentle but firm passes or frictions over successive parts of the body are alternated with the pouring on of small quantities of cold water, until the entire body feels cooled or the patient shivers a good deal. Rigor and chattering of the teeth must always be avoided, because it is an evidence of muscular contraction, and of a too decided temperature difference between the central and peripheral portions of the body, which causes the former to rise and thus counterbalance the effect. As the friction prevents this objectionable feature of all cold baths and enables us by the renewed application of cold water upon the warm parts of the sheet to maintain the cooling effect, we have in the sheet bath an admirable antifebrile procedure, the effect of which may be greatly enhanced by allowing the patient to remain in it, and covering him with a blanket and the rubber sheet, or by withdrawing the rubber sheet and leaving him in the blanket and wet sheet for half an hour. Its mildness, as compared with the full cold baths, renders it more acceptable to the patient and his friends, and it may thus be utilized as a valuable initiatory measure, intermediate between the ablution and the half-bath, which have been discussed. The sheet bath is applicable in all acute diseases in which an elevated temperature is a leading manifestation. I have used it as a valuable substitute for the full bath, when the necessary apparatus for the latter could not be procured. For instance, in the country or in tenement houses, where bathtubs are not obtainable, linen sheets, or at least linen tablecloths (or even old and well-worn cotton sheets), a piece of oilcloth, a blanket, or bagging to protect the bed, a bucket of water, and a sponge are all that are needed. In the most humble home an ironing-board or a small door may be used in lieu of bed or sofa. By laying the upper edge of the board upon a

box or stool, or using the floor, laying an oilcloth upon the board or floor, a piece of bagging or a comforter over this, and saturating a tablecloth or even a cotton sheet, the sheet bath may be given with an abundance of water from a sponge or pitcher. The superfluous water running from the body may readily be kept from flooding the floor by careful mopping with cloths or with a sponge from which it may be squeezed into a bucket. It should always be borne in mind that a patient with a temperature of 103° and over is not in danger of taking cold. This bugbear often prejudices the physician as well as the patient against all hydriatric measures, and especially those which require the use of abundant quantities of cold water.

To enhance the antipyretic and soothing effect of this treatment in a tenement house or in the country, the patient should be removed to the bed, covered up in the wet sheet and blanket, and allowed to remain quiet for half an hour. Most frequently he will fall into a gentle slumber, from which he should not be aroused for any purpose.

The antipyretic action of the sheet bath may be explained as follows: The immediate effect upon the peripheral vessels is to contract them, render the skin anæmic and pallid, and drive the blood from the cutaneous surface toward the interior. For this reason a wet bandage and occasional affusions upon the head are necessary to prevent retrostasis with determination of blood to the head. Since, however, the shock to the sensory nerves is brief, and no sooner is conveyed to the nerve centres than it is reflected by the motor tracts, the local action is really evanescent. The sheet rapidly warms up if the patient's temperature is above 102°. The addition of cold water upon the warmest parts of the sheet abstracts heat from the blood in the cutaneous vessels, whose lumina have been increased by the frictions referred to. In this manner a gradual cooling off and reheating of the sheet ensues, which are conveyed from and to the parts beneath it. Each time the cold water impinges upon the sheet a deepened inspiration ensues, which furnishes more oxygen. The dilatation of the peripheral vessels removes the previously existing abnormal resistance to the blood pressure, and thus gives the heart freer action, reducing the pulse rate, and, if the patient be allowed to rest in the wet sheet, a calm sleep ensues, the result being cooling and refreshment, accompanied by slight exhaustion due to the mechanical irritation. A rational antifebrile effect is thus inaugurated, which does not fatigue the patient so much as the full bath, and which is more readily accepted by him and his friends than the latter.

This practical and ingenious method of applying water is exceedingly useful as a means of refreshing the nervous system of patients

who, by reason of feebleness in acute or chronic diseases, are unable to accept other and more heroic methods.

By modifying the sheet bath a more stimulating procedure may be obtained, which is well adapted for chronic diseases in which abstraction of heat is not required or is entirely contraindicated. This is the "kalte Abreibung" so much in vogue among the Germans.

The sheet bath differs somewhat in chronic cases, since the larger

Fig. 22.—Drip Sheet. First position. Photographed by Dr. Rossman.

proportion of these patients may be treated in a standing-position, which gives the attendant free scope for more vigorous friction. This is called the drip sheet.

In the Montefiore Home for chronic diseases, which is really an institution for incurables, receiving only the most desperate types of all chronic diseases, organic and functional, the sheet bath was used by the author in the form called "*drip sheet*" for several years prior to the construction of a douche apparatus. Having proved satisfactory, the procedure as there pursued may serve as a guide for its execution in private practice.

Technique of the Drip Sheet.—The temperature of the room should not be less than 70°. The patient stands in a foot or bath tub containing twelve inches of water at 100° F., to prevent chilling; a sheet dipped in water at 75°—daily or less frequently reduced until it reaches 60°—is placed dripping over his shoulders and back in the following manner. The left upper border of the sheet is held by the left hand, while the right hand gathers the right border into folds. The sheet

Fig. 23.—Drip Sheet. Second position.

is now dipped into a bucket of water, from which it is taken dripping and applied under the right axilla of the patient, as shown in Fig. 22. Pressing the sheet firmly to his side with the right arm (Fig. 23) the patient is directed to turn and thus envelop himself in the wet sheet (Fig. 24). When the entire body is thus covered, the upper border of the sheet is tucked in around the neck and the lower border is wrapped around the legs. The attendant now makes rapid passes *over* the sheet up and down the back, sides, and lower extremities with the outstretched hand (Fig. 25), occasionally slapping the surface to increase mechanical irritation. A basin of water from ten to fifteen

degrees below the temperature of the sheet water is poured over the head and shoulders two or three times at short intervals. This is alternated with frictions for from five to ten minutes. The sheet is now rapidly withdrawn. In most cases, especially after the treatment has been pursued for some time, the skin becomes decidedly hyperæmic. The patient now steps upon a woollen rug or blanket, and is thoroughly dried with soft linen towels. This is followed by

FIG. 24.—Drip Sheet. Patient turning.

friction with a warm sheet or towel, which increases the cutaneous suffusion. The patient emerges from this bath, during the first few days, somewhat fatigued but refreshed. If the fatigue is decided, the procedure should be shortened until the patient evinces more resisting and reactive capacity. Usually he is able to walk out, which is a great advantage. In good weather a gentle promenade after the treatment is a *sine qua non*, because the respiration is deepened and more oxygen may thus be made to enter the lungs.

The rationale of the drip sheet may be explained upon the same principles which govern other similar procedures. As the wet sheet

envelops the entire surface of the body, the thermic irritation is more pronounced than it is from an ablution. It stimulates the cutaneous vessels and the muscular structures of the skin also to contract for a brief time, and to dilate just as quickly and completely. The frictions made by the rapid to-and-fro passage and pressure of the flat hand over separate portions of the sheet-covered body greatly enhance

Fig. 25.—Drip Sheet. Friction.

the reactive dilatation of the cutaneous vessels. A large quantity of blood is thus drawn from the interior to the general surface.

Physiological investigations having shown that two-thirds of the entire blood quantum may find lodgement in the skin, the enormous derivative effect of a good sheet bath becomes evident.

The repetition of the thermic irritation incident to the renewed pouring of cold water upon those parts of the body which have been warmed by friction of the attendant's hands affords a renewal of all these results, which in chronic cases produce tonic, and in acute cases antifebrile effects of unmistakable value.

Interesting practical observations on the effect of the drip sheet

have been published by Dr. Storoscheff, of Moscow.* Examination during the process showed more or less warming of the skin, which sometimes was so pronounced as to cause vapor to rise from the sheet. This, doubtless, arose from the influx of blood to the dilated cutaneous vessels.

The *respiration* was at first deepened after a gasp, and then increased. In fifty drip sheets given to sixteen hospital nurses, ages from twenty-one to twenty-four years, Gritzay found the respiration lowered in thirty-two, unchanged in nine, and increased in three. The force was ascertained by Waldenburg's pneumatometer. Respiration was increased forty-five times, and unchanged five times; expiration was increased thirty-three times, unchanged thirteen times, and diminished four times, the increase averaging fourteen millimetres. The average increase of inspiration exceeded that of expiration.

The number of heart beats was generally diminished; the blood pressure was increased thirteen times, unchanged sixteen times, and diminished only three times. The average increase of blood pressure was eight millimetres.

The *rectal temperature* was diminished in all cases.

The *muscular capacity*, ascertained in the upper extremities by Berg's dynamometer, was increased 3.5 kgm., as an average. Pletysmographic tracings showed much lower waves with slanting excursions and modified secondary waves, the reflux waves becoming less distinct.

Feit gives the result of experiments made to ascertain the *effect of drip sheets upon nitrogen consumption* and assimilation of the nitrogenized constituents of food in four students, aged from twenty-three to twenty-five years, who, during a period of twenty-one days were under close observation. The method employed, food given, etc., are stated in detail. The treatment was given morning and evening. In all these cases the nitrogen consumption was increased, the maximum being thirty-one per cent, the minimum one per cent. *Assimilation* of nitrogenous materials was improved in all instances; the *appetite* increased in three cases and diminished in one case. The *pulse* became slower, and remained so for an hour; the *respiration* was deepened, but there was an average increase.

The *vital capacity*, studied in five women after a drip sheet of 54°, was increased by from three hundred to fifteen hundred kilograms; an increase of from one hundred to one thousand kilograms remained for an hour in four cases out of five.

In 1890 Everneeff observed carefully the influence of the drip sheet upon the assimilation of fats in healthy persons from nineteen to twenty-nine years of age. Although the appetite was increased, there

* Blätter für klinische Hydrotherapie, Nos. 1 and 2, 1894.

was no noticeable change in the *assimilation of fats*, judged by the excretion of fatty acids, etc.

Therapeutic Indications.—There are many chronic ailments to which the drip sheet is applicable, especially as a substitute for the douche, which can be had only in institutions, viz.: as a tonic in chlorosis, anæmia, and neurasthenia; as a derivative in intestinal catarrhs; as a revulsive and alterative in melancholia, hypochondriasis, neuralgias; and in pulmonary and bronchial diseases.

The flexibility and simplicity of the method commend it especially. It is probably the most flexible hydriatric measure known. By wringing the sheet well out, or by using a coarser sheet or a lower temperature or a shorter time, or by slapping with instead of simply pressing the outstretched hand over the wet sheet, the local excitation of the cutaneous nerves and vessels will be enhanced just to the extent which the judgment of the practitioner may deem requisite. By saturating it with more water the antipyretic effect is increased, which may be still more intensified by more prolonged application and more frequent addition of colder water, or by a finer texture of the sheet. The duration of the sheet bath is a matter for the most careful discrimination. *Two to five minutes* suffice in most cases for the tonic effect, while for the antipyretic effect fifteen to twenty minutes may be necessary. It is, of course, understood that the excessive sensitiveness of the skin in the presence of cutaneous diseases, or any inflamed surface, preclude the use of the sheet bath entirely.

In the care and judgment necessary in adapting the sheet bath, as most other hydriatric procedures, to various conditions, must be sought the reason why the best-informed medical men in France and Germany send their chronic cases which have resisted simple measures to colleagues who have made a special study of hydrotherapy, and consign them to their treatment entirely. A large experience enables these gentlemen to adapt, by infinite variations, seemingly slight to the uninitiated, certain modifications which promote recovery after less intelligently applied hydriatric measures have sometimes failed.

I do not desire to be understood, however, that the general practitioner is not perfectly competent to treat such cases hydriatically. On the contrary, *it is the aim of this work to lend him such assistance as may enable him to treat his patients at home, and to discover the limitations of domestic treatment, for many cases are needlessly sent away from home to water-cure establishments in which water is anything but scientifically applied.*

The Cold Rub.

This is the "kalte Abreibung" of the Germans, who apply it usually in the morning on rising from bed, while the patient is still warm. It is a modification of the drip sheet.

Technique.—A linen sheet, preferably of coarse texture, is wrung out of water at 60°–75° and quickly wrapped around the patient in the manner described above. Frictions are made by rapid passes, as with the drip sheet, but there is more active rubbing done, because the object here is not to abstract heat but to produce a decided cutaneous hyperæmia. Frequent slapping (Abklatschen) facilitates the attainment of this object.

The duration of this procedure varies with the object in view. After the rub the sheet is dropped; the patient is rapidly dried, dressed, and preferably sent into the open air after partaking of a cup of hot milk. The *therapeutic indications* of this procedure are anæmia of feeble persons, phthisis, and other conditions of defective hæmatosis.

Some neurologists have recommended this method under the name of "drip sheet" as an excellent procedure in rest-cure cases, for promoting sleep. The indefiniteness of current hydriatric terminology is illustrated by terming this procedure a drip sheet. How can we have a *drip* sheet after the sheet is *wrung out?* This erroneous term seems to have been perpetuated, as in several recent works a "drip sheet" is briefly described as being prepared by "wringing a sheet out of cold water," etc. Such errors must be avoided in discussing procedures; the latter should be definitely described or stated.

THE WET PACK.

The wet pack has been applied for a very long time in the practice of hydrotherapy. This procedure is not, as has been claimed, an invention of Priessnitz. It was described by Lucas, an English physician, in 1750. Doubtless Priessnitz discovered it independently, for he was too unlettered to have been aware of Lucas' writings. The followers of the peasant water doctor apply the wet pack more frequently than any other procedure. The wet pack, like all other hydriatric measures, requires care and precision in its application in order to be followed by good results. A dread of damp sheets is in the minds of the lay people so intimately associated with rheumatism and colds that the idea of being placed into a wet pack calls forth a shudder in the patient to whom it is novel, while, on the other hand, the hydropaths who are familiar with it abuse it by claiming innocuity and all manner of curative virtue for it.

The *technique* of the wet pack is as follows: A large woollen blanket is spread upon a hair or other mattress, most appropriately placed (if a wire mattress is used a rubber sheet must intervene to protect it from the moisture) upon a high four-legged cot, best located in the middle of the room, so that the attendant may have ready access to it from all directions. A large coarse linen sheet, *well wrung out* of water of a temperature of from 60° to 70°, appropriate to the case, is

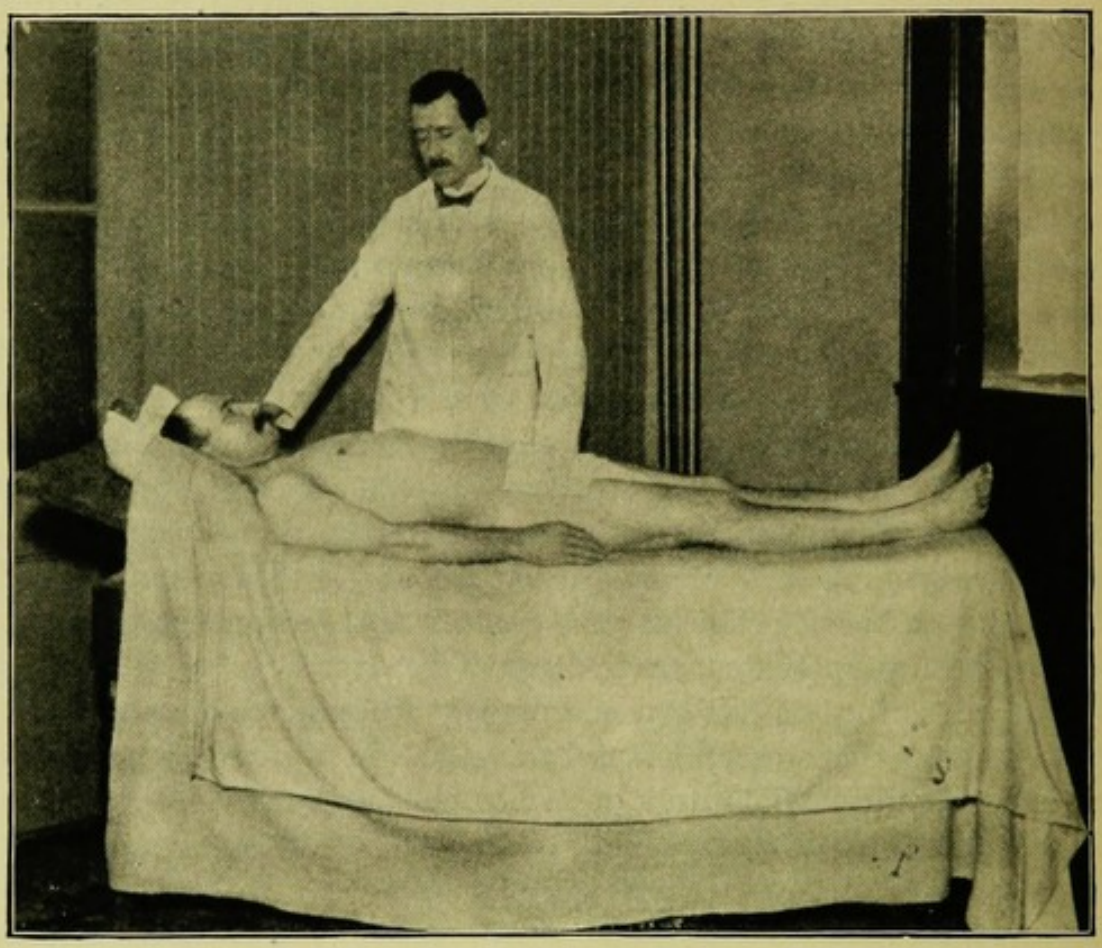


Fig. 26.—Wet Pack in Readiness, Showing Wet Sheet and Blanket.

spread upon the blanket, which should be long enough to extend two feet or more beyond the patient's extremities, and so placed that its left third hangs over the left edge of the cot (Fig. 26). The patient, provided with a wet turban, now lies upon the cot with arms elevated above his head, so that he occupies the junction of the middle with the right third of the sheet. The latter is now drawn across the body from right to left; its upper portion is tucked along the left side of the trunk; its lower portion is placed between the lower extremities (Fig. 27). The arms are now restored to the side of the body; the left overhanging portion of the sheet is brought over from left to right so as to envelop the arms and entire body, and its border is tucked along the right side, as shown in Fig. 28. The blanket is now

drawn firmly from the left and tucked under the right side of the body, the right border of the blanket being drawn over to the left in the same manner, firmly secured under the body, and its upper corner drawn around the neck and secured beneath it (Fig. 29). The lower border is firmly tucked around and over the feet. *Everything depends upon complete exclusion of air from beneath the blanket cover.* The patient is now covered with several woollen blankets, if he is chilly.

FIG. 27.—Wet Pack. Sheet drawn from right to left.

If the covering has been skilfully done, the patient will resemble a mummy whose head is enveloped in a wet turban (Fig. 30).

Modifications of this procedure consist in partial packs, in which only parts of the body below the axilla are enveloped in the damp sheet. The duration of the pack (which should be from one-half hour to an hour), the texture of the sheet, the temperature of the water, and the extent of the pack, as well as its repetitions, modify the effect materially, as will be seen. All wet packs must be followed by some hydriatric method which restores tone to the cutaneous vessels that have been relaxed by it. Either a half-bath, a sheet bath, or a cold ablution will serve the end, and these are selected with regard to the need of each separate case. In institutions, the circular bath and douche of

70° to 80° afford a more pleasant because more rapid sequel to the wet pack. The room in which the wet pack is administered should be well ventilated until a short time before the patient is removed.

Rationale of the Wet Pack.—The first effect of contact with the cold damp sheet is an irritation of the cutaneous nerves and vessels, which induces contraction of the peripheral vessels, and which continues until the individual's power of reaction comes into play. This de-

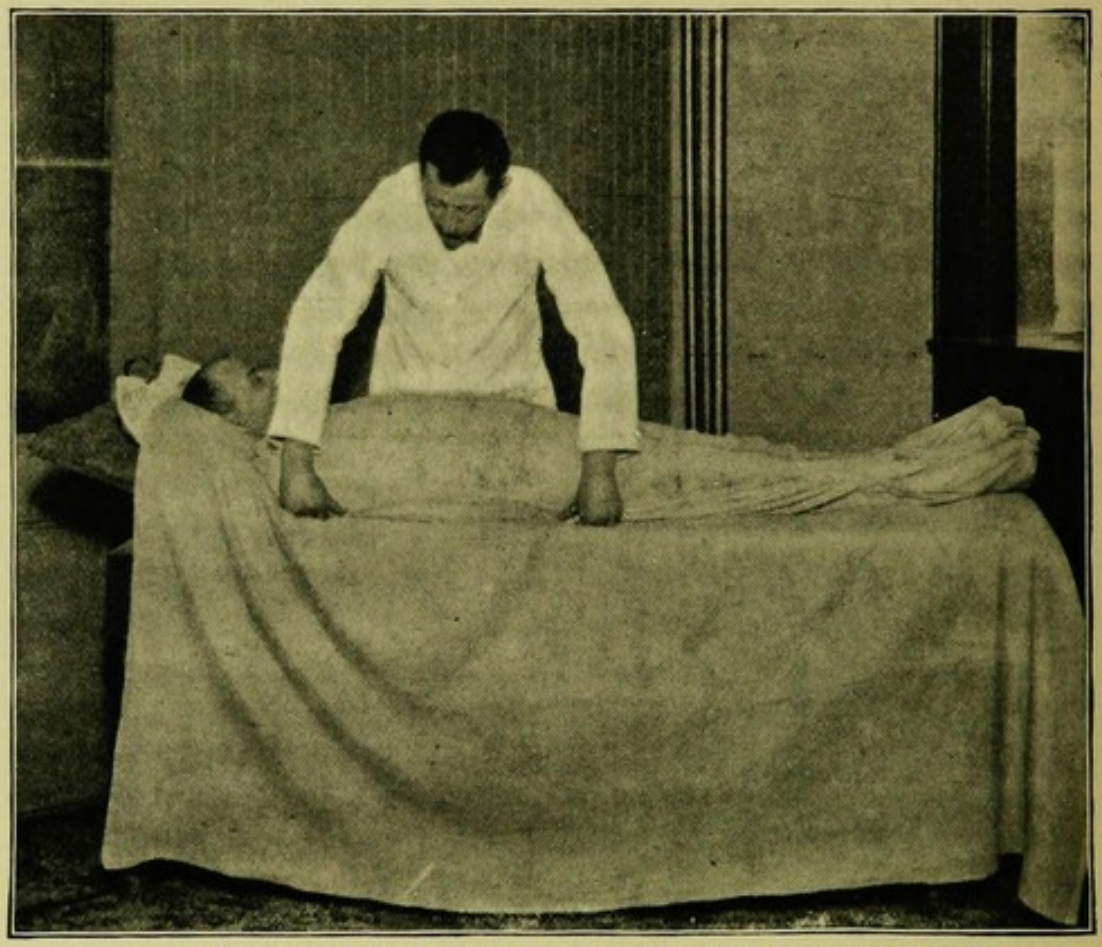


FIG. 28.—Wet Pack, Second Stage. Sheet carried from left to right.

pends, as in all hydriatric procedures, upon the age and condition of the patient; old people and children do not react so readily as adults, and a previous high temperature of the skin furthers rapid reaction, as does also a vigorous normal condition. It should be borne in mind that the wet pack differs from the preceding methods in an important respect. There being no mechanical aid given by attendants, as in the sheet bath or half-bath, *reaction depends entirely upon the vital powers of the patient.* This fact distinguishes the wet pack completely from all other hydriatric procedures, and demands judicious recognition of the patient's reactive capacity. For this reason it should not be resorted to until the latter has been well ascertained or trained by other procedures.

As soon as the first shock is over, which lasts from five to twenty minutes, and sometimes produces shivering, the cutaneous vessels begin to dilate; warm blood flows from the centre to the periphery, in the effort the system makes to equalize the temperature between the skin and the sheet. When the body temperature is high, as in fevers, there is no chilliness. The cooled blood is at first driven from the surface to the subjacent structures, but very soon the warm blood from

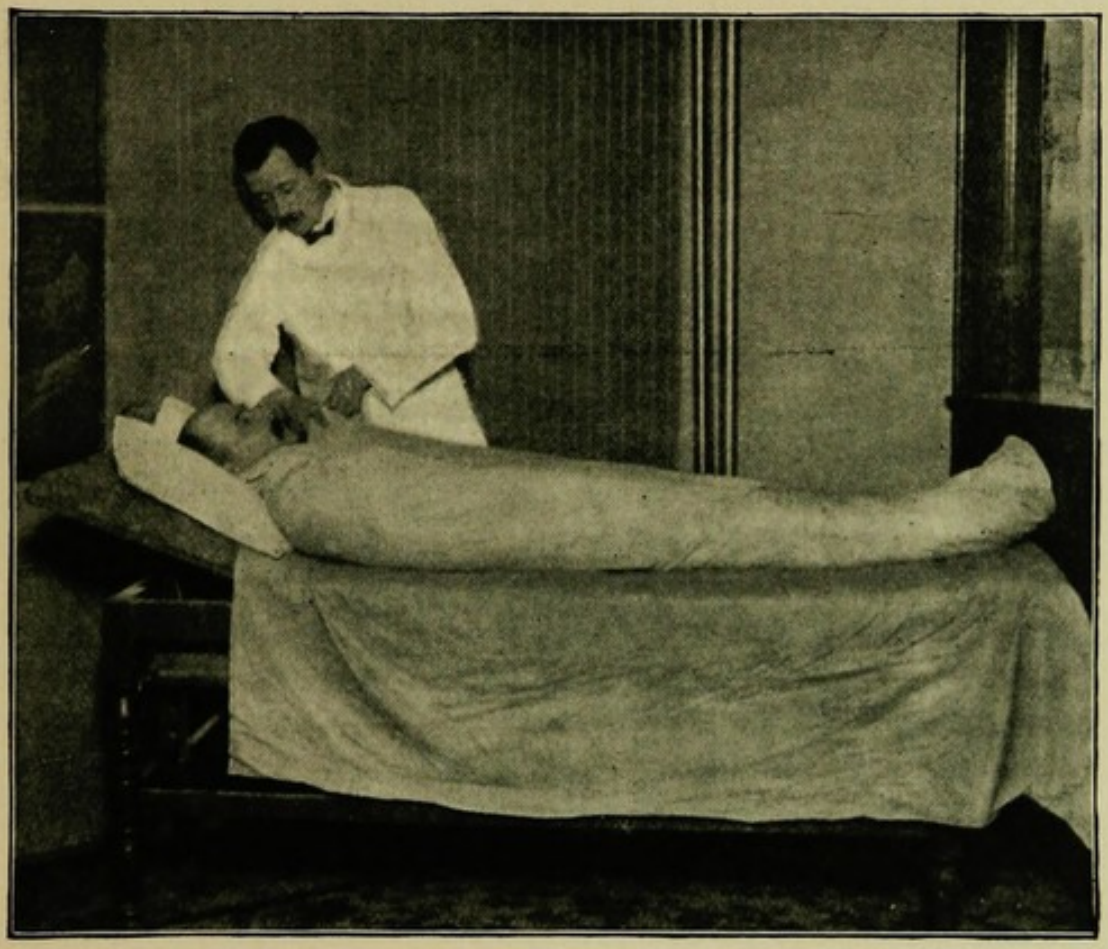


FIG. 29.—Mode of Securing Blanket, rubber sheet being shown hanging over cot.

the interior takes its place, and dilatation of the cutaneous vessels is the result. This continuous interchange of temperature, which occurs easily and slowly in patients with normal temperature, gives rise to a vaporization from the sheet which, in fever, furthers loss of heat from the skin. The latter is increased by radiation from the blanket, and by the state of rest in which the patient is placed and the consequent formation of a vapor which envelops the entire body. This continues as long as the sheet remains cool and just as long as the thermic irritation is renewed, more feebly each time, until the sheet is thoroughly warmed.

Under more prolonged application of the wet pack (with which the author has had no experience) Ziegelroth* has found the additional

* Deutsche Medizinal-Zeitung, July 5th, 1897.

effect of elimination of toxins. After detailing how the primary irritation by cold arouses a reflex excitation of the respiratory and cardiac centres, and how reaction ensues, producing a widening of the cutaneous vascular area, he points out that the skin is so filled with blood and heated by the latter that after an hour the sheet will steam on removal. This hyperæmization of the skin should not be interrupted, but the wet pack should continue three hours. The skin now excretes

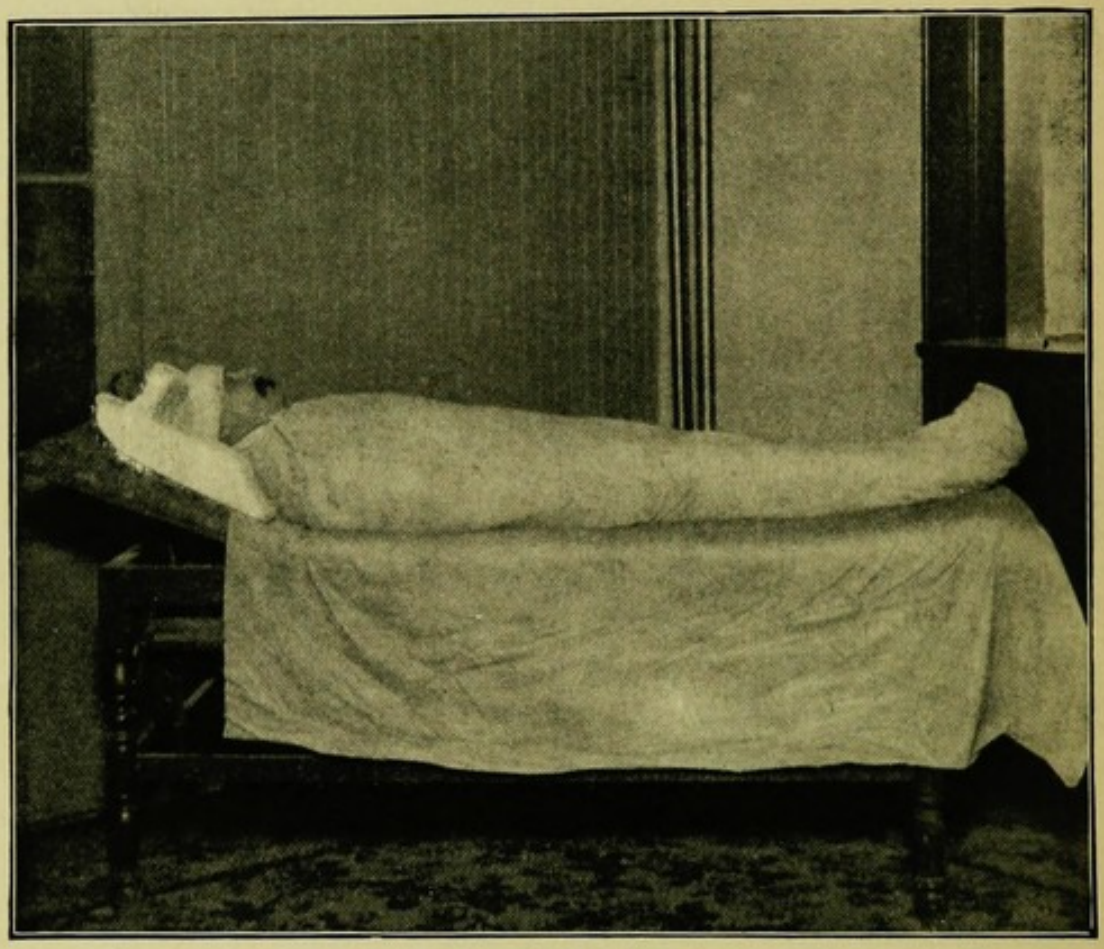


FIG. 30.—Wet Pack, Complete.

more actively, producing evaporization into and through the damp sheet. The odor of the latter when removed often bears testimony to this enhanced excretion. The relief felt by most patients Ziegelroth ascribes, aside from the favorable influence upon the circulation, to the removal of toxins. Although this latter claim has not been sufficiently well demonstrated, the odor of the sheet is substantiative evidence. It has been specially observed in acute rheumatism. This eliminative process is aided materially by the excitation of cellular combustion, induced by the pack. No better measure is open to the physician for furthering intra-organic oxidation, for the combustion of autotoxins, for transmutation of the products of regressive metamorphosis into soluble substances capable of elimination. Bouchard, who is a well-known

authority on the subject, has said: "Chose remarquable, ces hommes à sécrétions sudorales fétides cessent d'exhaler une odeur mauvaise, s'ils viennent d'être atteints de quelque maladie fébrile." It is positive that these autotoxins are consumed in the powerfully enhanced combustion which represents the fever process, and that they are thus eliminated from the organism. The so-called "curative power of fever" probably is due to this oxidation of toxins and autotoxins, and it may also be the reason why sometimes chronic diseases are removed by acute intercurrent diseases, and why many individuals feel much better after acute febrile diseases. The prolonged applications of the wet pack, two to three hours, would therefore seem to offer upon this *rationale* a method of elimination which may serve many useful therapeutic purposes.

Experiments upon animals for the demonstration of the *rationale* of the wet pack are not wanting.

Schüller has shown the action of the wet pack upon trephined rabbits. He wrapped them in a sheet wet with water at 34°, and covered them with wax cloth and woollen blankets, snugly tied up, so as to leave only the head free, and laid them for two or three hours upon a table. The temperature sank one or two degrees, but began to rise again in two and a quarter hours. The respiration became more slow and deep, and the pulse less frequent. The animals reacted less to irritants and at first seemed to be drowsy, but with the rise of temperature they became more lively and began to kick actively. A striking effect upon the vessels of the pia mater, which had been exposed by trephining, was noted. After a primary rapid dilatation the vessels became narrower, the brain sank in more and more, and the dura mater was raised up by cerebro-spinal fluid, which accumulated abundantly underneath it. The cerebral movements became more slow and more equable. This lasted several hours. External irritants, pinching, rubbing, or lifting the animals, produced at first rapid but afterward shorter cerebral movements and greater but changing dilatation of the vessels. As soon as the pack was removed dilatation of the vessels occurred, but they soon resumed their normal calibre. Respiration and cerebral movement became more frequent. Warm compresses upon the belly and back of the animal produced a contraction of the vessels of the pia, with acceleration of pulse and respiratory movements; the former became less perceptible, the latter more shallow.

These experiments render the action of the wet pack upon the human body intelligible. We often find the patient slumbering as soon as the temperature is equalized between the body and the sheet, and warmth is evolved by the reactive process, which fills the cutane-

ous vessels and thus diminishes the amount of blood in the cerebral vascular area. Moreover, the quiescent state of the patient, and the removal of all those reflex influences which arise from the cutaneous nerves and are conveyed to the brain in ordinary conditions, must contribute to the calming effect of the wet pack.

The effect of the wet pack upon the muscular system has received careful attention from Vinaj and Maggiora.* After retaining the indi-

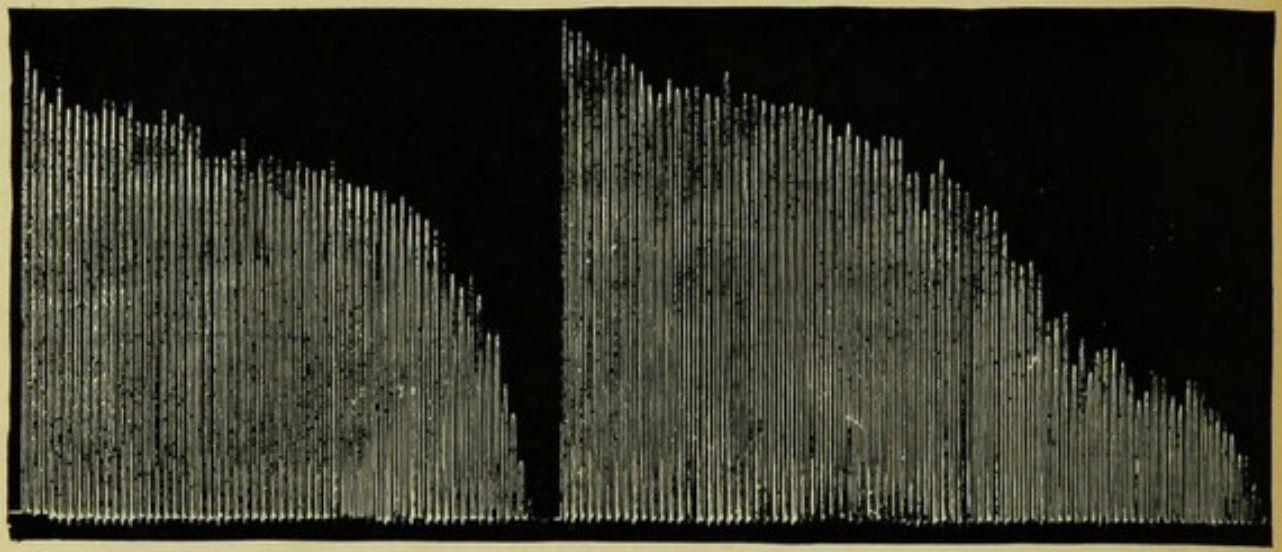


FIG. 31.—Fatigue Curve of Left Hand, after wet pack of two hours.

FIG. 32.—Fatigue Curve of Right Hand, after pack and cold dip.

vidual in the wet pack two hours, the left middle finger was exposed and its fatigue curve taken (Fig. 31). Immediately afterward he was removed from the pack and dipped into a tub of cold water. Now the "fatigue curve" of the right middle finger was taken (Fig. 32). These were compared with the normal curve taken before the pack, which was identical with Figs. 1 and 2.

TABLE SHOWING MUSCULAR LIFTING-CAPACITY AFTER WET PACK.

Curves.	Conditions of Experiment.	LEFT HAND.		RIGHT HAND.	
		Lifted, Height. Metres.	Working Result. Kgm.	Lifted, Height. Metres.	Working Result. Kgm.
(1) Fig. 31.....	After wet pack	2.370	7.110		
(2) Fig. 32.....	After cold dip	.....	.....	3.840	11.520
3	Normal	1.737	5.211		
..	Normal	.....	.....	1.690	5.070

This table shows the enormous increase of lifting-capacity after the wet pack followed by the usual cold bath, and it furnishes a partial *rationale* for the tonic effect usually derived from this procedure.

* Blätter für klinische Hydrotherapie, 1892.

Therapeutic Indications of the Wet Pack.—If abstraction of heat is the chief aim, the temperature of the sheet should be 60° to 70° for the first pack; the patient must be removed from the pack when the latter is warm, and placed in another two degrees higher, which has been prepared on the same or on an adjoining bed. He is again removed into another pack of two degrees higher as soon as he warms the sheet and superincumbent blanket, which is ascertained by applying the hand to various parts. Liebermeister has shown that five such wet packs of ten minutes' duration will abstract as much heat as one full bath at 65° F. for fifteen minutes. When the temperature, therefore, is high (above 102°), or when insurmountable objection is made to other more or less heroic measures, the wet pack is a useful and acceptable alternative in fevers. The physician must decide whether he would prefer five packs, consuming fifty minutes' time, to a full bath of fifteen minutes. The character of the case will aid him in this decision. My own experience is in favor of the full bath, if the ablution and sheet bath and half-bath have proved insufficient, and the proper help and tubs can be obtained. For mild cases, however, with temperature of 100° to 103°, especially in cases of non-infectious type, this pack is an admirable antifebrile remedy. As it may be modified by repetition of sheets wrung out of water of higher temperature, each application being of longer duration, if the body continues to cool, or by lowering the temperature of the damp sheet if the body temperature does not fall, we possess in the pack a most flexible remedy—subject to accurate dosage, as it were. In fevers, the first impression of cold upon the surface will cease abruptly and give way to the first-mentioned process of vaporization. This induces a soothing effect upon the peripheral vessels and nerves, and in patients who have been tossing restlessly sleep often ensues.

If this calming effect be the chief indication at that period of the disease, the patient having lost sleep or being on the verge of delirium, it would be wise to permit him to remain in the pack until he awakens, and then give him a rapid cold ablution. If, however, the high temperature without depreciated nerve tone—adynamia—be the therapeutic indication, the patient should be removed from the pack as soon as the blanket or sheet beneath begins to feel warm. He should now be put into another pack, as directed above, the process being repeated until four or five packs have been given, or the temperature has been sufficiently reduced, precaution always being observed to permit him to remain in the last pack, which cools but does not chill him, for ten or fifteen minutes. If he is not too much fatigued, a rapid ablution with water of from 50° to 60° should be administered before he is again dressed. This method is slower, but its effect is more enduring than the more rapid cooling by the full bath, for the reason that the

compensating elevation, which is the normal conservative reaction, is more deliberate and tardy.

Many corroborative contributions from practical hospital physicians may be cited in favor of the wet pack in acute diseases. Rendu * offers the results of ten years' observations with the wet pack. He claims that it may be readily substituted for the cold full bath; that it reduces temperature and favors elimination of toxic products; that it relieves the kidneys, refreshes the nerves and prevents cardiac collapse; that the lay public would more readily accept the cold wet pack than the cold bath; that it is, therefore, more applicable in private practice. Rendu yields to the prejudices of people who insist upon medication, by adding some innocent vegetable decoction or salt to the water of the pack. He claims that neither age nor constitution offers a contraindication to the wet pack. He lauds the prolonged wet pack especially in acute nephritis (in which Kussmaul has recommended it), and he opposes all diuretic remedies.

Wachsmuth has recommended the wet pack in severe diphtheria, losing three cases out of fifty, two of which were *in extremis*.

Rationale in Chronic Disease.—If the body temperature is normal or a little above normal, as is the case in most chronic diseases, the thermic irritation is the same as in acute disease, but the response to it is quite different, owing to the usually depreciated nerve tone and diminished reactive capacity. The peripheral vessels are contracted; the patient probably shivers longer, because the surface is not so rapidly supplied with fresh blood and the latter is more readily cooled. In extreme youth and in old age the power of reaction to the thermic irritation is diminished. This also depends upon the more or less vigorous condition of the patient, and, to a certain extent, upon his temperature. The cooling effect lasts ten minutes or longer, during which time the patient feels somewhat uncomfortable, and often begs to be removed from the pack. The first impact of cold upon the surface, too, often produces gasping respiration and enhances the discomforts experienced. These, however, pass away more or less quickly. The equalization between the body temperature and that of the damp sheet and the evaporation from the latter envelop the body in a vapor of its own creation. The relative labor to which the system is thus subjected is of great benefit to the circulation, and it has been demonstrated that it aids in enhancing tissue metamorphosis. The patient, lying quietly in the pack, often falls asleep. Indeed, I have seen at Professor Winternitz's institution at Kaltenleutgeben numbers of patients soundly sleeping, although the packs were usually given before 7 A.M., *i.e.*, just after rising from bed.

* Revue d'Hygiène Thérapeutique, June, 1893.

The calmative effect of an hour's sleep in a gentle poultice, as it were, is valuable in functional neuroses, hysteria, and some heart troubles, as will be shown.

Max Herz, of Vienna,* calls attention to the fact that by the wet sheet the epidermis is saturated with water. He investigated the radiation of heat in a feverish tuberculous patient, and discovered that despite an elevated axillary temperature, the patient did not lose more heat by radiation than did one who was free from fever in the same environment. Herz then soaked the skin thoroughly and found that heat radiation increased. Radiation depends upon the condition of the cutaneous surface, and there can be no doubt that a succulent epidermis radiates heat more readily than a dry skin. The heat given off by the epidermis is always replaced by heat furnished by the blood circulating beneath it. If the epidermis is a bad conductor, loss of blood heat meets greater resistance, while in a better conducting condition it literally "sucks up" the heat. These observations afford a rational explanation of the antithermic effect of wet packs.

In an able monograph on the wet pack and massage, which is the only scientific contribution to hydrotherapy yet made in this country, Dr. Mary Putnam Jacobi furnishes so intelligent and comprehensive an explanation of the wet pack that I reproduce it in testimony of my appreciation of this isolated contribution to the subject by an American physician.

"The increased production of heat, determined by the stimulation of the heat-regulating apparatus, irrespective of the amount of heat abstracted by the cold, involves functional activity (1) in the sensitive afferent nerves; (2) in one or more parts of the nerve centres; (3) in centrifugal nerve fibres of some kind terminating in muscles; (4) in the muscles where are performed the chemical processes involved in the production of heat. Thus the organism is induced to perform a definite and not inconsiderable amount of work. On this account its nervo-muscular tissues, or a large portion of them, are brought into a condition favorable to nutritive assimilation. But this is not all. When the reaction after the cold pack is normal, the column of blood which sets inward toward the chylopoetic viscera very soon turns outward again, accelerating the entire circulation of these organs in the same direction. As a most important result, more nutriment is carried into the general circulation, and with the abatement of the gastro-intestinal hyperæmia the appetite revives.

"Sleepiness during the pack nearly always occurs in successful cases, and we have found the greatest benefit to accrue when the patient was able to sleep for half an hour after the completion of the pack

* Monatschrift für praktische Heilkunde, Juli, 1895.

and massage. If we may assume, for reasons already stated, that during the first period of the pack blood circulates in increased volume and under increased pressure through the nerve centres, and that in consequence the acid fatigue products, which have been maintaining a permanent excitation of nerve elements, can be completely removed, the immediately subsequent diminution of blood supply, effected during the second part of the pack, cannot fail to be a great advantage, for it lowers the functional activity of the nerve tissues that has been unduly prolonged, and brings them, therefore, into the condition which is a necessary preliminary to the beginning of nutritive assimilation. The diminution of blood supply is not sufficient to interfere with this latter process, for it is not below the point which exists in sleep, the physiological period of the nutritive assimilation in nervo-muscular tissues. Accepting Ranke's law for these tissues, that they are only nourished when fatigued, *i.e.*, relaxed, we may see further in the muscular relaxation induced by the warm moisture of the pack a condition most favorable for the nutrition of the muscles."

The *therapeutic applications* of the wet pack in chronic diseases are extensive, it being valuable in all chronic cases in which defective tissue metamorphosis is a prominent element, as in *diabetes*, *rheumatism*, *gout*, some disorders of the digestive apparatus, *anæmia*, and *chlorosis*. In the functional neuroses the wet pack offers a means of allaying irritability, and, if succeeded, as it should be, by a half-bath, douche, or other active mechanico-hydriatric procedure, it will refresh the nervous system, improve tissue change and the blood-making function, and invigorate the circulation. Thus a combination of effects results which no other procedure is capable of furnishing.

THE WET COMPRESS.

This simple application is perhaps the most universally used hydriatric procedure. In Germany it is called the Priessnitz Umschlag. Although this water quack doubtless was original in its application, the merit of its invention should be assigned to Lucas, the discoverer of the wet pack, of which it really is a modification. All that has been said of the *rationale* of the latter procedure may be applied to the wet compress.

Technique.—Two or four folds of old *linen*, thin or thick as may be required, and of the necessary size and shape to conform to the part which is to be treated, are formed into a compress. Cotton cloth is objectionable, because it does not receive or hold moisture so well. If, however, linen is not available, the oldest and most worn cotton cloth should be selected. The compress is wrung out of water of the re-

quired temperature and is covered with flannel or with a dry piece of linen of the same shape, but an inch or two larger in every direction. As the method differs in accordance with the therapeutic aim, it is necessary to enter into a detailed description of the compresses commonly applied to different parts of the body.

The head compress consists of a *linen* towel well wrung out of water at 60°–75° F., which is applied to the head like a turban. It is useful in all procedures in which retrocession to the cerebral vessels may be apprehended, as in wet packs and hot-air baths. It is a commonly accepted idea among hydrotherapists that this application prevents uncomfortable symptoms and even dangerous congestions. Whether this purely empirical practice is based on correct reasoning or not, the wet turban certainly renders the procedures in which it is applied more agreeable.

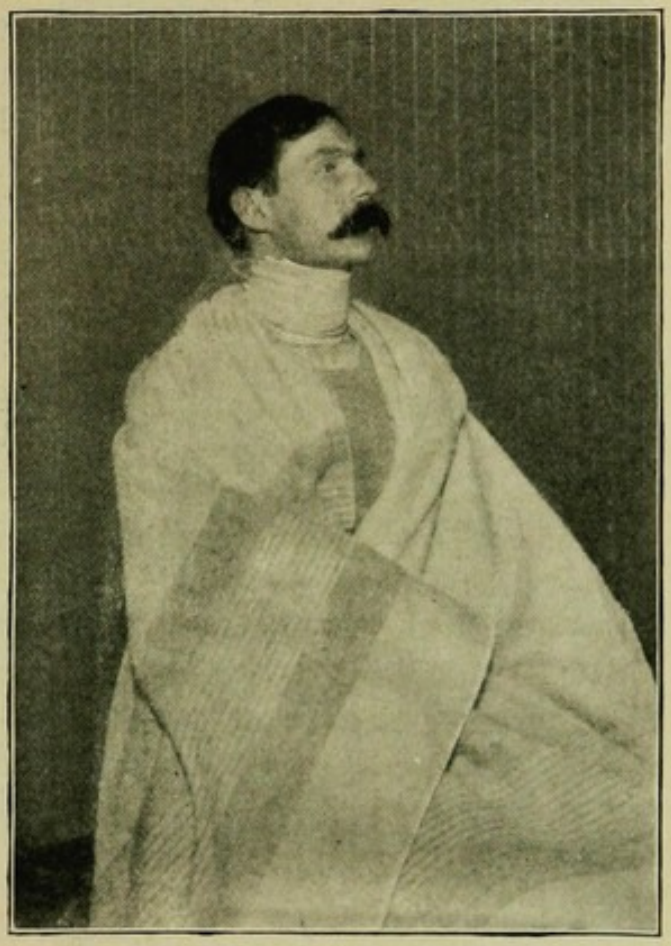


Fig. 33.—Imperfect Throat Compress.

The Throat Compress.—Although this compress is probably more frequently applied than any other, it is remarkable how little its *rationale* is understood and how imperfectly it is applied. The usual method is to fold a handkerchief or napkin into a narrow bandage, dip it in cold water, wring it out, and wind it around the neck, securing it by a pin (Fig. 33). In a very short time the movements of the patient displace this bandage, which has been applied loosely to prevent choking, so that it loses its shape, allowing air to enter freely from above; more or less chilling is then produced and the compress dries rapidly. As will be seen in the description of the therapeutic indications of the throat compress, the object is defeated by this imperfect application, unless it is intended to treat some tracheal or laryngeal trouble. When intended for the treatment of tonsillitis, diphtheria, and other pharyngeal affections, the throat compress should be applied as follows: A piece of old thin

linen, of sufficient length to reach from below the ear on one side to the same point on the left, is folded into a bandage of four layers. A piece of flannel, eight by twenty-four inches, provided with a slit for each ear, is also made ready. These bandages are *fitted* by actual measurement to the patient's head, so that they may pass under the chin from ear to ear. The linen compress bandage is now wrung out of water at 60° and laid upon the middle of the dry flannel bandage. While the wet bandage is placed under the chin, the flannel bandage is unrolled from the top of the head and passed over the right side of the head (the right ear being made to protrude through the slit), and then passed under the chin to the left side, where the left ear is also allowed to protrude (the slit being made longer than actually needed, to insure perfect apposition of the bandage and prevent pressure on the ear). The entire bandage is now firmly drawn over the head and secured by pins (Fig. 34). Two sets of bandages are required—one being allowed to dry while the other is in use.

FIG. 34.—Throat Compress.

In children and restless patients, additional security is afforded by a circular turn around the head, forming a bandage to which the throat compress may be pinned.

The chest compress is prepared by cutting three folds of old linen of a sufficient size to fit the entire chest from the clavicles down to the umbilicus, with slits in the region of the axillæ, made by exact measure, sufficiently deep to allow the upper edge of the compress to reach above the clavicles and admit of the junction of the flaps thus formed on each side, to cover the shoulders. Two such jackets, and two pieces of closely woven thin flannel of the same shape, but an inch wider and longer, should be provided and fitted to the patient. One of the linen compresses is rolled up and soaked in a basin of water at 60° F., and

wrung out so that it remains quite damp without dripping. The flannel is now spread out upon an even surface and the wet compress put upon it, so that there remains an edge of flannel about an inch wide all around. Both are rolled together half-way. While the patient is gently turned upon his left side (Fig. 35), with the precaution of not allowing any exertion on his part, the compress is so placed upon the bed that the rolled part lies in close proximity to the left side of the patient and the lower edge of the left slit is under the left axilla. Now the

FIG. 35.—Application of Chest Compress.

patient is quietly turned upon his back, so as to release the rolled-up portion. The latter is now unrolled, and both edges of the compress are brought forward upon the front of the chest and are thus made to envelop the latter snugly. The flannel cover, which has been allowed to lie upon the bed during the application of the wet compress, is now brought forward so as to cover the latter. It is secured by two safety pins in front and one pin upon each shoulder (Fig. 36).

The well-known oil-silk jacket may serve as a model *for the shape* of this wet compress. It should be changed every half-hour, unless the patient's temperature is below 102.5° F.; every hour unless the temperature is 99.5° F., when it should be discontinued. Before the change is undertaken the second compress is prepared in the same

manner as the first, care being taken that the water temperature shall be 60° F. When it and its flannel covering are rolled up in readiness, the first compress is removed and the second is applied. Thus a rotation is kept up every half-hour or hour, as the case may require, night and day, unless the patient is asleep. The water in the basin should be renewed each time, and the compress rinsed off in another basin before it is rolled up for soaking, in order to insure thorough cleanliness and

FIG. 36.—Chest Compress Complete.

prevent furuncles by furthering asepsis. Two sets of compresses are required to admit of changing each.

The *technique* of the procedure has been entered into with a detail that may seem needless. As will be shown later, these details insure precision, and upon their exact execution may depend success or failure. The physician should himself supervise the first application of all compresses, just as he should supervise the first Brand bath in typhoid fever. A skilled nurse can apply these compresses with a minimum of disturbance.

There is need, too, of individualization. In the average case a temperature of 60° F. will be appropriate. Should the patient evince stupor or muttering delirium, a lower temperature should be adopted, and the chest should receive one or more dashes of colder water before

renewal of each compress. The same procedure is indicated in broncho-pneumonia, when the bronchi are blocked by secretions or cyanosis exists.

A higher temperature than 60° F. may be used if there be much jactitation, insomnia, or excitability. In the latter event great benefit will accrue from allowing the compress to remain two hours and moistening it more thoroughly before application, thus converting the compress into a soothing fomentation that is not relaxing like a poultice.

The *rationale* of this chest compress will be fully discussed in an article on pneumonia.

An excellent chest bandage has been devised by Winternitz and termed by him "crossbinder" ("Kreuzband"). A bandage made of linen 2½ to 3 inches wide and 16 to 20 inches long, two folds thick, is wrung out of water at 60°–70° and prepared. The left end of this bandage is placed on the back below the left shoulder; it is now carried forward across the chest, turned around the latter, and brought forward across the chest in front over the left shoulder, and again around the chest below. This is covered with flannel.

The abdominal compress consists of a piece of linen in three folds, of sufficient size to reach from the sternum to the pubis and lap over on each side of the abdomen. This is wrung out of water at 60°–70° F., and held in position by a flannel bandage a little wider and long enough to reach around the body, being snugly secured in front by safety pins.

When a change of this bandage is necessary the flannel is simply opened, the fresh compress applied, and the flannel again secured. When the latter becomes so damp as to convey moisture to the bed clothing, it should be changed. It is always well to keep two or more sets of compresses on hand. Each compress should be boiled once a day for fifteen minutes, to prevent septic furunculosis. The author is cognizant of an instance in which a most able physician became prejudiced against these compresses, because his hospital patient, a depreciated individual, suffered from painful furuncles while convalescing from a severe attack of pneumonia treated with compresses. If the exact technique here described be followed, no untoward circumstances will occur. The nurse should be cautioned to provide a dry flannel cover to prevent the patient's clothing and bed clothing from becoming damp. Rubber sheets must be avoided; they prevent evaporation and defeat the object of the compress, which is cooling and secondarily stimulating. An extra sheet folded several times and placed under the trunk of the patient is the best protection. This precaution applies to all compresses.

The Neptune girdle consists of a bandage of coarse linen, suffi-

ciently large to cover the entire lower part of the trunk, from the ensiform cartilage to the pubes, and long enough to reach around the entire trunk and afford a double cover for the abdomen. This is wrung out of water usually of 60°–75°, snugly wrapped around the body several times, covered with another linen or a flannel bandage and secured by pins. These bandages are changed twice or three times in twenty-four hours, the part being washed with cold water each time before a fresh bandage is applied.

The Combination Compress of Winternitz.—This is a modification of the *Neptune girdle*, which is applied in certain conditions mentioned

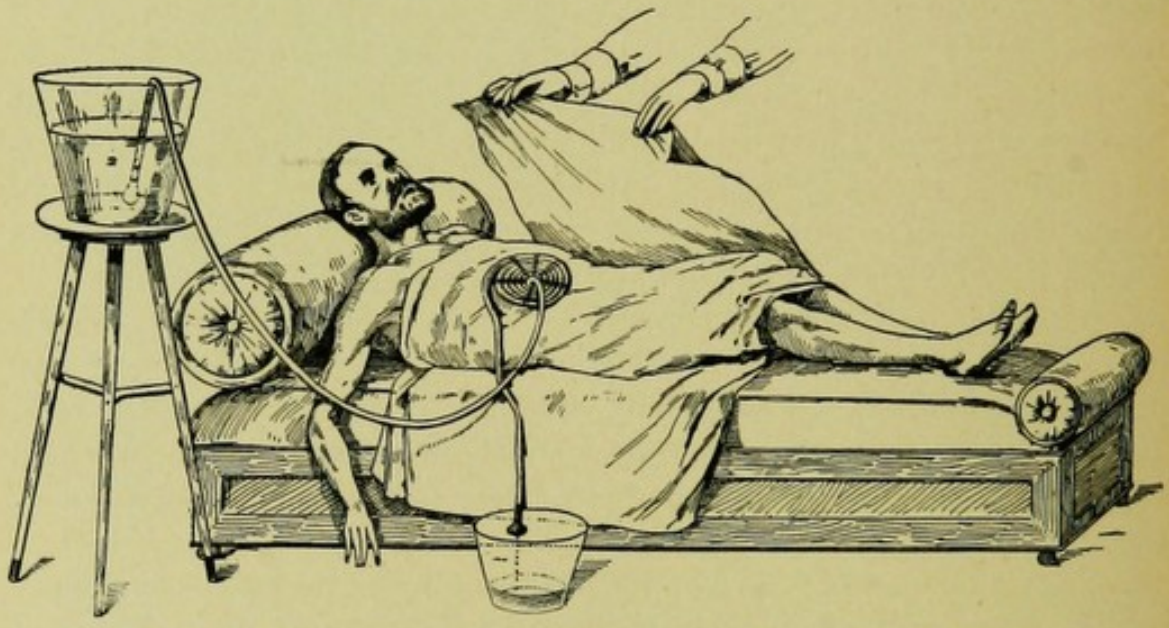


Fig. 37.—The "Winternitz Combination" Compress. (From "Blätter für klinische Hydrotherapie.")

below. He applies the wet compress as usual, but lays a Leiter or rubber coil upon the epigastric region, and covers it with a dry bandage.

A bucket of very hot water being in readiness upon a shelf or other high point near the bed, the afferent tube of the coil is connected with the hot-water supply, which is made to flow through the coil into a vessel connected with the efferent tube (Fig. 37).

Rationale of the Combination Compress.—The cold wet compress enveloping the trunk from above the base of the ensiform cartilage to the pelvis produces, like all cold procedures, an anæmic condition of the skin beneath. The cutaneous vessels are contracted, the peripheral nerves are irritated, and the respiration is deepened. Reaction quickly ensues; the parts grow warm, the vessels become dilated in a tonic manner, and the circulation is rendered more active. Beneath the part which is covered by the coil containing hot water, reaction is more rapid and the part becomes warmer and hyperæmic. As a con-

sequence the epigastric region is covered by a warm moist vapor; a decided calming of the cutaneous nerves ensues; this is doubtless transmitted by reflex through peripheral ganglia to the underlying parts, which are at the same time rendered less congested by reason of the derivative effect to the skin.

This compress has been used with advantage in obstinate vomiting, organic or functional, even in the vomiting of pregnancy; in gastric catarrh, hyperacidity, ulcer of the stomach; also in dysmenorrhœa and pleuritis when applied instead of poultices; in typhlitis, pneumonia, meningitis. In the anorexia which is so common in phthisis and other wasting disease, it is highly lauded by Wendringer,* who cites several striking histories. Like Winternitz himself, he induced patients to take large quantities of food during the application of this compress and coil, and often the food was retained after failure of all other remedies to effect this result.

The *technique of the wet compress* differs according to the object aimed at, compresses being applied according to the latter.

The antiphlogistic compress is composed of two layers of old and thin linen, which are dipped into water not over 60° F., and applied snugly over the inflamed part. It is not intended to influence the latter when the inflammation is deeply seated. Its therapeutic action is due to a contraction of the inflamed vessels, which contraction must be maintained by frequent renewal and by avoiding any covering; otherwise the compress would soon be converted by the heightened temperature of the inflamed part into a fomentation or poultice, the effect of which would be contrary to that desired. The tonicity of the vessels is enhanced by the impact of the cold conveyed by the moist linen; the part becomes anæmic, and the circulation, which has been accelerated by the inflammatory process, is diminished. The process being inhibited, because the migration of white cells is interrupted, exudations are prevented, and the nutrition of the part is enhanced by the tonic stimulation induced by cold. An exact adaptation of the latter to the therapeutic indication is, however, essential, as in all other hydriatric procedures, for if the temperature of the water be raised beyond 75°, or if the cold be not maintained, the contraction of the cutaneous vessels will be followed by dilatation and the antiphlogistic effect will be inhibited. If, on the other hand, the temperature of the water be too low, 40° to 50°, the peripheral nerves and vessels may be paralyzed by its continuous application, or, if the latter be intermittent, dilatation must follow, which would not further our therapeutic aim, but rather oppose it by producing an afflux of blood to the already hyperæmic skin. For the purpose of cooling inflamed cutaneous parts near the surface, a

* Monatshefte für Wasserheilkunde, December, 1894.

compress moistened with water at from 50° to 60° F. should be applied; the latter may be frequently renewed by allowing cold water to drip upon the linen, the excess being received on a thickly folded towel lying beneath the part; or, what is still better, ice bags, or a coil through which cold water is made to flow continuously, may be applied over the cold compress for the purpose of maintaining the low temperature of the latter.

Cooling Deep-Seated Parts.—Contrary to the commonly prevalent idea that cooling applications made to the cutaneous surfaces penetrate deeply if sufficiently cold and prolonged, the author is convinced that the heat-regulating machinery of the body is immediately called into action for the purpose of resisting the invasion of cold into the interior and that it thus frustrates the object in view. The application of ice bags in pneumonia, pericarditis, peritonitis, gastritis, appendicitis, etc., is so universal that the author opposes this practice with great hesitance and reluctance. Due consideration of the experimental and practical data bearing upon this subject, however, may convince the reader, as it has convinced the author, of the fallacy of the established practice. The action of cold on temperature has been fully set forth on page 78, and therefore need not be reiterated. In connection with and in support of this physiological proof the excellent experiments of Dr. W. Gilman Thompson* may be of interest. Dr. Thompson etherized several dogs, shaved the abdominal wall, and made a small incision on one side of the latter through which a long-stemmed thermometer was passed to the opposite side of the abdomen. When the thermometer was felt pressed up beneath the skin an ice coil was applied for an hour. So long as the dog's circulation was maintained, the thermometer remained uninfluenced, but as soon as the dog was killed the temperature of the abdominal cavity began to fall very rapidly. Heat applied by poultices showed a corresponding behavior. In a cadaver with an abdominal wall not over one-half or three-quarters of an inch thick the cold of an ice coil penetrated very slowly, but finally, after three-quarters of an hour, it caused a diminution of intra-abdominal temperature of 25° F. If a cold coil be placed on the abdomen of a typhoid patient and water of 32° or 34° F. be allowed to run through it, a thermometer placed between the coil and the abdominal wall would average 64° to 70° F. Hence, so long as the circulation is fairly good, it appears to be impossible to influence materially the deep-seated vessels by external local contrasts of temperature; certainly it is impossible to control hemorrhage by these means, and, practically, Dr. Thompson has never seen any benefit from such attempts. If any result ensues it must come through very circuitous reflex action.

* "International Clinics," 1892.

Some interesting experiments by Silex* also demonstrate the fallacy of the views entertained on the application of cold for inflammatory conditions. He anæsthetized the conjunctiva with tropococaine. The temperature (ascertained by a thermo-electric apparatus) of the healthy conjunctiva was 1.51° C. less than that of the mouth, while in cases of conjunctivitis, corneal ulcers, etc., that of the conjunctiva was 0.89° C. less; inflamed eyes were only 0.62° C. warmer than healthy eyes. In a few cases of iritis the conjunctival temperature was 0.92° C. higher than the oral. The application of cold compresses to the lids *increased* the temperature of the conjunctiva; warmth *diminished* it. In a case of gonorrhœic blennorrhœa the temperature of the conjunctiva increased 2.24° C. after ice compresses were applied for ten minutes. His experiments on animals showed an increase of temperature in the organs over which ice had been applied.

Cooling applications to the head have long been in use in meningitis and other hyperæmic conditions within the cranial cavity. Esmarch has shown that cold may be conveyed through bone. This is probably because the circulation in the cranial bones not being sufficiently active to resist the invasion of cold into the interior they rather aid in conducting it to the meninges. The ordinary ice bags used for this purpose are clumsy and, despite their popularity, inadequate. Aside from their weight and roughness, there is always more or less condensation on the outside of the bag, which causes wetting of the pillow and conduces, in subfebrile conditions, to rheumatic pains. An improvement on the ice bag is a wet compress of two or three thicknesses, which is made to cover the head (preferably after the hair is clipped) and which is held in place by a rubber-coil cap (Fig. 38). Through the latter ice water may be made to flow for the purpose of maintaining the continuous low temperature desired.

FIG. 38.—Head Compress.

II. *The stimulating wet compress* is most frequently used. It consists of two or three folds of old but coarse linen, which is well

*"Ueber kalte und warme Umschläge," Münchener medicinische Wochenschrift, 1893, No. 4.

wrung out of water at about 60°, covered by a flannel or by another linen bandage, and allowed to remain until it is warmed thoroughly in acute cases, or until it is dry in chronic cases.

Not infrequently the stimulating compress does not warm up; the patient feels chilly and uncomfortable. The compress need not be discontinued on that account. It is necessary only to apply cold water with friction before the compress is applied in these cases, for the purpose of inciting the activity of cutaneous vessels by this thermic irritation and thus enhancing reaction. The same purpose may be accomplished by using much colder water for the compress and wringing the latter more thoroughly. This is contrary to the prevalent idea, which is based on the error that cold water depresses and warm water stimulates.

Rationale of the Wet Compress.—The usual effect of cold upon the cutaneous vessels is at once produced; they contract by reason of the stimulus from the cold; the part becomes cold, but very soon, according to the temperature of the water and the reactive capacity of the patient, an active hyperæmia ensues—the tonic dilatation so frequently referred to above. Now the compress becomes heated by the afflux of arterial blood beneath it; the further dissipation of heat being inhibited, it accumulates underneath the compress, which gradually attains the temperature of the part—the dry covering preventing rapid evaporation. Thus heat is accumulated until the compress becomes dry, so long as the application is snugly made; the vessels receive an active afflux of blood, local tissue metamorphosis is enhanced, and diseased conditions are removed by the improved blood supply. There is produced an alternating effect, cold succeeded by warmth, which eventually increases the quantity of blood circulating in the cutaneous vessels, and must also affect the circulation in the underlying muscles, because the vessels of the latter are in direct connection with the former. Moreover, these vessels are also connected with the deeper circulation, as is demonstrated by the enlargement of the abdominal veins which is often noticed in persons suffering from cirrhosis of the liver. As has been shown in explaining the *rationale* of other cold procedures, whenever the cutaneous vessels are contracted a compensatory dilatation of the deeper vessels ensues. Thus the deeper parts lying underneath the compress receive a sudden afflux of blood during the first impact of the cold compress, and when the cutaneous vessels dilate under the reaction which follows the vessels in the deeper parts are again narrowed. This active fluxion between the vessels of the deep and superficial parts must exert a powerful influence upon the latter. Moreover, the irritation of the cutaneous nerve endings by the sudden impact of cold, and the subsequent calming of their irritation by the

warming up of the part and its being bathed in a vapor, are conveyed to the central nervous system and thence reflected upon the organs depending upon the latter for innervation. We need refer only to the effect of the cold compress upon the inspiration, which is deepened, and upon the pulse, which is slowed.

A compress wrung out of warm water would produce a primary contraction of the cutaneous vessels, which would be followed by their relaxation and loss of tone, while the underlying parts would become hyperæmic. But in this instance the primary thermic effect upon the central nervous system would be almost *nil*, while the soothing effect upon the peripheral nerve endings would be decided.

Both cold and warm compresses produce decided effects upon the composition of the blood in parts lying beneath them and upon distant parts, also upon their temperature.

Effect of Different Compresses upon the Blood.—Winternitz has investigated the local action of stimulating and warm compresses.* He found that the composition of the blood after all thermic procedures differs according to the locality of the part from which the blood specimen is obtained, whether it lies near or upon the periphery or near the centre of the body. There was an increase of hæmoglobin in the blood cells and in the specific gravity of the blood as it approaches toward the central parts of the body, the blood from the finger tip or ear lobe being less rich than that of the skin over the abdomen or chest. The leucocytes did not obey this rule; they were sometimes increased at the periphery and sometimes at central points. After cold or warm compresses a great change in composition ensued in the blood of the parts to which they were applied and in the parts untouched by them.

The observation was almost regularly made that after cold an increase of erythrocytes, hæmoglobin, and specific gravity ensued. When cold was applied to the entire surface, the leucocytes were generally increased; local applications sometimes increased and sometimes diminished them. Decrease always resulted after cold sitz baths.

An examination into the effects of the so-called *stimulating compresses* resulted as follows: Before application blood from the finger tip showed 95 per cent of hæmoglobin, and 5,800,000 red and 10,000 white corpuscles; blood from the skin over the calf of the leg showed before the experiment 105 per cent of hæmoglobin, and 6,400,000 red and 8,800 white corpuscles. After a stimulating compress had been in position one and one-half hours around the leg, the blood was again examined and compared with that from the finger tip. This showed a loss of 5 per cent of hæmoglobin and of 500,000 red corpuscles, and that the leucocytes were also diminished. In the blood taken

* Blätter für klinische Hydrotherapie, 1894.

from the leg at a point where the compress had lain, the hæmoglobin had risen to 115 per cent, the erythrocytes had increased 1,000,000 to the cubic centimetre, and the leucocytes had increased 800. The change produced by the stimulating compress was most noticeable in the increase of red blood cells, just as we find in congested parts.

In order to ascertain the effect of warm compresses, the composition of blood from the finger tip and from the skin over the abdomen was studied. The finger-tip blood showed 95 per cent of hæmoglobin and 5,300,000 red cells; the blood from the abdominal skin showed 120 per cent of hæmoglobin and 7,000,000 red cells; while the leucocytes were 7,000, about the same in both specimens. After a warm compress (127° F.) had lain one and one-half hours upon the abdomen a comparison was again instituted, showing that in the blood from the finger tip the hæmoglobin had increased 10 per cent and the red cells 900,000; the leucocytes had also increased 1,000. But the blood taken from the abdominal skin beneath the cataplasm had lost 22 per cent of its hæmoglobin and 2,500,000 of its red cells, while the leucocytes were doubled.

This decided difference in the effect of cold stimulating and warm compresses should be noted. Active congestion, fluxion, and erythrocytosis were the result of the former, while the latter produced an acute leucocytosis with diminution of red cells.

This experiment demonstrates that the choice of temperature is not indifferent when wet compresses are indicated. Although the patient's sensations offer a fair guide, the *rationale* of cold and warm compresses enables us to adapt them to the actual requirements of each case. For antiphlogistic purposes it may be safely held that in the early stage of congestion cold applications are useful so long as the circulation in the affected part is still open, which is indicated by the turgor. But when the parts assume a cyanotic hue, when leucocytes have begun to adhere in large numbers to the vessel wall and emigration has become active, applications of warmth further the latter and hasten suppuration when it is unavoidable. The cold compress diminishes congestion, retards leucocytosis and emigration of white cells, while the warm applications have the contrary effect, each being most useful in the respective stage of inflammation.

The antiphlogistic effects of cold compresses are readily explained by the results of Genzmer's experiments * upon local blood letting. He came to the conclusion that the favorable effect of bleeding upon the inflamed parts beneath was ascribable, not to their becoming more anæmic, but to the fact that the blood stream became more rapid, and thus the corpuscles which had adhered to the vessel walls were loosened and

* Centralblatt für die medicinischen Wissenschaften, 1882, No. 13.

driven into the general circulation. The fluxion therefore which the application of cold or warm compresses produces in parts below them is the true cause of the changes in the latter when inflamed. Thus may the old theory of derivation be satisfactorily explained.

This effect of cold applications may be called into action in some local inflammations in which the parts appear cyanotic and it is important to prevent impending suppuration. Here hot compresses or cataplasms are also useful to arouse the surface circulation; as they cool off they widen the deeper vessels and thus re-establish the circulation which has become stagnant. This being accomplished, cold compresses may succeed the hot, in order to limit leucocytosis and by fluxion remove stagnant corpuscles. It is evident that by the exercise of sound judgment the proper temperature of the compress may be nicely adjusted to each case.

Effect of Compresses upon Temperature.—The effect of the stimulating compresses upon *the temperature of the part* has been studied by Winternitz, Pollak, and others.* During the first five minutes the changes vary from 1° to $\frac{3}{5}$° C. The cutaneous temperature reached its maximum most rapidly under a dry bandage of wadding, in five minutes. Under a wet compress of 104°, without cover, the temperature began to sink in fifteen minutes. Under moist compresses, with dry covering, around the chest or abdomen, the cutaneous temperature rose in some cases even after two and one-half hours had expired. The temperature of the skin fell if the wet compress was not protected by a dry one, doubtless owing to evaporation. The temperature between the skin and the compress continued higher than that of the skin, for an hour or longer, and fell when the compress began to dry. Covering the wet linen compress with some waterproof material prevented drying of the compress, owing to the obstruction of evaporation; the cutaneous temperature did not fall. The highest temperatures were obtained under dry compresses of linen and flannel, either covered with some impervious material or left uncovered. This observation would confirm the value of the old-fashioned cotton and oil-silk jacket for revulsive purposes.

The ideas entertained hitherto on the subject of cold and warm compresses are so vague that their mode of action, as ascertained by actual experiments, is of value. It is evident from these observations that there is no special advantage in applying hot compresses for revulsive purposes, because it is difficult to maintain their temperature. Such a compress, especially if covered with oiled silk to prevent necessity for frequent renewal, is chiefly useful for purposes of influencing local inflammatory processes by increasing leucocytosis, and thus bring-

* "Pathologie und Therapie der Phthise," 1887.

ing about suppuration when the latter is unavoidable or desirable. This observation confirms the value of the old-fashioned poultice, covered with oiled silk, which every practical physician has applied with satisfaction.

On the other hand, whenever revulsive action with a continuous tonic effect is desired, the cold wet compress, covered with dry flannel, is superior to all other applications, because it raises the cutaneous temperature in a physiological manner—by reaction—to a point beyond the normal, and on each renewal causes a dilatation which results in an afflux of blood into the part. Such compresses should not be renewed too often, however; the best rule being to renew them just before they become dry. If the patient complains of chilliness of the part, this is an evidence of feeble reaction, which may be counteracted by removing the compress and applying colder water with friction to the part for a very brief period, or by simply reducing the temperature of the compress. Here, as in all other hydriatric procedures, the fact is evident that the colder the water within reasonable limits and the more brief its application, the more active the reaction which follows.

Therapeutic Indications.—In *tonsillitis* and other inflammatory throat troubles the stimulating compress has been used effectively; not, however, as is ordinarily supposed, for the purpose of cooling the tonsils, etc., but with a view to producing a hyperæmia in the tissues lying between the inflamed part and the compress, and chiefly by reflex action to render the affected part anæmic. When suppuration is threatening and the physician desires to hasten it, the throat compress is less wrung out and is allowed to remain longer, in order to hasten the process by the warmth thus produced and maintained (see *Rationale* and *Technique*).

The *chest compress*, described above, is not used by the author for cooling purposes; for reasons referred to, he does not approve the application of ice or very cold compresses for hæmoptysis or pulmonary hyperæmia. The stimulating chest compress, however, is useful in phthisis and pneumonia. Aside from the effects referred to in discussing the *rationale* of all compresses, the chest compress causes a deep inspiration, and thus aids in filling the lungs with oxygen and expelling accumulated secretions. Evaporation from the heated compress slowly goes on through the badly conducting flannel covering, creating a warmth around the chest, which is comforting to the patient, allays cough and dyspnœa, and thus contributes materially to that alleviation of symptoms which leads to recovery. In phthisis and subacute pulmonary affections, and in chronic infiltration, the chest bandage may be worn day and night; in most cases its use at night suffices.

In febrile cases nothing contributes more to the reduction of tem-

perature, relief of pain, and alleviation of the general malaise than do the chest compresses, containing just enough water not to permit its flowing upon adjoining parts. Such a compress may be renewed as the case demands.

In *pneumonia* the chest compress is the most important remedial agent, if applied every half-hour when the temperature is above 102.5°, hourly if below, and removed when it falls below 100°. The cold compress (60° F.) produces a deep inspiration; it contracts the cutaneous vessels, which rapidly dilate and soon form a soothing poultice differing from the old-fashioned warm poultice in being more cleanly, and in maintaining a tonic dilatation which aids the heart in propelling the blood through the contraction of the vascular coats, which warm applications would paralyze by relaxation. One cause of heart failure will thus be removed by the half-hourly stimulus to the cutaneous arterioles, arising from the shock and subsequent reaction. That temperature is also reduced by the wet compress in pneumonia the author has repeatedly observed.

The *abdominal compress* has been found very useful in many acute diseases, especially in *typhoid fever* as recommended by Brand, for the purpose of continuing the reduction of temperature following the full bath, in gastritis, hepatitis, peritonitis, appendicitis, and in the entero-colitis of children and adults when accompanied by fever. In these cases it reduces temperature, and by producing hyperæmic conditions of the skin (contrary to the commonly accepted idea) it acts as a revulsive. Moreover, the soothing effect of such a compress is an invaluable therapeutic auxiliary in these trying cases, not infrequently preventing the necessity for anodynes, hypnotics, and antipyretics. For these purposes frequent renewal, about every hour, is required.

In many *chronic diseases* involving the intra-abdominal organs, be they functional or organic, a properly applied *Neptune* girdle will be found of great value. Here the wet compress should be worn until it is nearly dry. In the various chronic gastro-intestinal disturbances of adults and children, which lie at the foundation of dyspepsia, diarrhœa, and constipation, such a compress is very useful if worn day and night.

In *chronic appendicitis*, occurring in two colleagues, Drs. B. and W., a wet compress was worn continuously over the right iliac region for over a year, with the result that there has been no recurrence during the past ten years. I am in the habit of ordering these continuous wet compresses renewed twice or three times daily in many cases of old exudations near the surface of the body.

In *insomnia* the Neptune girdle, applied at bedtime, has served me well as an auxiliary by reason of its derivative and soothing effects.

In *gastric troubles*, especially in obstinate vomiting, the Winternitz

combined compress (page 118) has proved of good service after failure of all other measures. The first case in which Winternitz applied this measure was that of an hysterical woman, who was dyspeptic, had lost appetite, had eructations, cardialgia, and constant vomiting, which had reduced her greatly. Despite all treatment, including hydrotherapy and rest cure, she grew worse. Winternitz applied his wet compress covered with the hot-water coil and ordered a glass of milk half an hour later. Neither pain nor vomiting occurred. The application was repeated each time before nourishment was given. The latter was gradually increased in quality and quantity. After the patient left the bed, the apparatus was applied in the sitting-posture with the same result. Rapid improvement in the general condition, weight, and hæmoglobin ensued and continued.

In cases of *obstinate vomiting* of pregnancy Buxbaum* obtained a good result in one week. Wendringer reports in the same journal the successful management of great emaciation with diarrhœa in a pregnant woman, by the use of a high hot enema followed by the Winternitz combination compress.

In *acute, subacute, and chronic rheumatism* the wet compress is an important auxiliary to other treatment. In the J. Hood Wright Memorial Hospital acute articular rheumatism is treated with greater satisfaction, since the addition of these compresses. From twenty to thirty-five per cent of time is saved by the abbreviation of the attacks. The duration of the cases, as shown by a comparison instituted by members of the house staff with those of other hospitals, is certainly shortened. In these cases the wet compress should consist of two or three folds of old linen, tightly covered with flannel, and snugly applied on the joints; too frequent renewal being avoided by allowing cold water to drip upon the linen after exposing it anteriorly by removal of the flannel cover. Winternitz recommends wadding as a superior covering for the compress in subacute and chronic cases.

The *hot fomentation compress* demands a separate description. It consists of two pieces of old blanket, about eighteen inches square, which is saturated with boiling water, and thoroughly wrung out by means of a wringer. The latter may be constructed of a crash towel, to the upper and lower extremities of which strong sticks, about twenty-five or thirty inches long, are secured by stitching, so that their ends project on each side. This wringer is placed in a basin and the blanket pieces are laid upon it. Boiling water is *now* poured upon the latter until they are thoroughly saturated. The sticks are used for twisting the towel in opposite directions, so that not a drop of free water remains on the blanket compress. The painful parts which are to receive the

* Blätter für klinische Hydrotherapie, 1892, p. 56.

hot fomentation are well anointed before the patient is snugly wrapped in a dry blanket pack. This accomplished, he is approached by the attendant, holding the twisted towel containing the hot, moist blanket cloths. These are laid aside until he has opened the blanket sufficiently to slip the hot fomentation out of the towel upon the affected part. This being rapidly done, the enveloping blanket is quickly closed. If the patient complains of the heat, he should be persuaded to bear it. The fact that the receiving part has been anointed and that the hot water has been expelled from the cloth precludes any danger of a burn. That imperfect wringing, however, enhances this danger has been observed by the author and should be constantly impressed upon the attendant. In the beginning of the treatment it is well not to apply the compress too hot, in order to inure the patient to higher temperatures gradually. The compress should be renewed or repeated every ten or fifteen minutes; three or four usually suffice to produce a vapor bath. After the termination of the fomentation the patient is gradually uncovered; successive parts are rubbed dry, and quickly washed off with water at 75°, with friction; he is then again dried and put to bed. When accessible a jet or fan douche of 85° may be applied with great benefit.

In *sciatica* there is no treatment approaching this simple procedure in efficiency when followed by the cold douche.

M. L——, aged thirty-five years, a salesman, has been suffering from sciatica of the left leg for two months, having run the gamut of all the usual remedies, from salicylic acid to actual cautery. His recovery was probably prevented by continuing on his journey until he reached New Orleans, where he again sought medical advice. On his return to New York he was put to bed, a mercurial purge was administered, and he was put on a milk and farinaceous diet. Once a day these hot fomentations were applied to the sciatic region, and when he was perspiring he was allowed to remain in the pack, covered by an extra blanket, for from one to three hours. He was then rapidly dried and subjected to an ablution with water at 70° This treatment was continued for two weeks, during which time he was induced to drink abundantly of water. The pain subsided after the second treatment, and the patient made a complete recovery in three weeks.

Lumbago and intercostal or other muscular rheumatic affections are rapidly relieved by the hot fomentations, repeated every night. In recent cases two or four applications suffice to restore suppleness to the muscles and render motion painless.

The Precordial Compress.

The method of applying this compress is as follows: The precordial region is covered with a piece of linen, in three or four folds, wrung out of water at 40°. Upon this is laid a rubber coil through which

ice water is made to flow steadily. A flannel bandage around the chest holds the compress and cooling apparatus securely.

Rationale.—The cooling of the structures lying above the heart doubtless exercises a reflex stimulus upon the cardiac nerve supply, because the pulse is slowed as soon as the cold penetrates to the deeper structures, which is usually in about half an hour. The cardiac contractions become more vigorous, being evidenced by increase of arterial tension and filling of the radial artery. Julien * showed by some experiments on animals that the ice bag applied to the precordial region was capable of raising the blood pressure from 120 mm. to 170 and even to 190 mm., at the same time diminishing pulse frequency considerably.

Therapeutic Indications.—In cases of functional arrhythmia or tachycardia, in enfeebled heart action due to loss of compensation, and in some cases of adynamia in acute diseases the precordial cooling compress has proved in the hands of the author an excellent heart tonic.

Winternitz has obtained such good results from it that he regards it as the "hydriatic digitalis." In my estimation it is far superior to digitalis in the *cardiac neuroses.* It is not applicable in degenerative conditions of the heart. Julien † had occasion to test the efficacy of precordial ice applications in a case of typhoid fever of grave type—a typical picture of the ataxo-adynamic form of the disease. The patient had lost consciousness and lay on the bed entirely uncovered, in a tetanic attitude varied only by certain spasms of the head. The temperature remained all the time above 104°; the pulse had reached successively 120, 140, and 160. Under these circumstances Julien ordered the application of ice over the heart as a last resort. He watched the pulse closely, ready to stop the attempt at the first signal of danger. But in less than fifteen minutes he saw the number of the pulsations diminish and their amplitude increase; in a short time the almost imperceptible undulations of the artery gave place to more decided elevations. Whenever he removed the refrigerant, the alarming symptoms returned immediately, so that after many trials he concluded to leave the ice bag in place for several days. After that the temperature yielded, the cerebral phenomena disappeared, and the patient was out of danger. He is convinced that she owed her safety to the decisive measure which he had adopted. In another case also he accomplished by this means a result equally remarkable. In conclusion, he remarks that the beneficial effects show themselves in from fifteen to twenty minutes from the beginning of the application, and reach their maximum at the end of an hour. It is true, he says, that they are very evanescent, disappearing rapidly when the application is

* Gazzetta delle Cliniche, 1887. † *Loc. cit.*

suspended, but there is no danger in prolonging it as long as the general condition remains precarious. In some cases, under its action, the height of the pulsations has been observed to be tripled, which means a pulse more ample, fuller, and more tense, with the subsidence of dicrotism, intermittence, and irregularity, and with a longer duration of the diastole. An interesting fact noted is that the effects of alcohol and atropine on the circulation are in a measure neutralized by the ice bag. This, says the author, is not astonishing, since alcohol has the property of lowering the blood pressure by paralyzing the vasomotor nerves, and atropine increases the frequency of the pulse by paralyzing the pneumogastric nerve. This antagonism, he suggests, may possibly be serviceable in some cases of poisoning.

In my hospital practice this observation has been confirmed; not infrequently patients have been tided over serious adynamic conditions by the precordial cooling compress.

In *chronic endocarditis*, especially in aortic insufficiency, this compress has assisted me materially in the effort to restore lost compensation, when digitalis acted badly.

CHAPTER VI.

THE FULL BATH.

This variety of bath consists of the complete submersion of the body in water, so that the upper surface of the latter reaches the lower part of the chin, the head being the only part uncovered by the water. It is familiarly known as the tub bath in this country and as "Vollbad" in Germany. The fact that this is the chief variety of bath and that the technique, effects, and therapeutic application differ according to the temperature of the water used, renders it necessary for the more perfect understanding of this subject to divide its consideration into:

1. The cold full bath.
2. The warm full bath.
3. The hammock bath.

1. The Cold Full Bath.

This procedure has been applied with notable success in the treatment of typhoid fever and other infectious diseases. A detailed de-

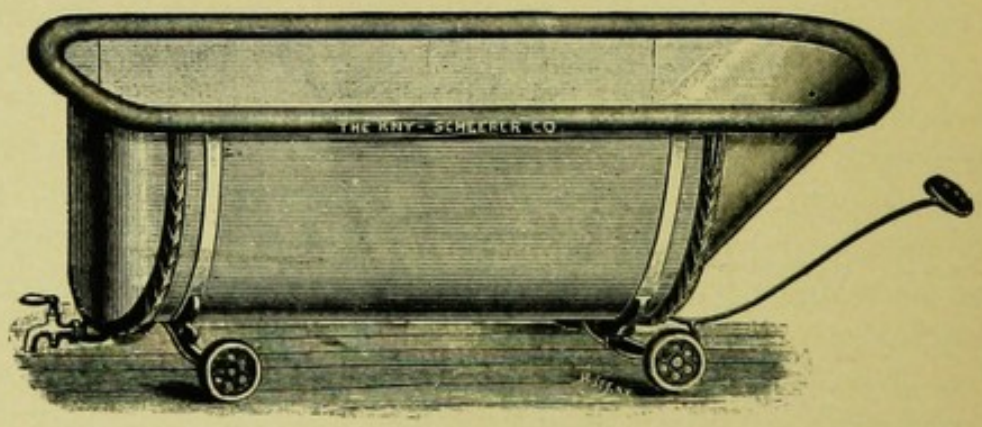


Fig. 39.—Steel-Clad Portable Tub.

scription of the method and *rationale* demands attention, because of the frequent and almost universal resort to this form of bath.

The technique of this bath varies with the therapeutic object we have in view, as will be shown. The cold full bath is applied as follows: In acute cases, a tub of sufficient length and breadth to comfortably accommodate the patient, and filled to three-fourths of its

depth with water ranging from 90° to 65° F., as required, is placed near the patient's bed and protected by a screen, which prevents his being excited by the preparations.

Unless it is absolutely unavoidable, the stationary bathtub in the ordinary city bathroom which contains a watercloset should never be used. While it offers certain conveniences for obtaining the proper temperature of the water, it is inconvenient to the nurses and oppressive to the patient to be brought into the contaminated atmosphere of so small a room. The agitation involved in transporting the patient even from an adjoining bedroom may also be injurious. For private

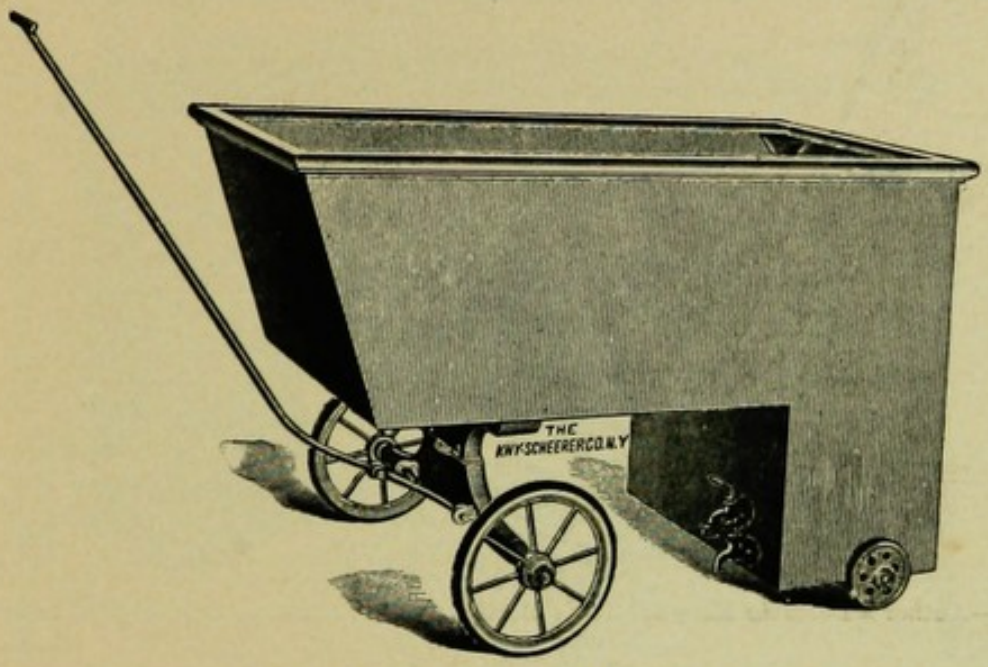


Fig. 40.—Author's Portable Hospital Tub.

practice the ordinary tin bathtub, between five and six feet long, which is made by the Central Stamping Company, and may be obtained at the tin stores and at the large city department stores, is perhaps the best adapted. A piece of carpet being spread alongside the bed the tub is placed upon it, raised upon bricks or blocks of wood, or upon several low chairs or benches to nearly a level with the edge of the bed. The head of the tub should be on a line with the foot of the bed, so that the patient may be turned in lifting. This position will be found most convenient to the nurses, who have to remove the patient from and to the bed and rub him during the bath. The tub may be partly filled before being placed in position; then water may be conveyed to it in buckets, which should be filled and emptied with the least possible noise. A convenient mode of filling the tub is by attaching a piece of rubber tube to a washstand faucet, and thus leading the water into it. In hospital practice one of the tubs illustrated in Figs.

39 to 41 will be found more useful, because of their superior durability and the ease of cleansing them.

Fig. 39 represents a steel-clad portable tub, made by the manufacturers of aseptic surgical furniture, Richard Kny & Co.

Figs. 40 and 41 represent a portable tub designed by the author for use in the small wards of the Manhattan Hospital. It possesses certain advantages over the ordinary six-foot tub. The shape of the tub is well shown in the diagrams. It is fifty inches long and twenty-seven inches wide, and consists of two parts, so arranged that the

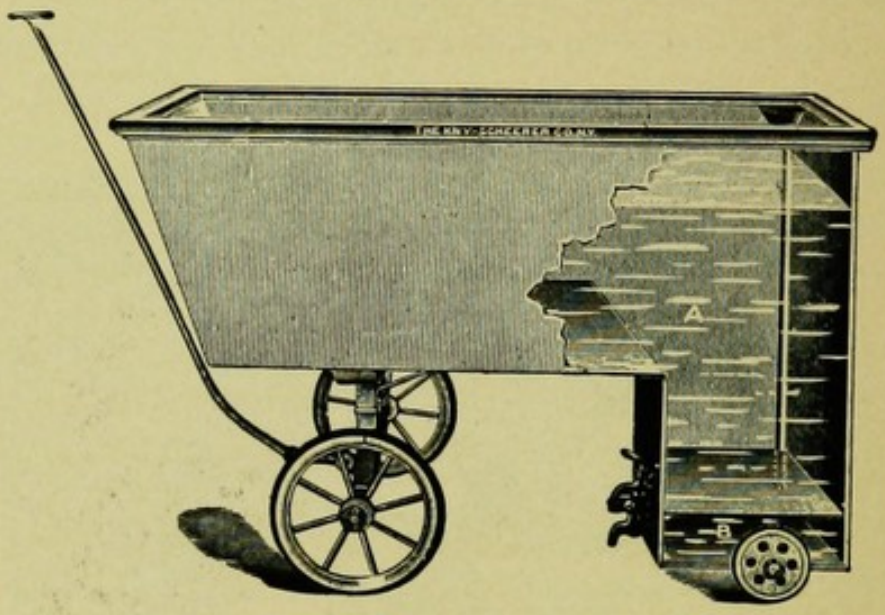
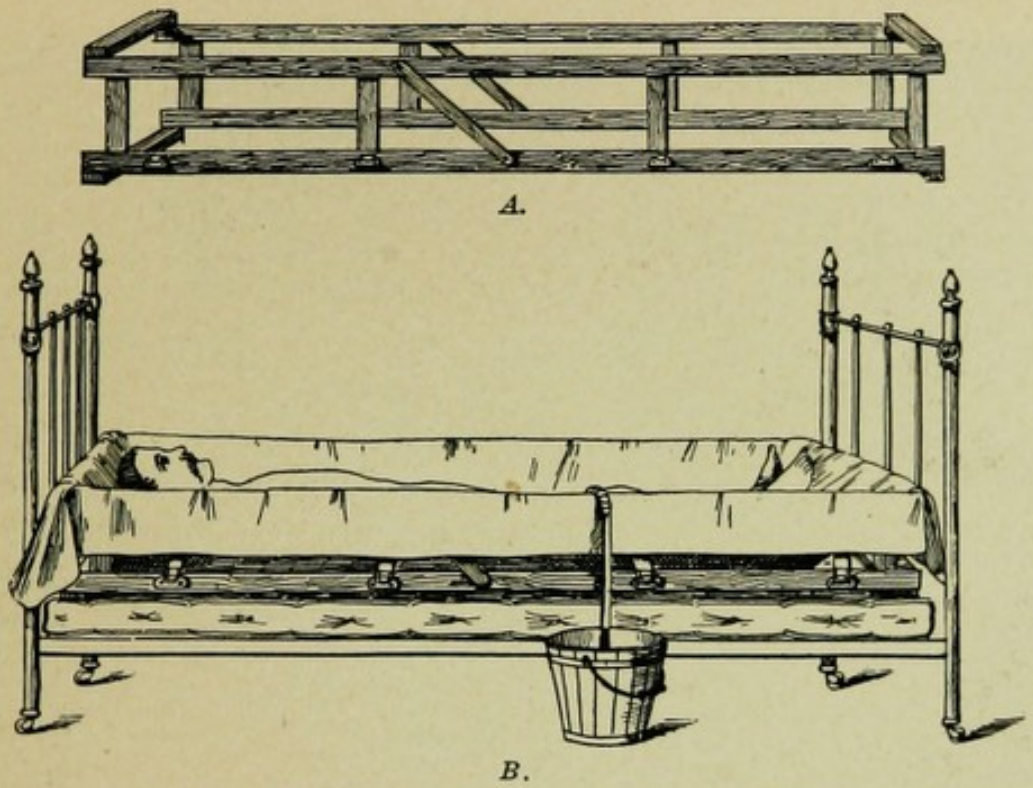


Fig. 41.—Author's Portable Hospital Tub. Sectional view, showing tube leading to hot water compartment, *B*.

patient's lower extremities are bent at right angles to his recumbent body, the feet resting upon a double bottom, which is filled with hot water. The latter is poured into the double bottom through a tube with a funnel-shaped opening which is secured in one corner of the tub; a faucet upon the posterior aspect of this hot-water receptacle gives exit to the hot water. The object of this tub is to afford the patient an easy recumbent position, and prevent the cold water from chilling the feet and producing painful cramps during the bath (Fig. 41). Its short and compact form renders it more portable than the ordinary tub. The Kny-Sheerer Company has constructed the bathtub of highly enamelled wood and lined it with tinned copper, thus rendering it easily cleaned. The height of the tub saves much back strain to the nurses, whose constant attention is required for friction during continuance of the bath. A similar tub has been in constant use in the hospital for five years, and has proved satisfactory and serviceable.

The Burr Portable Bath.

When the patient or his friends shrink from the seemingly heroic tub bath, or when the latter is impracticable on account of lack of room or for other reason, the tub of Dr. A. H. Burr, of Chicago, serves a very useful purpose. It consists, first, of a large rubber sheet, with rings attached near its margins by elastic tapes; second, of a light wooden crib, with fastenings along the lower rail to hold the sheet.



A.

B.

Fig. 42.—Burr Portable Bath. *A*, Frame; *B*, complete.

This frame folds by two movements into a compact bundle. The accessories are a hose with metal yoke for a siphon, a sponge, and a bath thermometer. In use, the rubber sheet is first slipped under the patient, brought up over the pillow, and tucked up alongside the body. The frame is then unfolded, placed down over the patient, resting on the mattress, surrounding patient, pillow, and rubber sheet. The edges of the sheet are then drawn up over the top rail of the crib down to the lower rail, and fastened by its rings. This completes a light and perfect tub, capable of holding twenty gallons of water. It can be emptied by siphon in four minutes (Fig. 42).

A Simple Bed Bath.—Dr. A. C. Haven has devised a serviceable modification of the Burr bath, which reduces its cost and is more simple.* Such a bath may be improvised out of a clothes line, a

* Medical Record, January 8th, 1898.

dozen ordinary wooden clothespins, and three yards of table oilcloth. "Tie a loop of rope firmly around the headboard, another around the footboard, and connect by two parallel ropes; attach the oilcloth with clothespins, and you have as comfortable a bath as the most expensive, at a cost not exceeding seventy-five cents. The loops around the headboard and footboard may be dispensed with in metal beds. Four feet of garden hose with a wooden plug in one end makes an excellent siphon. Such a bath I have now in use." Dr. Haven says:

"My only desire is to extend the benefits of the bath to the masses.

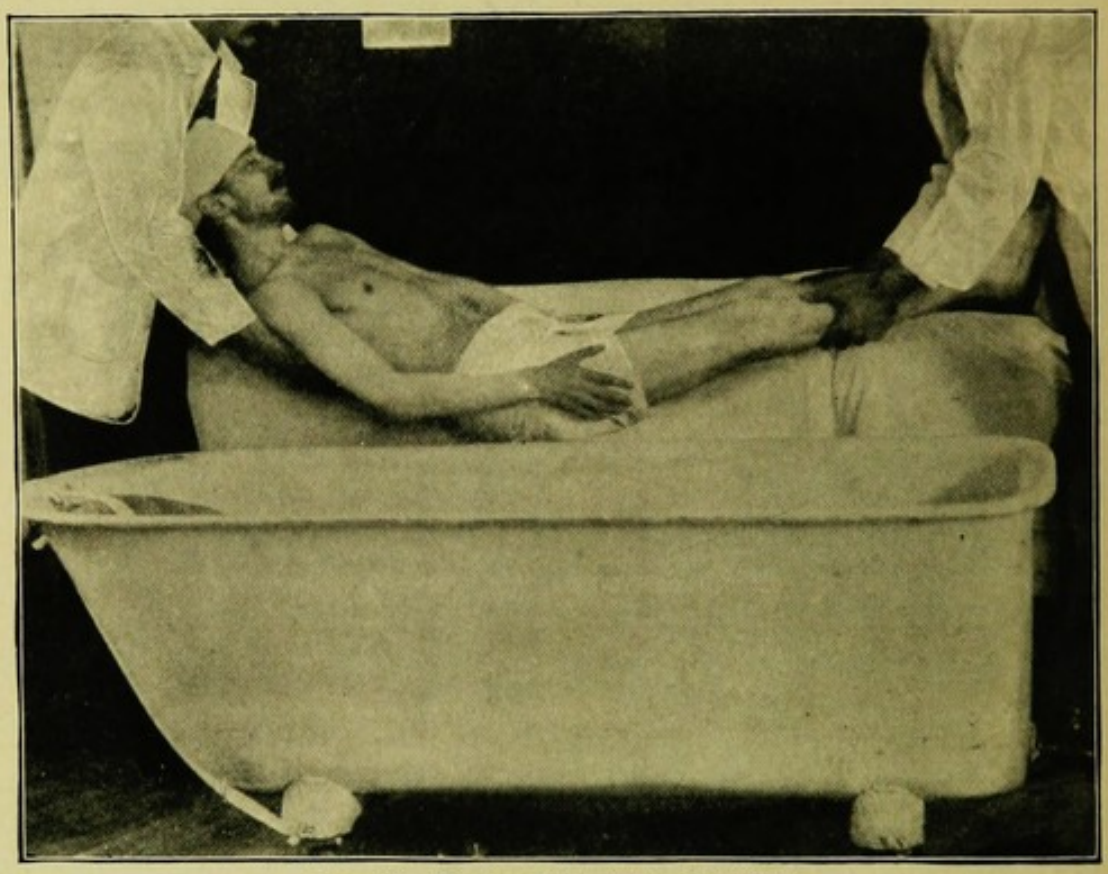


FIG. 43.—Placing Patient into Cold Bath.

The patient in the crowded tenement and in the country farmhouse can be shown by his physician in a moment how to obtain the benefits of that health-giving fluid—cold water."

Technique.—The cold full bath is administered as follows: The patient receives a stimulant. He is undressed, and a light napkin is applied to cover the sexual organs. His face is now bathed with ice water, and, if too feeble to step into the bath, he is lifted into it by two assistants (Fig. 43). With the greatest gentleness and least fuss, he is lowered into the water. He gasps and shudders a moment, or perhaps cries out. But gentle reassurance by word and deed, a calm demeanor, devoid of haste, and the *absence of all actual force or argument* to resist his natural desire to escape from the seemingly heroic treatment, rarely

fail to quiet his apprehensions. Friends or relatives must be advised to leave the room, as their presence would increase the anxiety of the patient, and render him more resisting to injudicious and unavailing explanations. If an air cushion has been suspended at the head of the tub, it will afford a good resting-place for the patient's head; a large water-cushion ring makes a comfortable support for his nates. In the absence of a support for the head the nurse will hold it up with the left hand, while with the right gentle friction or chafing will be practised over successive parts of the body (Fig. 44). This may be done

Fig. 44.—Friction in Cold Full Bath.

perfectly by an assistant, who in private practice may be a member of the family or a friend. Care should be taken that every part of the body (except the lower part of the abdomen) receives the benefit of these frictions, *which are regarded as of supreme importance* by the originator of this method, in preventing chilling, collapse, cyanosis, and heart failure. The effect of this continuous gentle chafing is a suffused redness, which is in marked contrast to the previous pallor of the surface, and demonstrates that the calibre of the superficial vessels is being considerably enlarged. As friction is executed upon successive parts of the body, we really manage to maintain a constant contraction and dilatation of the peripheral vessels, the former being accomplished by the contact with the cold water in motion, the latter by the friction and its

attendant reaction. *Complaints of chilliness must not be regarded as an indication for removal of the patient* from the bath, unless it be accompanied by decided chattering of the teeth; the former is voluntary and may be emotional, the latter is usually involuntary. A small pulse, a cyanotic or shrivelled condition of the *hands*, too, are regarded by the inexperienced as a warning signal to remove the patient from the bath, before he has received its full effect. These symptoms may be due, it should be remembered, to the local action of the cold upon the superficial vessels, and need not be regarded as threatening unless the *face*

FIG. 45.—Wrapping Patient after Bath.

becomes cyanotic. Often the finger nails become cyanotic when the patient grasps the edge of the tub in his effort to hold himself while shivering. Pressure against the edge of the tub prevents return of venous blood. All these signs may therefore be fallacious. Cyanosis of the face, however, is a manifestation which demands cessation of the bath. Not being submerged, the face can be rendered cyanotic only by actual enfeeblement of the heart action, a condition which is exceedingly rare when the bath is administered *with friction*. That a small pulse is not an indication of heart failure will be evident to the reflecting observer from the fact that it becomes less rapid and compressible, having lost its dicrotic character. Bystanders who are

not familiar with these seeming manifestations of shock, and especially members of the family, should be excluded from the room during and immediately after the bath, because their alarm may interfere with the proper execution and duration of the bath and thus seriously cripple the efforts of physician and nurses. If their presence and assistance be needed, a simple explanation of these symptoms should be given them ere they occur, so that they may be forewarned to aid the attendants in resisting the usual entreaties of the patient to be removed from the bath. The duration of the cold full bath depends upon the object in view, which will be treated under the proper heads. Several times during the bath, which usually lasts fifteen minutes, a basin of water at 50° F. is gently poured over the patient's head, around which a handkerchief folded like a bandage, two inches wide, has been tied in a knot over the nucha. This forms a gutter, and prevents the surprise produced by cold water flowing over the face. If the patient is somnolent or delirious, cold water is poured over head and shoulders also.

Before the termination of the tub bath, the patient's bed should be made ready in the following manner: A double blanket is spread upon the side of the bed to be occupied by the patient after the termination of the bath; a pillow covered by a towel being placed *under* its upper portion. Upon the blanket is spread an old linen sheet (cotton is inferior because it does not absorb water readily, and it is sometimes necessary, as will be shown, to let the patient remain in it before drying). Several hot-water bags or bottles are prepared for the feet, which are usually cold after the bath. The bath being finished, the patient is gently lifted out, the napkin covering the sexual organs is rapidly dropped, and he is placed upon the previously prepared linen sheet, so that the upper edge extends above his shoulders to the nucha. He is now carefully wrapped as follows:

Being laid upon the sheet so that his nucha touches the upper edge, the sheet is brought around the body, a fold being pressed in between the arms and the body and between the lower extremities, with the object of preventing the approximation of wet body surfaces. The blanket is now wrapped around the patient (Fig. 45). If the temperature has been high, above 103° in the rectum, the patient is allowed to lie in the sheet for five or ten minutes; if the temperature is lower, he should be at once dried with the sheet and afterward with soft towels. In either case hot bottles may be placed to the feet. Usually the patient who has been restless previous to the bath will fall asleep. In some cases shivering may continue until reaction ensues. Prolonged shivering after a cold bath points to some defect, either in duration or temperature. The former must be diminished or the latter increased, or both. During and after the next bath, more attention should also

be paid to friction and to the administration of stimulants in order to further reaction by *vis a tergo*. The application of heat to the extremities is objectionable, because it produces an artificial heat externally, and its necessity indicates some serious defect in the mode of application of the bath if it recurs after several baths.

This is the ideal bath designed by Ernest Brand, of Stettin, for the treatment of typhoid fever, to which we shall have occasion to devote much attention. The technique has been rather minutely described, because the author has seen the bath so frequently applied *without friction* and otherwise improperly, and its success as a therapeutic measure depends upon its exact execution. In a discussion of "tubbing" in typhoid fever by the New York Academy of Medicine,* Dr. A. B. Ball said that "the reason why the doctors at Bellevue, including himself, had given up the bath treatment some years ago was that they *did not employ rubbing*; everybody who had tried the more recent method, adding friction, had been convinced that there was no other method at command which was so valuable."

Another full bath which has received much well-deserved praise from clinical observers is the graduated bath, devised by Von Ziemssen, of Munich. This procedure is executed as follows: The preparation for bathing and drying the patient is the same as in the Brand bath. Water at 90° to 86° F. is poured into the tub until it is about one-third full. The patient being placed in it, the attendant bathes the body with the hand and sponge, while another attendant adds water at about 40°, at points where it does not come in immediate contact with the body, until the temperature of the water reaches 77° to 72° F. It will be necessary usually to remove some of the water from the tub by a faucet or pitcher while colder water is added. *Chafing is here also an all-important element of the bath.* The only difference between this and the Brand bath is the gradual accustoming to the cold water in the former, which seems less heroic to the patient and his friends. The bath may be prolonged to half an hour; indeed, this is the time required for it by Ziemssen. When it is finished the patient is wrapped in a previously warmed woollen blanket without being dried, for a quarter of an hour, and then he is dried and his clothing is replaced.

The Ziemssen graduated bath is less objected to by the lay people and by inexperienced practitioners, because it begins with tepid water and its gradual reduction is less intimidating. There are several objections to it, however, which overbalance this sentimental advantage. Its long duration is excessively fatiguing to patients and attendants; it requires more labor to supply the requisite quantity of hot and cold water and ice. The addition of the latter is especially horrifying and

*New York Medical Record, November 7th, 1896, p. 692.

should be avoided in the presence of the patient. Moreover, it is an exceedingly difficult matter to reduce water from 90° to 70° F. while the patient lies in it. The gradual reduction of the bath temperature, it may also be stated here, diminishes the stimulating effect of the cold; a point which is more fully enlarged upon in the physiological portions of this work and which must again be emphasized, because of the singularly persistent fallacious idea that such a bath is less heroic. The patient, being exposed to a more prolonged bath and being less stimulated, will necessarily react with less promptness. Hence the Ziemssen bath is superior to the Brand bath only as an antithermic procedure, when the latter is the chief indication, which is rarely the case. Another and very serious objection is that the temperature of the water for each subsequent bath must be raised twenty-five degrees by adding hot and removing cold water, and this must again be reduced during the bath. This is an increase of labor and trouble without adequate result. The Brand bath requires little if any changing of temperature; the same water may be used for twenty-four hours or longer, if it has not been soiled by the patient. The temperature of the water, which rises from five to ten degrees during the interval between the baths, may be restored by removing a few bucketsful and replacing them with ice water, or more simply by wrapping a large piece of ice in a piece of muslin and moving it to and fro in the tub. The latter should be done without observation by the patient, who may be terrified by seeing ice added.

Physicians and others who have been subjected to both varieties of baths claim that the sudden immersion into the coldest temperature required is far less unpleasant and chilling than the gradually reduced bath. The latter is certainly far more fussy and troublesome.

Rationale.—The *rationale* of the cold full bath, which has been chiefly applied in typhoid and other infectious fevers, is so exactly in accordance with modern physiology that it must inspire confidence, born of conviction to the attendant who applies it with a clear understanding of its aims and capabilities.

General Effect.—The cold bath produces in a greatly enhanced degree all those effects which have been described as following other cold procedures. There are a simultaneous contraction of all the cutaneous vessels, a simultaneous shock to all the cutaneous nerves, a shock—the results of which would be dangerous were it not counteracted by active friction of the body, which is the *sine qua non* of a full bath. Be it understood here that I regard only those procedures as *cold baths in which the body is submerged completely* for more than a momentary period in a tub of cold water. I do not use the cold bath in any non-febrile disease, in which I depend upon procedures which are applied to

the body briefly or partially. The cold bath differs in its *rationale* from the latter procedures, described at length elsewhere, in that it produces its effect upon the entire body at once. The reactive capacity of the patient is strained to its utmost in the cold bath, while in ablutions or douches, the application being local, reaction is called out only at the points of impact of the cold water and is aided by the freedom of the remaining portions of the body from the shock. In fevers the high temperature present aids in reaction and thus neutralizes the effect of the shock, especially in the earlier stages. Inasmuch, however, as prolongation of the shock would demand more reactive capacity than a fever patient possesses, friction of the entire body is resorted to in order to stimulate the cutaneous nerves and vessels artificially. Right well is this accomplished, both in reduction of temperature and stimulation of the nervous system.

Rationale of the Action of Friction.—Winternitz has enunciated the law that the amount of temperature reduction from a hydriatric procedure depends more upon the intensity of the thermic and mechanical irritation of the cutaneous sensory nerves than upon any other element. To the indefatigable labors of Winternitz, aided by his assistants, we owe the first demonstration that active mechanical action on the skin, combined with the application of cold water, enhances the temperature-reducing effect of the latter, as Pospischl has shown. By friction or other active stimulation of the surface, circulation during the bath, as by the wet sheet and half-bath, etc., the cutaneous vessels may be made to dilate quickly and in tonic action, so that a larger area for cooling the blood which circulates in near proximity to the cooling medium—the water—is created. The cooler blood, passing inward, is exchanged for hot blood coming from within. This simple yet effective method of reducing the temperature explains many inconsistencies in the effect of cold baths in fevers. It is now clear that the compensatory heat increase which follows all external cold applications does not depend upon the absolute amount of heat abstraction produced by contact with cold water, but upon the intensity of the thermic-nerve irritation, and upon the degree of actual cooling of the peripheral terminal nerve fibres which govern by reflex action the temperature regulation. This will explain why two cold baths of the same temperature and duration may produce quite different effects in the same individual, if in the one case he lie quiet and undisturbed, and in the other he be subjected to active friction of the cutaneous surface. In the first instance the peripheral circulation is impeded, the surface is cooled down almost to the temperature of the surrounding water, the heat production in the muscular layers is greatly enhanced, and the rectal temperature not much if at all diminished; in the other, the

peripheral circulation continues stimulated, the area of the vessels is widened, the cutaneous surface is cooled down less, but the blood coming to its superficial vessels is cooled more.

Tremor is also prevented by friction. Changes in heat production are enhanced by the tonic or clonic muscular contractions, either voluntary or involuntary, which usually occur when the body comes in contact with water much below its own temperature. By neutralizing this effect—by the abolition of tremor—friction, during a cold bath adds, therefore, materially to its antithermic effect. Although tremor may not prevent the lowering of temperature very much, it is one of the compensatory elements in producing heat while the latter is being lost elsewhere, and thus aids the skin in its compensatory function for heat regulation.

The regulation of the body temperature depends mainly upon the changes in heat dissipation, therefore chiefly upon the condition of the peripheral nerves and vessels; inasmuch as we may influence these energetically by the cold bath, we possess in it a powerful agent for affecting the temperature of the body in disease.

Winternitz points with justifiable pride to the confirmation, by the most recent investigations, of the views he has long promulgated, and he concludes his magnificent chapter* on this subject as follows: "If you connect the above with what happens in thermic and mechanical procedures with regard to the blood and heat distribution, the control of heat dissipation—or rather, as I may say now, the control of the degree of heat production—you will find it quite natural that hydrotherapy is the most sovereign remedy, not only in the first stages of febrile diseases, not only in fevers, depending upon heat retention, but in all fever processes especially, because no other remedy is so capable of meeting the chief therapeutic indications of the latter."

That I am fully in accord with Winternitz on this point, I shall endeavor to demonstrate in the chapter on hydriatric management of fevers.

The shock to the nervous system by the impact of cold water upon the entire body in the cold full bath and the stimulus invariably following such shock are intense and would overwhelm the fever patient, if they were not judiciously applied and carefully apportioned to the actual condition of his nerve centres. Usually an alcoholic stimulant or a cup of strong hot coffee is administered just before the patient enters the bath, and the constant friction, causing a wavy impact over some parts of the body and a stimulus to the nerve terminals at other parts, counteracts the shock and holds it not only within safe but also within effective limits, when the cold bath is applied in fevers.

* *Op. cit.*

Taking typhoid fever as the most representative type of infectious fevers, the *rationale* of the action of the cold bath may be readily worked out.

There is an infectious process established in the organism by a cause which is beyond control or removal. The manifestations of the presence of the toxic agent are as follows:

I. The nervous system receives the chief brunt of the attack from the specific infective agent. Beginning with undefinable malaise, ataxia, general lassitude, somnolence, other adynamic manifestations develop which culminate in stupor, delirium and coma, subsultus, tremor, and death.

II. The temperature is invariably elevated, rendering the patient uncomfortable, depriving him of sleep, impairing his organic functions, and if the elevation is prolonged without remission sooner or later dangerous interference with the heart and brain ensues.

III. The circulation is seriously interfered with. The heart, being called upon to do extra duty, threatens to fail and often does fail.

IV. The skin, kidneys, and lungs are so seriously handicapped that they fail in the performance of their important functions.

V. The corpuscular elements and the chemical composition of the blood are so unfavorably influenced that the resistance of the organism to the toxic invasion is decidedly impaired.

I. *The influence of the cold bath upon the nervous system* is paramount. Though gradual and insidious in the beginning, the manifestations arising from a depreciation of the nerve centres never escape the experienced observer; indeed, they are the most uniform characteristics of all infectious fevers. Only one observation will be quoted in support of this view. Dr. Edward Delafield says, in a paper on typhoid fever, read before the New York Academy of Medicine,* in referring to the reliability of symptoms in the diagnosis: "A study of all the temperature curves shows that we must not expect too close a resemblance to the schematic curve." In contrast with the unreliability of this and other symptoms, he correctly insists that the appearance of the patient is characteristic. "A dull apathetic expression, the skin of the face dusky colored, the cheeks often bluish, the mind dull and sluggish, all these conditions were well marked; in only one case were they notably absent." These symptoms are the expression of a depreciated condition of the nerve centres, which in typhoid and other infectious fevers are the leading point of attack and must therefore be the leading point of defence. From this nerve depreciation arises a condition of the circulation which by its interference with the various organic functions often leads to lethal results.

* Medical Record. November 12 h, 1883.

The stimulation of the nerve centres by the cold bath arouses them from their lethargy and thus protects the organs from the paralyzing influence of the toxæmia. Such an effect is evident after each bath; the greater the delirium or stupor, the more evident is it. Repetition of the bath gives a totally different aspect to the case. As the author said in a discussion of the subject by the New York Academy of Medicine:* "The effect of these cold baths upon the patient overwhelmed by typhoid may be likened to the effect of external stimuli applied in opium poisoning. In the latter the patient's vitality is maintained by preserving the nerve centres alert until the poison can be eliminated. This requires but a brief time, and the stimulating treatment may be heroic (flagellation, faradic electricity, walking, etc.), while in typhoid fever several weeks must elapse ere the bacterial life period terminates; hence the cold bath has proven its value; the systematic repetition of stimulation of the cutaneous nerve conveys it to the central nervous system, and maintains its integrity."

II. *The rise of temperature in infectious fevers* is due to a disturbance of the centres governing the formation and dissipation of heat. For all practical purposes we may address our efforts to the removal of the interference with heat dissipation. The justly eminent clinician, Traube, has demonstrated that the rise of temperature in fever is the direct result of the contraction of the peripheral vessels, by showing that a chill, with its consequent cutis anserina, is always accompanied by a rise of temperature. But, as the rise sometimes precedes the chill, this doctrine was regarded as defective until Maragliano demonstrated by means of Mosso's plethysmograph, which shows with the greatest accuracy the slightest change in the volume of any part, that the blood-vessels begin to become narrower in the stage of invasion of fever before a rise of temperature can be recognized; that as this vascular contraction continues the temperature begins to rise; and that chill ensues only after both have continued for some time. He also showed that the maximum rise of internal temperature coincides with the maximum contraction of the cutaneous blood-vessels. Additional evidence of the correctness of this view is furnished by the observations of Bettelheim in Von Basch's laboratory, and confirmed by Geigel, that the reduction of temperature produced by antipyretics is always accompanied by dilatation of the cutaneous vessels, which increases heat loss, and that every new exacerbation is initiated by a renewed contraction of the peripheral vessels.

Rosenthal, Leyden, and Botkin have more recently demonstrated that in many forms of fevers the rise of temperature may be traced, as above stated, to a diminution of heat dissipation from the surface,

* Medical Record, February, 1890.

which results in actual retention and accumulation of heat in the body. These and other investigators have also shown that the evaporation from the surface is inhibited.

This explanation of the rise of temperature in fever is of immense importance, because it renders the reduction of elevated temperature by the bath a strictly scientific proceeding.

That temperature elevation is due chiefly to the impaired condition of the cutaneous vessels is also clinically demonstrated by the fact that it is simply and scientifically removed by hydriatric measures. It is the chief object of the latter to improve the tone of the superficial vessels, to dilate them *actively*, and thus increase the dissipation of heat, as has been again and again demonstrated by Winternitz, Pospischl, and others; and also to increase the elimination of water from the surface.

This fact emphasizes the importance of precise attention to the method of bathing. To immerse the patient in a full bath of low temperature without friction, or to wrap him in ice sheets, as has been done in the faulty practice of some hospitals, must result in narrowing the superficial vessels and keeping them closed. If such treatment does not induce collapse, reaction may slowly take place, and the former high temperature again be reached or exceeded. If, however, the patient is carefully placed in a bath of 65° to 70° F., and constant and unremitting gentle friction is practised over the entire body (Brand), the coats of the superficial vessels are stimulated, reaction from the first shock ensues, the vessels contract and dilate actively, as the ruddy condition of the skin which has been subjected to friction testifies.

The mechanical irritation not only removes the obstacle to heat dissipation, but, as Weyrich and Pospischl have proved by exact experiments, it increases the elimination of water from the surface from sixty to ninety per cent. Moreover, the cooled blood is sent from the dilated vessels back to the interior of the body, and thus a direct cooling effect is produced besides, as shown above.

The baths, therefore, when combined with friction, fulfil both indications for removing high temperature, while medicinal antipyretics fulfil only the first—heat dissipation.

In the discussion of the best temperature-reducing baths known to hydrotherapy, this subject will, I trust, be so clearly brought out that it will demonstrate the error that *the colder the bath the greater is the reduction of the temperature.* This erroneous idea has been the cause of numerous disputations between the adherents of Liebermeister and those of Winternitz. Voit, to whom we owe so much in connection with the study of the physiology of heat regulation, has demonstrated that increased tissue metamorphosis, amounting to as much as

forty per cent, does follow the application of cold; but that no rise of temperature can be produced in this way if we do not have a simultaneous disturbance of that greatest heat-regulating organ, the skin. If a patient with a temperature of 104° F. is placed in a bath of 65° F., and allowed to remain there until he shivers, the vessels of the skin become more contracted and heat elimination is really prevented. The tremor will, to a certain extent, add to the increase of inner temperature by producing heat, as shown by the experiments, elsewhere referred to, of Speck and Loewy. How different will be the effect of a regular *Brand bath with friction* must be seen to be appreciated. As previously described, the cutaneous vessels are dilated, and more cooled blood is carried to the interior to be exchanged for hot blood. On the other hand, if a nerve or heart stimulus be the chief object of the bath, a brief application of cold, with mechanical force to the surface, as described under the head of half-baths, produces a reaction which does not, unless prolonged, affect temperature so decidedly (because the blood has not been exposed to the heat-lowering influence sufficiently long), but, by exciting the reflexes, brings the blood to the surface, deepens the respiration, and invigorates heart action, as shown above.

The cold bath cannot vie with the medicinal antipyretics in its temperature-reducing properties. The latter are far more powerful, but, as will be shown, the reduction produced is at the expense of more important life-saving functions. The cold bath, moreover, diminishes temperature slowly but surely, each day or two showing a small gain for the patient. Since the high temperature is usually due to the intensity of the infection, the counteraction of the latter by the cold bath is of far greater moment in the final result than the mere two-hourly fall of several degrees following the use of medicinal antipyretics. While the latter may be profitably employed in small doses for the production of comfortable sleep, the cold bath is the most reliable and safe antithermic agent, since it does not interfere with other functions and fulfils other important indications.

III. *Heart Failure* stands as a dread spectre at the bedside of every patient suffering from an infectious fever. Liebermeister has well said that "it is much more difficult to prevent cardiac than cerebral paralysis." This enfeeblement of the heart arises from the disturbance of the vasomotor centres, by reason of which the peripheral vessels lose their normal tone. As Winternitz has so ably shown, we have here an imitation of Golz's experiments on frogs, which demonstrate that a loss of tone in the vessels of a large area of the circulation and a diminution of the tension in these vessels enfeeble notably the action of the heart.

Romberg* has recently furnished a careful analysis of the real causes of so-called heart failure in fever which offers confirmation of this view. What is the part played by the heart and vasomotors in those manifestations of infectious disease commonly regarded as heart failure? Romberg claims that in the course of most acute infectious diseases we observe disturbances of the circulation which clinically manifest themselves as diminished tension and diminished filling of the arteries, and which are commonly referred to heart enfeeblement. Undoubtedly, however, the condition and conduct of the peripheral vessels are, in connection with those of the heart, of decisive import. In order to decide how far the heart and how far the vasomotors are concerned in the production of heart failure, Romberg has made some experiments. When the descending aorta is compressed above the diaphragm, or when the belly of an animal is subjected to massage, blood pressure rises, because the flow into the abdominal aorta is interfered with, and the heart, being more readily and completely filled, drives a larger quantity of blood into the aorta. But the conditions are quite different when increase of blood pressure is produced by strong irritation of the skin or mucous membranes. In this case it is the consequence of a reflex irritation of the vasomotor centre in the medulla oblongata, as is also the interrupted respiration.

Starting from these facts Romberg infected a number of rabbits with the bacillus pyocyaneus. This resulted in a temporary rise of blood pressure which was followed by a diminution to an extraordinarily low degree. But even in these conditions pressure on the aorta and massage of the belly produced a decided rise of blood pressure, while irritation of the sensory nerves and suffocation were entirely without effect. The same results were reached under infection of Fraenkel's pneumococcus. From this experiment Romberg concluded that these infectious processes damaged the circulation by a paralysis of the vasomotors without interfering with the working-capacity of the heart.

Paessler† confirmed the results of Romberg's observations. He went further, however, in establishing the fact that the damage by these infections was due chiefly to the vasomotor centre in the oblongata, while the peripheral and vascular nerves and muscles, as well as the centres of Golz in the spinal cord, retained their normal functionating capacity until death. Paessler made some experiments on a large number of rabbits infected with Loeffler bacilli. As in other infections, the damage was inflicted almost altogether upon the vasomotors, without effect upon the cardiac capacity. The *final lethal effect upon the*

* Berliner klinische Wochenschrift, Nos. 17 and 52, 1895.

† Kongress für innere Medicin, Wiesbaden, April 7th, 1896.

circulation was here also chargeable to paralysis of the vasomotors and not to any damage to the heart. That the peripheral vascular nerves and muscles remained intact was proven by injections with barium chloride, which produced a decided rise of pressure. Paessler concludes his observations by affirming the necessity of search for remedies which will more surely and harmlessly stimulate the vasomotors.

Happily, we are already in possession of such a remedy. That the effect of the cold bath upon the peripheral circulation in infectious fevers is due to the stimulating influence upon the vasomotor centre is very probable, though it cannot be asserted positively; but that the cold bath combined with friction approximately reproduces by contraction and subsequent tonic dilatation and filling of the cutaneous vessels the normal tone and resistance of the heart, and thus reinstates lost blood pressure, is beyond dispute. That this effect, combined with the reflex stimulus conveyed to the nerve centres governing the heart itself by the cooled blood circulating through them, refreshes and invigorates that organ, lessens the number and increases the force of its contractions, and prevents dicrotism, has been positively demonstrated by the author and by hundreds of other observers.

Dr. Hobart A. Hare demonstrates this by the apt comparison of the heart to a locomotive.* "The vasomotor system is made up," says Hare, "on the one hand of the vasomotor nervous apparatus, and on the other of the blood-vessels themselves. The resistance offered to the heart by the properly acting vasomotor nervous system, through its influence on the vessels, is identical with the friction offered to the driving-wheels of a locomotive. The locomotive is intended to meet and stand any resistance, and if the resistance be removed by slippery rails the wheels fly around ineffectually, racking the machinery and destroying its usefulness.

"From the above some important diagnostic and therapeutic facts are learned: (1) that a rapid pulse may be due in no way to a disordered heart, but to vasomotor relaxation; (2) that the proper way to treat this rapid pulse is to put sand on the track and increase the resistance, and not to make more steam—or give digitalis—which will only cause the engine, or heart, to work away on slippery rails with more wear and tear, and make no progress."

The cold bath increases this "resistance."

In order that the tonic effect upon the heart be continuous, it is important that the bath be repeated at sufficiently frequent intervals (three hours having been ascertained as the proper average) with careful regard to the effect produced. It would be difficult if not danger-

*Therapeutic Gazette, vol. xii., No. 3.

ous to maintain the failing cardiac action by alcoholic or other stimulants during a period of many days. Repeated cold baths, with accompanying frictions, not only aid the heart, but are free from deleterious effects.

In the early stages of typhoid fever, when reactive power has not been much enfeebled, chattering of teeth, facial pallor, and a small pulse, during the bath, ensue later than in the more advanced stages. But these must not deter us from continuing the bath; they demand increased friction of the surface, and perhaps a little alcoholic stimulant. If superficial hyperæmia is readily induced by the friction, a small pulse, or even a pinched countenance, does not demand removal from the bath. These may arise from the local effect of the cold. Decided chilliness and prolonged chattering of teeth, however, are indications to remove the patient, because the muscular contractions incident thereto induce, as Speck and Loewy have shown, increased oxidation, which must be avoided in such cases.

The most positive evidence of the improved condition of the pulse after the cold bath is found in the fact that, *while it feels small and almost thread-like, it has gained in force and tension*, and continues so. The effect of the cold bath is not so pronounced in the advanced as in the early stages of infectious fevers. This may be explained by the fact that the response of the nervous system when overwhelmed by toxæmia is more feeble and therefore the reactive power is more in abeyance, unless baths have been used from the beginning. In the third or latter part of the second week of typhoid, either a higher bath temperature (75° to 80° F.) or more brief application of the same (65° to 70°) is indicated, always bearing in mind that the *rapid application of low temperature is more refreshing and stimulating, though not more heat reducing, than the prolonged application of a bath of higher temperature.* The reverse idea, though erroneous, seems to be so well established in the lay as well as in the professional mind that it is difficult to dislodge it.

Modifications required in other infectious fevers may be devised under a careful consideration of the *rationale* set forth above. These will be referred to under the proper headings.

IV. *Failure of the Eliminating Organs—Skin, Kidneys, and Lungs.* (*a*) The skin fails in its function of depuratory excretion, as evidenced by its dryness, pallor, and bloodlessness. The cold full bath removes the pallor by bringing more blood to the cutaneous vessels, and rendering it more soft and pliant, and it enhances excretion by removing dead epithelium which obstructs the outlets of the sweat glands. It has been shown (pages 22 and 23) that the elimination of toxins through the skin is promoted by certain hydriatric procedures.

More important, however, than this effect is that produced on the kidneys.

(*b*) *Failure of the Kidneys.*—The interference with the elimination of toxic products from the kidneys is a constant manifestation in infectious fever. That the quantity of urine is notably diminished is readily observed, but that its chemical constitution is changed has been recently demonstrated in an exact manner. Albert Robin* has found as the mean of a large number of observations that the accumulation of waste products in the system was large in proportion to the gravity of the case, and that the solid constituents of the urine rose from 48 per thousand in the height of the disease to 60 per thousand during convalescence. He also found the extractive matters in the normal blood to be from 4 to 4.5 per cent, while in mild cases of fever they were 6.5 per cent, and in fatal cases reached 12.1 per cent. The blood therefore contained, during the period of infection, double the normal quantity of extractive toxic matter. Robin concludes these interesting observations by stating that in infectious poisoning the organism becomes charged with insoluble and toxic hydration products, the formation of which is accompanied by the evolution of much heat. It is important for the safety of the organism that these toxic products be eliminated by oxidation and changed into soluble compounds.

The influence of cold baths upon the chemistry of the respiration has been studied by Robin and Binet, who experimented on more than one hundred cases, which furnished one thousand analyses. By comparison of the results of the latter with those obtained from the analyses of normal urine, an important number of facts was established which may serve for clinical and therapeutic application. In the average severe cases of typhoid the relative percentages of absorbed oxygen and of exhaled CO_2 are decidedly below the normal. In severe cases which resulted in recovery the relative percentages diminish still more, while absorption of oxygen through the tissues increases; during convalescence the former again rises, O and CO_2 are decidedly increased, the largest proportion of O serves for the formation of CO_2 and the quantity absorbed by the tissues does not differ from the normal. Even the most severe and fatal cases of typhoid demonstrated an inverse ratio between respiratory changes and the intensity of the disease; the more intense the latter the less perfect was the exchange of gases.

These facts justify the application of remedies which increase oxidation, while those not so influencing the latter should be rejected. Antipyretics undoubtedly belong to the latter category, because their action is similar to that of the disease, and the fever is not injurious to the organism, but rather a reaction against toxins. Cold baths, on

* Bulletin de Thérapie, vol. i., 5, 1895.

the contrary, augment oxidation and reduce temperature by enhancing the physiological resistance to infection. Baths increase combustion and the oxidation of the extractive products of disintegration and hydration. The incapacity of the living cell to fix and retain oxygen should be combated; *i.e.*, the flooding of the tissues with products of decomposition which are the more insoluble, the more poisonous, and the less easily eliminated the less oxygen they receive. Cold baths produce these marvellous effects in typhoid, because they enhance these oxidation processes, heighten arterial tension, enhance cardiac capacity and, by reason thereof, diuresis, whereby a kind of inner purification and ready removal of products of destructive metamorphosis ensue. Hence the success of cold baths agrees with the above-mentioned therapeutic indications to favor by all possible means the absorption of oxygen, not only in typhoid fever, but in all infectious diseases, especially if complicated with typhoid conditions; for the oxidation processes are the protective agency of the organism. Robin has found that a typhoid patient who absorbed for each kilogram of weight 5 c.c. of oxygen a minute, increased the amount of oxygen taken up to 6.49 c.c. immediately after a cold bath. The CO_2 exhaled increased from 3.77 c.c. to 4.45 c.c., while the urea increased to twenty per cent.

No other demonstration could so clearly prove the surpassing value of cold baths in infectious fevers.

Roque and Weil have shown by reliable experiments* that in the urine of typhoid-fever patients the toxins are double the normal, while under the bath treatment they are increased fivefold until convalescence occurs. This has been fully corroborated by Hewetson in the Johns Hopkins Hospital at Baltimore.

Not alone, however, is the toxicity of the urine enhanced by cold baths, but the quantity secreted is enormously increased. It is not rare to note the passing of from sixty to eighty ounces of urine during twenty-four hours, and on several occasions the quantity has reached under my observation over one hundred and twenty ounces. This increase of the quantity of urine is an almost invariable result of the cold full bath.

V. *Influence of the Cold Bath on Corpuscular and Chemical Constituents of the Blood.*—It has been shown by Boeckelmann and others that there is a rapid diminution of the blood corpuscles in blood taken from the cutaneous vessels in infectious diseases, and that during convalescence this is equalized and restored. Boeckelmann does not claim that there is an actual loss of corpuscles. It is probable that by reason of the enfeeblement of the heart, and perhaps of the spastic condition

* Wiener klinische Wochenschrift, 1895, No. 4.

and loss of tone in the cutaneous vessels (referred to above), certain vessels or vascular areas are deprived of the normal supply, causing stasis with increase of blood corpuscles—the globular stasis of Hüter, which yields as soon as the normal condition of the heart and peripheral vessels is restored during convalescence. That this stasis may be readily removed by the cold full bath, which finally increases the calibre of the cutaneous vessels, is proved by the observations of Cohnstein and Zuntz, who demonstrated that the quantity of formed elements in the large vessels depends upon the calibre of the capillaries and upon the activity of the circulation in the latter.

The effect on blood corpuscles and hæmoglobin following cold baths in typhoid fever has been carefully studied.

Breitenstein* offers a table of observations made on twenty-six patients, which demonstrates that in the large majority of cases the cold bath exercises a pronounced influence upon the blood admixture. In twenty-nine cases there was an increase of at least fifty thousand red cells to each cubic millimetre, which was accompanied by a corresponding increase of hæmoglobin. In most of the observations the increase reached one hundred thousand red cells; in one case it reached a million. That this effect of the cold bath upon the corpuscular elements of the blood is not due to the reduction of temperature is evident from Breitenstein's observations as to the effect of antipyrin, which reduced temperature and pulse, without increasing the red cells.

Breitenstein concludes from his carefully conducted experiments that the cold bath exercises upon the circulatory apparatus an influence which changes the composition of the blood by removing stasis in certain organs or internal parts, through the increased energy which it induces in the circulation, and that the deepening of the respiration furthers a rapid circulation, which counteracts venous stasis—effects which cannot be obtained from medicinal antipyretics.

Thayer and Billings of Johns Hopkins Hospital have also shown that there is an enormous increase of the corpuscular elements of the blood taken from the lobe of the ear after cold baths in typhoid fever. In some instances the leucocytes were enormously increased (threefold). This observation has been confirmed by many investigators, including my son, Dr. H. B. Baruch, at the Mount Sinai Hospital, and myself in private patients.

Recent investigations tend to show that the chief defence of the organism lies in the blood, probably in the leucocytes,† and that any

* Archiv für experimentelle Pathologie und Pharmakologie, 37, p. 260.

† Emil Fischl (Prager med. Woch., vol. xxii., 5, 1897) shows that by virtue of the leucocytes the body possesses a powerful protective agent against the invasion of pathogenic organisms. He injected the Fraenkel diplococcus

method capable of bringing leucocytes into the general circulation from the remotest portions of the vascular field, where they have been sluggishly dormant, must aid the organism in repelling the bacterial enemy.

Moreover, Bouchard has shown that an excess of acid in the blood is one of the manifestations of auto-intoxication, and he attempted to neutralize this by alkalies without avail. Bireger and others also proved that the alkalescence of the blood is diminished in infectious diseases. Alois Strasser has pointed out that alkalescence of the blood is decidedly increased by cold hydriatric procedures.

It follows, therefore, that the chemical and corpuscular constituents of the blood which are unfavorably influenced by the infection are restored to a more normal condition and relation by cold baths.*

The quantity of hæmoglobin, according to Korowitzky,† fluctuates greatly in infectious diseases, especially in typhoid fever (18.48 to 7.24 per cent) and in pneumonia (16.74 to 8.64 per cent). This change begins in the first stages of the fever; it is not due to an absolute reduction, but to the partial inanition incident to these diseases, which decreases not only the mass of blood, but also its corpuscular and hæmoglobin constituents.

That cold hydriatric procedures favor the re-establishment of normal conditions in all the blood constituents has been amply demonstrated.

Conclusion.—The detailed *rationale* furnished above shows clearly that the cold full bath, properly administered, fulfils every therapeutic indication in infectious diseases in the strictest scientific manner.

Therapeutic Indications of the Cold Full Bath.

Taking the view that a cold full bath implies the *immersion of the entire body* in cold water from 10° to 30° below the normal body temperature for from five to twenty minutes, with continuous friction, the author regards it as indicated only in prolonged fevers, as shown by the elaborate discussion of its *rationale*. The field for its application is therefore enormous despite this limitations.

While I deem the cold plunge, *i.e.*, dipping the body in water of the above-mentioned temperatures, as useful in some few cases of neurasthenia, hysteria, and anæmia, after the patient has been trained

into the aural vein of rabbits; a decided increase of the white corpucles was noted in the animals which survived, while in those which died of the infection no pronounced leucocytosis was observed. The subsidence of the leucocytosis was synchronous with the disappearance of the micro-organisms from the blood.

* See Breitenstein, page 56.

† Congress of Russian Physicians in Kiew, 1896.

by milder measures to bear such a dip with a good reaction, these diseases do not come under the therapeutic indications for a *full bath*, because the patient's stay in the water is of very brief duration and friction is *not used* in these cases.

Only by following the exact technique described on pages **136–141**, may a cold full *bath* be obtained. Such a bath is useful chiefly in *the infectious fevers*, each one of which demands some change in the duration of the bath and the temperature of the water, as will be shown in the detailed description of the methods adapted to typhoid fever, pneumonia, the exanthemata, etc.

Fevers.

The general practitioner encounters in his daily routine work many cases in which an elevation of temperature is a prominent if not the principal manifestation. To combat this symptom appears to have been the chief aim of the therapy of the past. Upon it have been expended more thought and more labor than upon all other manifestations of disease. The impress of this long-existing idea is still recognized in the minds of the lay people, and unfortunately it has not been eradicated entirely from the minds of the medical profession. There are still many who regard fever as the essential factor of acute disease, and high temperature is still a dread enemy which must be met by the physician with powerful weapons. But this fallacy is happily losing its hold upon medical men. The following pages are intended to aid in relegating this horrid bugaboo into the obscurity which it deserves.

Fevers offer the most prolific field for hydrotherapeutic success. If we dwell upon their hydriatric management more fully, perhaps, than upon any other subject, the importance arising from the frequency, universality, and fatality of the infectious fevers furnishes ample warrant.

Typhoid Fever.—Taking typhoid fever as the best example of infectious fevers, the following pages will be devoted to its treatment by the cold full bath.

The frequent discussion of typhoid fever by our medical societies bears evidence, not only of its incalculable importance, but also of the instability of our present therapeutic methods in this disease. Brilliantly and learnedly though we may discuss typhoid fever, favorable though our individual statistics may be, still the figures of our boards of health reports bid us "mend our ways" in language more eloquent than human tongue or pen can formulate. Twenty-five or forty per cent is the death rate from typhoid fever in our American cities;

twenty-six per cent is the mortality of the New York hospitals in recent years, according to Dr. Delafield's investigations. The import of these figures cannot be overestimated. May they be changed? This may be accomplished by the cold bath, a method of treatment which has the sanction of long usage, the authority of judicious clinical observers, and the evidence of unimpeachable statistics.

It is proposed to offer here, not empty polemics, but arguments which are the result of mature deliberation and sifting of evidence afforded by clinical and experimental data, obtained from various sources and compared with my own, in the various methods of treatment advocated during the past thirty years of my professional career. About twenty years ago I had settled upon the Ziemssen graduated cold-bath treatment as the most promising method of treating typhoid fever, and I obtained more satisfactory results from it than from any other. But finding many objections to it, which are referred to on pages **140–141**, and using it altogether as an antithermic agent, when other antipyretic methods came into vogue with so much promise of success, based upon the idea that the reduction of high temperature was the chief desideratum, it was natural for me to be carried away upon the tide which so completely swept over the entire profession. As the treatment by cold baths involved so much trouble, and proved so distressing to many patients and their friends, I was glad to abandon it in favor of the first reliable medicinal antipyretics which came into use ten years ago. The physician who was in active practice during the eighties and early nineties is familiar with the potent sway exercised at that time by the antipyretic idea in the therapy of fevers. The milder forms of bathing by wet pack and sponging, with quinine, antipyrin, the ice coil, and, later, antifebrin and phenacetin, gradually displaced the expectant plan, just as the latter had displaced the previously prevalent spoliative methods.

A review of experience in the last decennium, derived from personal observation in private and hospital practice and in that of many colleagues, as well as from society discussions, develops the fact that *the mortality of typhoid fever has not been reduced by the antipyretic method of treatment.* A fair, conscientious, and exhaustive review of the results of the various methods in vogue during the past thirty years has demonstrated that the adoption of strict cold bathing has inaugurated an epoch in the treatment of typhoid fever, because it has greatly diminished the mortality.

How fatal typhoid fever is at the present time may be gathered from the statistics given above. This mortality is even larger than that furnished by the recently gathered, careful statistics in Germany, which show that under the expectant treatment of 11,124 cases the

mortality amounted to 21.7 per cent. Dr. Murchison has compiled 27,051 cases, in which the mortality per cent was 17.45.

Jaccoud has collected 80,140 cases on the continent, with a mortality of 19.23 per cent. The English army statistics averaged, for the six years ending with 1877, 32 per cent mortality; in the navy it was 25.5 per cent.

The most favorable statistics on record are those of the Boston City Hospital, furnished by Dr. A. L. Mason.* "With the exception of eighty-nine cases treated by Dr. Edes, the Brand system has not been adopted at this hospital, but pyrexial symptoms have been met by *cold sponging and affusions*, with the internal administration of antipyretics, antiseptics, and tonics. During 1890 and 1891, six hundred and seventy-six cases of typhoid fever were thus treated, of which seventy were fatal = 10.4 per cent. This remarkable result is doubtless due to the fact that over one-third of the cases entered during the first week of the disease, and that hydrotherapy was used very largely in all cases."

These statistics, to which others may readily be added were they not sufficiently large, present to us the appalling fatality of typhoid fever under the expectant and antipyretic plans, which claim, by nourishing the patient, placing him in good hygienic surroundings, combating complications as they arise, and reducing the temperature, to conduct him to a safe issue. Much stress has been placed during the past quarter of a century upon high temperature as the predominating element of danger in typhoid fever. It has been claimed that parenchymatous degeneration of the heart, kidneys, and other organs was the direct result of prolonged high temperature, and the chief energy of therapeusis was expended upon this hydraheaded monster. This idea was indeed sustained by, if it did not originate in, the marvellous success of the cold-water treatment, which Brand, of Stettin, in 1861, brought before the profession in Germany, and which was modified by Liebermeister, the high-priest at the altar of antipyresis, as well as by Jürgensen, Ziemssen, and others, and converted into an antithermic bath.

The history of this special subject is instructive, inasmuch as it illustrates how surely bedside experience will, sooner or later, demolish the most stately structures erected by theoretical reasoning. Brand never claimed that this bath treatment was chiefly directed against the high temperature. On the contrary, this was a secondary object with him. Liebermeister's criticism† is at once the best exposition and the highest encomium of Brand's method. On page 15 he says: "The

* Boston Medical and Surgical Journal, April 7th, 1892.

† "Handbook of General Therapeutics," Wm. Wood & Co., 1885.

work of Brand, which was published in 1861, ranks high above the level of the publications of the professional hydropathists of to-day. Still, the author occupies pretty much the ground of Priessnitz. The pre-eminent importance of abstraction of heat is not sufficiently recognized; the main action of water is more than that of stimulation," etc. Liebermeister himself has changed his views, as is evident from his more recent writings. That the standpoint of Brand is correct, and that it is sustained by the most incontrovertible evidence of experimental study, seconded by clinical experience gathered from carefully recorded data, are to-day evident. Thinking men now realize that the introduction of the powerful antipyretics has not reduced the mortality of typhoid fever, and that the only advantage from them seems to be that the *patient is enabled to die with a nearly normal temperature.* The fact that the statistics of private and hospital practice show a mortality reaching beyond twenty-four per cent, since the introduction and abundant use of antipyrin and its substitutes, proves their inadequacy. And the fact becomes more glaring when statistics of the cold-water treatment reveal the astounding reduction of mortality to 3.9 per cent, and when the *rationale* of the action of antipyretics is carefully studied (see pages 170 and 171).

It has become our solemn duty to pause, weigh the reasons of this enormous difference in the mortality, and ascertain if it may not be further reduced by a more universal adoption of the Brand bath. I propose to establish the fact that this mortality may be reduced, as Brand has reduced it, to *one per cent.* Those who, like myself, have personally witnessed the fatality of typhoid fever in New York City may, as I once did, shrug their shoulders in doubt, and fortify their argument against these baths by their own *small statistics* gathered in private practice and *not recorded;* or by the imperfect records of hospital statistics, in which persons of all ages, sexes, and conditions, and cases in all stages, are mingled in unutterable confusion and admitted usually late in the disease. An examination of the following pages and an analysis of the reasons offered to prove the superiority of the cold-bath treatment will demonstrate that this is not a chimera, but a substantial fact, based upon the most reliable clinical data.

Brand offers the statistics of 19,017 carefully gathered cases of typhoid fever,* which demonstrate that under the general influence of all kinds of cold-bath treatment, without, however, its strict enforcement, the mortality has been reduced from 21.8 per cent to 7.8 per cent. But this is not all. He has obtained from twenty-three German and French distinctly designated sources the reports of 5,573 cases (to which I have added more recent reports), statistical evidence which

* Deutsche medicinische Wochenschrift, 1887.

has not yet been and cannot be controverted, and by which it is clearly shown that the cold-bath treatment originally recommended by him has reduced the mortality to 3.9 per cent. The latter percentage, however, still includes many imperfectly managed cases. Eliminating these, the number treated strictly by Jürgensen, Vogl, Brand, and others up to January, 1887, amounted to 1,223 cases, of which twelve died, *a mortality of one per cent.* And yet this is not all, for the most significant fact deducible from these statistics is that *not one of the twelve deaths occurred in any case that came under treatment before the fifth day.* Brand boldly asserts, on the strength of these 1,223 cases, of which he treated one-fourth in private practice, the remainder coming from Jürgensen's clinic at Tübingen (which approximates private practice), Vogl's military practice at Munich, and the military hospitals at Stralsund and Stettin, that *all cases of typhoid fever coming under treatment before the fifth day should recover.*

Medical statistics are proverbially unreliable, but the exactness of the figures presented by Brand, in his able polemic in the *Deutsche medicinische Wochenschrift* for 1887, cannot be doubted and his deductions cannot be gainsaid, because they are furnished from civil and military life, from university clinics and military hospitals, in which the cases were observed by competent and well-trained men, and they have been confirmed by more recent reports, as I shall show.

Valuable as these statistics must be as an argument in favor of strict cold bathing, the results of the latter are better illustrated by some comparative statistics made by several clinical observers. For instance, the official records of the Second Prussian Army Corps, quoted by Brand, show that, while from 1849 to 1866 the mortality among 1,970 cases was 26.3 per cent, it was reduced among 2,714 cases of strict cold-bath treatment to 4.3 per cent. This enormous reduction is the more glaring when this mortality of 4.3 per cent is compared with that of other armies. In the French army, it was 32.2 per cent; in the Italian, 28.6 per cent; in the Austrian, 27.4 per cent; and in the English, 23.8 per cent, during the same period. Indeed, so striking was the reduction of mortality wrought by this treatment in the German military hospitals that the Prussian War Department deemed it incumbent upon itself to issue, on January 25th, 1883, a circular to the medical service, in which it was urged that "inasmuch as the Brand treatment has been instrumental in reducing the mortality of typhoid fever in the various hospitals from 25 per cent to 8 per cent, we are justified in expecting that, with an increased perfection and more general adoption of this treatment, it may become possible to save a still larger number of sick men."

As doubt has often been cast upon the correctness of these statistical

statements and their applicability to our own country, the following opinions from reliable sources may confirm them.

Dr. J. C. Wilson, of Philadelphia, now Professor of Practice in Jefferson College, wrote me on October 16th, 1890: "I confess to having entertained misgivings as to the accuracy of Brand's statements for a long time; but I took occasion last spring to investigate the matter systematically for myself. *No one who has done this, following the method closely, and avoiding medication, can doubt the efficacy of the treatment.* In this community, it would be at present impracticable to introduce the treatment to any great extent in private practice; but the publication of statistics which are incontrovertible, and which prove that the average mortality can be reduced from its present figures, perhaps sixteen per cent, including hospital and private practice, to two or three per cent, will in a short time render the employment of baths practicable both in public and private practice. I find the trouble lies chiefly with our physicians, some of whom are closely hidebound and subject to traditions. But there are many others who are open to conviction."

In *The Medical News*, December 6th, 1890, Dr. Wilson says: "Severe symptoms were mitigated, and mild cases ran a most favorable course. As a rule, patients did not object to the baths. When they did so, their objections ceased after a few baths had been administered. Complications were trifling, there were no sequelæ, and in every case the convalescence was rapid and satisfactory."

In a lecture published in Lippincott's *International Clinics*, for July, 1891, page 19, Dr. Wilson says: "This treatment has consisted almost exclusively in a routine procedure, and in that respect is wholly at variance with the general teachings of this country in regard to the management, not only of this disease, but of the other infectious febrile diseases. It is, moreover, a treatment radically different from any method hitherto practised in the other hospitals to which you have access, and is only briefly discussed in your text-books. It has now been systematically and continuously carried out in this hospital during a period of sixteen months, and our studies in regard to it embrace, so far as I am informed, a longer period of time and a larger number of cases than in any other American hospital. These are, collectively, sufficiently large to warrant a review of our work at this time, especially as our results coincide with those which have been placed on record upon a much larger scale abroad.

"The method of Brand treated with indifference outside of Germany, where it originated, for a long time met with violent and systematic opposition in the country of its birth. By degrees it won its way to favor, step by step, in spite of this opposition. The general

testimony in regard to its effect upon the case is in entire accord with the statement of Brand."

Dr. Wilson* reports four hundred and eight cases treated by systematic bathing in the German Hospital and the Hospital of Philadelphia with thirty-two deaths = 7.84 per cent. The greatest number of cases were admitted during the second week of the attack. Hence the strict Brand method, which demands the application of baths during the first week, could not be applied.

Dr. James Tyson, Professor of Clinical Medicine, University of Pennsylvania, thus testifies to the value of the Brand method.† "I have been anxious for an opportunity to give emphasis to a method of treatment which, while it has received the acknowledgment of the large majority of hospital physicians, has, for various reasons—some of them quite potent—failed to come into that general use which its efficiency demands for it; and I have thought that an opportunity would be presented here of reaching many who, by reason of their residence outside of the larger cities, have not had their attention called so forcibly to its superior advantages as was needed to secure its more general adoption in private practice. Further, I am able also to show a means by which the treatment is bereft of one of its most serious inconveniences. I allude to the Brand bath method of treating typhoid fever. *I have become so satisfied from my personal experience with this method that it without doubt greatly surpasses any other in the results attained by it that I feel impelled to do what I can to extend its use.*"

In the transactions of the State Medical Society of Indiana for 1889, Dr. G. C. Smythe, of Indianapolis, Ind., reports two hundred and eight cases of typhoid fever treated by baths by himself and three colleagues, with five deaths (2.5 per cent). He says (page 8): "No one has a right to oppose this treatment upon purely theoretical grounds. He who does so, and refuses to adopt it, signs *the death warrant of twenty individuals out of every hundred* with this disease, and a discriminating public will hold him responsible."

The present status of the Brand method in New York City is evident from the following report‡ of a discussion of cold baths. Dr. Delafield, Professor of Medicine in the College of Physicians and Surgeons, New York, said that "to his mind the tubbing treatment of typhoid fever was altogether the best which we now had. In employing it one did so for the disease and not for the temperature. One should not wait for an excessive rise of temperature."

* Medical News, November 30th, 1895.
† Therapeutic Gazette, July 15th, 1895.
‡ Medical Record, November 7th, 1896.

Dr. A. B. Ball, Professor of Clinical Medicine in the same school, thought "the reason why the doctors at Bellevue, including himself, had given up the bath treatment some years ago was that they did not employ rubbing. Everybody who had tried the more recent method, adding friction, had been convinced that there was *no other method at command which was so valuable.* The influence upon the respiration, causing deep inspiration, must be among the most beneficial effects. With women he had continued the treatment during menstruation, and it had received the approval of some of his gynæcological friends whom he had consulted about it. With some patients it might be best to begin the bath at 85° or even 90° F. The great mistake was to suppose that it was intended simply to reduce the temperature."

Dr. W. P. Northrup, Professor of Pædiatrics, Bellevue Hospital, said "the beauty about the bath treatment of typhoid cases was, to quote Dr. Delafield, that they ran such a comfortable course. He had applied it in all cases for three successive autumns at the Presbyterian Hospital, except in a few cases in which at the strong recommendation of a doctor in the city he allowed Fraenkel's toxin to be tried. These patients, although recovering, suffered such great discomfort from their disease as long as the baths were withheld that he made up his mind, if he were forgiven for thus allowing them to suffer, never to repeat the offence."

Sir William Broadbent* says: "While, however, cold sponging, the wet compress, the ice bag, and similar measures are useful and grateful, they fail to exercise the desired control over the temperature when the fever is at all severe. A resource of greater power is the bath, and it must be said that whenever this has been systematically tried the mortality of typhoid has been considerably reduced."

It would seem that even the leaders of medical thought in Great Britain have not yet disenthralled themselves from antipyresis and apply the cold bath as an antipyretic still, as is evident from the excellent lecture of Dr. Broadbent from which the above extract emanates.

Dr. Tuttle† states that "in the New York Hospital during the year ending November 1st, 1892, there were seventy-six typhoid patients treated by the cold bath, with a mortality of only five per cent. The Brand method was carried out more perfectly in this than in any other hospital in the city, as in most of them the treatment was mixed, in some a bath being given when the patient seemed to stand the high temperature poorly, and in others baths with intestinal antiseptics and other medication, but in none with such good results as above." The fault

* Lancet, 1896, vol. ii., p. 426. † Southern Medical Record, 1892.

referred to by Dr. Tuttle is very prevalent, the fact being lost sight of that the ideal results of Brand can be expected only from following strictly his method.

Dr. Osler, Professor of Practice in the Johns Hopkins Hospital,* gives the statistics of typhoid mortality for six years, ending May, 1895: Cases admitted before introduction of hydrotherapy, 33; mortality 24.2 per cent. Cases admitted since introduction of hydrotherapy, 356; mortality 6.6 per cent.

"Two advantages are claimed for hydrotherapy in typhoid fever—a mitigation of the general symptoms of the disease and a reduction in the mortality. Our experience during the past five years bears out these claims.

"In general hospitals, to which cases rarely are admitted before the end of the first week, the full benefits of the cold bath, as described by Brand, cannot be expected; nevertheless, in any large series, the severer manifestations appear to be less common. As has been urged so often and so ably by many writers, the beneficial action is not so much special and antipyretic as general, tonic, and roborant. The typhoid picture is not so frequently seen, and we may have twenty or more cases under treatment without an instance of dry tongue or of delirium among them. It is a mistake to claim, as do the too ardent advocates of the plan, that severe nervous symptoms are never seen. I have taken the pains to go over carefully our records on this point. There were in the first three years thirteen cases, in the past two years nine cases with delirium."

While Osler's comments are correct, the fairness of this statement may be enhanced by calling attention to the fact that the "ardent advocates of the plan" claim the absence of severe nervous symptoms only in cases in which strict bathing is begun very early in the disease. My observations demonstrate the correctness of this claim and that the earlier bathing is begun the more pronounced is the abolition of delirium and stupor. Since, however, "in general hospitals cases are rarely admitted before the end of the first week, the full benefits of the bath cannot be expected," as Osler says; hence the claims of the "ardent advocates," are not a mistake.

"A far more important claim is that the use of the cold bath reduces the mortality from the disease. The comparison of death rates as a measure of the efficacy of any plan of treatment is notoriously uncertain unless *all* the circumstances are taken into account. Our own figures for the past five years, for example, illustrate this: 6.2 per cent in the bathed cases, ten in the unbathed cases—as the latter group is made up entirely of cases too mild to bathe—and six patients

* Reports, vol. v.

in whom either the disease was not recognized or who were too ill on admission to treat.

"In the Metropolitan Fever Hospitals, London, the death rate, as given in the Report for 1893, was seventeen per cent. The cold-bath treatment, rigidly enforced, appears to save from six to eight in each century of typhoid patients admitted to the care of the hospital physician.

"While I enforce the method for its results, I am not enamored of the practice. I have been criticised rather sharply for saying harsh words about the Brand system. To-day, when I hear a young girl say that she enjoys the baths, I accept the criticism and feel it just; but to-morrow, when I hear a poor fellow (who has been dumped, like Falstaff, 'hissing hot' into a cold tub), chattering out maledictions upon nurses and doctors, I am not inclined to resent it, and to pray for a method which may be, while equally life-saving, to put it mildly, less disagreeable."

The author is fully in accord with Dr. Osler's hope that a more practical and agreeable mode of saving life in typhoid fever may be devised.

Dr. Glenard, Professor of Medicine in Lyons University, who, as a prisoner of war in Stettin, assisted Brand in treating typhoid fever among the French prisoners, and on his return to France became a warm propagandist for the Brand method, concludes a paper before the French Congress for Internal Medicine, 1894, as follows: "The treatment of typhoid fever with cold water has not only resisted all onslaughts against it in France during the past twenty-five years, but its value is so far undisputed that many Prussian professors regard it as a specific. Easily executed in town and country, in the houses of the poor as well as of the rich, the remedy should become the common property of all physicians, and our hospitals should afford ample material for its thorough mastery."

Dr. F. H. Hare, of the Brisbane Hospital, Queensland,* offers an excellent *résumé* of the work of a large general hospital. From 1882 to 1887, 1,828 cases of typhoid fever were treated on the expectant plan, with a mortality of 14.8 per cent. From 1887 to 1896, one hundred and ninety cases were treated with the Brand system (?) of cold bathing with a mortality of 7.5 per cent. There has occurred, therefore, a reduction in the mortality of the disease of practically fifty per cent; or, in other words, about seven of every one hundred patients admitted have been saved by the bath treatment. This result harmonizes exactly with the latest conclusion of Osler on this subject. He says: "The cold-bath treatment rigidly enforced appears to save

* Medical Record, May 8th, 1897.

from six to eight in each century of typhoid patients admitted to the care of the hospital physician.

"The series being sufficiently long to exclude errors due to paucity of data, the variations have practically disappeared; there is instead, as pointed out by Osler, a remarkable uniformity in the results.

"The most important result of the systematic employment of Brand's treatment is the alteration it has effected in the constitution of the mortality list. The statistics of the first three years of the decade led to the conclusion that the treatment was ineffectual to reduce the mortality from perforation and hemorrhage, and that the vast bulk of the reduction was due to the prevention of those complications and modes of death which, being more or less common to the febrile state however induced, are termed pyrexial. Further experience has simply verified this.

"In the 1,902 cases of the ten-years' bath period, 56 patients died of perforation, or 2.9 per cent; 23 of hemorrhage, or 1.2 per cent; while 64, or 3.4 per cent, succumbed to other causes. The following table shows the modification which has been imprinted upon the constitution of the typhoid mortality list by the introduction of the cold-bath treatment:

Causes of Death in Typhoid.	According to Murchison. Percentage.	Brisbane Hospital before Introduction of Bath Treatment. Percentage.	Brisbane Hospital after Introduction of Bath Treatment. Percentage.
Perforation	3	2.9	2.9
Hemorrhage	1.4	1.88	1.2
Other causes	12.8	9.73	3.4
Total mortality.	17.2	14.5	7.5

"Thus almost the whole of the reduction in mortality, amounting to seven in every one hundred admitted, falls upon the third group of causes; or, in other words, perforation and hemorrhage, which together used to cause only about one-fourth of the total deaths, now under the bath treatment cause more than half, and this in spite of the fact that they are if anything actually less fatal.

"An important point brought out by this report is the comparative mortality of the sexes. Statistics on a large scale show that under ordinary treatment the female mortality is slightly higher than the male. In Brisbane, during the expectant period, 1,160 men and 668 women were admitted. Of the former 164 died, a mortality of 14.14 per cent; of the latter 107, a mortality of 16.02 per cent. The difference is in spite of the admitted fact that men are about twice as liable as women to succumb to perforation and hemorrhage.

"It follows, therefore, that the female wards offer a better field for the cold-bath treatment than the male."

These statistics present almost exactly the same result as those of the second division of Vogl's hospital, in which the same mixed treatment was pursued. They are equally valuable, because all sources of error are eliminated in this judicious report. It may be of interest again to refer to the fact brought out by Brand, that perforation and hemorrhage are prevented only by the strict *early* cold bathing. The reason for the absence of reduction of these complications in the Brisbane Hospital rests on the fact that in a general hospital cases are not admitted before the fifth day, and in the Brisbane Hospital the treatment is mostly a combination of the Brand method with antipyretics.

Bouveret records* one hundred cases of typhoid fever treated by the strict cold bath, with a mortality of three per cent. The average date of admission of the fatal cases was the sixteenth day. He commences in advanced cases at 79° or 80° F., reducing the temperature of the baths to Brand's standard of 65°, if fever does not yield. *He has never had syncope or heart failure from the bath, because he never omits friction over the body,* except over the abdomen. He treats strictly in accordance with Brand's rules, except that the abdominal wet compresses are kept cold by ice bladders contained within them.

Private Practice.—Thus far the observations of hospital physicians and teachers only have been cited. Although these include their experience in private practice, the following statements from physicians in private practice alone may be of interest.

In an essay read before the Detroit Medical Association and published in *The Physician and Surgeon*, December, 1889, Dr. Carl Borning says: "In reviewing sixty-one cases—which I have treated without a death by Brand's method, with no medicine except one or two large initial doses of calomel—I have to say most emphatically and decidedly that Dr. Brand's method of treating with cold baths typhoid fever or typhus fever, or in fact all diseases with a continuous abnormally high temperature, is the very best, the ideal mode of treatment, and the one which should be pursued in every case, may it be severe or mild. *If this plan is persisted in from the beginning, no anxiety need ever be felt by the physician about his patient, for he will surely recover.* The course of the disease will be relatively mild, and all these various and dreadful complications which are so common with any other plan of treatment will be almost entirely excluded. But in order to get these results *you have to carry out Brand's directions to the letter.*"

Dr. Barker, of St. Louis,† states that he has treated forty-five cases

*Lyon Médicale, 1891. †Therapeutic Gazette, p. 515, 1895.

in private practice, thirty-five of which received baths of 70° or 75° for fifteen minutes. In the latter he had not a single death. Barker has abandoned sponging, rubbing with ice, etc., for "immersion, which, although troublesome at first, requires less skill and can be relied on for pronounced effect."

Dr. Carl Sihler, of Cleveland, Ohio, was so firmly convinced of the life-saving value of the Brand method in typhoid fever that he under-

TABLE OF COMPARATIVE MORTALITY UNDER VARIOUS METHODS OF TREATMENT IN TYPHOID FEVER.

Reporter.	Source.	Treatment.	Number of Cases.	Percentage of Mortality.
Jaccoud	Various sources	Expectant	80,140	19.25
Murchison	Various sources	Expectant	27,051	17.45
Brand	Various sources	Expectant	11,124	21.7
Delafield	New York Hospitals, 1878–83.	Expectant	1,305	24.66
Tripier	Lyons Hospital, 1866–77.	Expectant	229	26.2
Vogl	Munich Military Hospital, 1841–78.	All kinds, chiefly expectant.	5,484	20.7
Hare	Brisbane Hospital, 1882–87.	Expectant, quinine, and cold wet sheet.	1,828	14.82
Wilson	German Hospital, Phila.	Expectant and some baths.	271	13.29
Tripier	Lyons Hospital, 1873–81	Expectant and bathing	629	16.5
Bouveret and Teissier.	Lyons Hospital, 1882–87	Strict baths in severe cases.	376	6.9
Vogl	Munich Military Hospital, 1868–81.	Expectant and baths	2,841	12.2
Brand	Various sources	All kinds of cold baths	19,017	7.8
Riess	Berlin Hospital	Permanent tepid baths	1,000	8.5
Ziemssen	Tübingen Clinic	Graduated baths and antipyretics.	2,000	9.6
Vogl	Munich Military Hospital, 1877–87.	Strict cold baths and antipyretics.	702	7.6
Hare	Brisbane Hospital, 1875–81.	Cold baths and some antipyretics.	1,173	7.84
Hare	Brisbane Hospital, 1887–96.	Strict Brand	1,902	7.05
Naunyn	Königsberg Clinic	Strict cold baths	145	6.9
Vogl	Munich Military Hospital (2d division), 1882–87.	More strict baths and less antipyretics.	144	4.1
Vogl	Munich Military Hospital (1st division), 1880.	Strict cold baths	428	2.7
Vogl	Munich Military Hospital, 1882–87.	Strict cold baths	141	3.5
Bouveret	Lyons Red Cross Hospital, 1891.	Strict cold baths	100	3
Brand	Various sources	Strict cold baths	2,198	1.7
Brand	Same cases, omitting those not treated before fifth day.	Strict cold baths	2,150	0
Wilson, J. C.	German Hospital, Phila.	Strict cold baths	94	1
Wilson, J. C.	German Hospital, Phila.	Strict cold baths	408	7.8
Vogl	Munich Military Hospital, 1893.	Baths of 59°	426	8.4
Tuttle	New York Hospital, 1893.	Strict cold baths	76	5
Sihler	Private practice	Strict cold baths	80	5
Barker	Private practice	Strict cold baths	35	0
Borning	Private practice	Strict cold baths	61	0
Baruch	Private practice	Strict cold baths	32	0
Murtra	Australia	Strict cold baths	173	5.4

took, at his own expense, the work of translating Brand's, Vogl's, and Tripier's contributions, because "here was a chance for missionary work in a field which promised many good results." He justly says

that, while his personal experience "covers the first period with the water treatment, when serving my apprenticeship, and shortcomings and mistakes in the application of the method would be apt to make such observations of little value," it demonstrates clearly "with what degree of accuracy and how extensively an ordinary practitioner in private practice is able to follow" this method, even among the laboring classes. During two years Dr. Sihler treated fifty-four cases of typhoid fever with water, with three deaths, and twenty-six mild cases, some of which had baths, with but one death; and concludes by saying: "With this method a powerful means for good is placed in the hands of the physician, and I would no more think of placing any one dear to me personally, suffering from typhoid fever, into the hands of a physician who does not act according to the principles of Brand, than one who had to undergo an operation into the hands of a surgeon who does not act according to the principles of Lister."

Since adopting the strict Brand method I have treated thirty-two successive cases in private practice, without a single death, while during the last year of the expectant and antipyretic treatment I lost thirty-three per cent of my typhoid cases.

The above table, which I have gathered with care to exclude all unreliable statistics, presents at a glance the comparative merits of the various methods of treatment. The figures astounded me when I sought them out, and I trust that the lesson they teach will be impressed indelibly upon the mind of the reader.

Reasons for the Therapeutic Supremacy of the Cold Bath in Infectous Fevers.

While statistics have demonstrated the superiority of the Brand method, it is well that physicians divest themselves of the empirical influence of mere figures, which, it has been said, may be marshalled in any cause to prove anything, and *investigate the reason* why the cold-bath treatment of typhoid fever is superior to the antipyretic, expectant plan. Therefore I do not ask the acceptance of the evidence furnished alone, although it will doubtless be conceded that never in the history of medicine have statistics of such magnitude, from such reliable and diversified sources, been brought to bear upon a question of therapeutics.

The idea that high temperature is the chief determining cause of fatality in typhoid fever must now be abandoned. The sooner we cut loose from this fallacy the better will it be for suffering humanity. This position is fortified by the observations of many clinical observers

and by experimental laboratory demonstrations. Among the latter we find the clear and sagacious review of the pathology of fever by Professor Welch, of Johns Hopkins University, offered in his Cartwright Lectures, 1888, in which he gives a cautious, painstaking, and judicious weighing of all the evidence bearing upon the lethal influence of heat elevation in fevers, sustaining them by experimental and clinical data that must be convincing to any unbiassed mind. He says, in summing up,* that "the conclusion seems justifiable that *failure of the heart power is less an effect of high temperature than of other concomitant conditions.* The lessened perspiration, the renal disorders, and the digestive disturbances (with the possible exception of constipation) are referable also chiefly to other causes than the increased temperature. Both experimental and clinical observations strongly support the view, now widely accepted, that the disturbances of the sensorium, which constitute so prominent a part of the group of so-called typhoid symptoms, are dependent in a far higher degree upon infection or intoxication than upon the heightened temperature. Even in fever, such as typhoid fever and pneumonia, when the height of the temperature is undoubtedly a most important index of the severity of the disease, there exists no such parallelism between the temperature and the nature and severity of the symptoms as we should expect if these symptoms were caused by the increased heat of the body."

In the discussion of a paper on antipyretics which I had the honor to read before the section on practice of the New York Academy of Medicine, the lamented Dr. Wesley Carpenter said: "With regard to heart failure and degeneration of the muscular fibres of the heart, I had an opportunity, in connection with the pathological department of Bellevue Hospital, to examine microscopically the cardiac muscle in a sufficient number of cases to make it quite evident that they did not occur with the frequency one might be led to expect from reading the writings of the German observers."

Dr. A. L. Loomis said on the same occasion: "I am not certain, for I have been in the line of observation similar to that of Dr. Carpenter, that failure of the heart is due to parenchymatous degeneration, of which we have at times heard so much, and it has seemed to me to be due to failure in nervous supply as much as to muscular changes."

This is clear evidence from pathologists and clinicians, which I might corroborate by other home and foreign testimony.

Since it may now be regarded as an established fact that high temperature, minus infection, does not produce those serious degenerations formerly ascribed to it, we must seek in the infective process, and the

* Medical Record, April 28th, 1888.

ptomaine intoxication resulting from it, those deleterious effects upon the vital organs which undermine the system and eventually cause death in typhoid fever. As the chapter on its *rationale* has clearly pointed out, the cold-bath treatment yields the most triumphant results in combating these very effects of the infective and toxic agencies, of the true entity of which we have not yet positive evidence. It has been clearly demonstrated by numerous trustworthy observers that the reflex stimulus aroused by the shock to the extensive peripheral nerve endings so energizes the nerve centres which furnish innervation for circulation, respiration, digestion, tissue formation, and excretion, that the system is enabled to tide over the dangers which would ensue from failure of these functions.

This is, in a nutshell, the effect of cold bathing in infectious fevers; the simple cooling effect on the blood occupies a secondary though not unimportant office.

The vivifying effect of the cold full bath upon the nerve-centres referred to produces a vigorous cardiac action, which is evinced by the slower and more regular pulse and an improved tension of the vessels, and appetite and digestion are enhanced, enabling us to enforce a more perfect nutrition; it deepens and lowers the respiration, preventing stasis of bronchial secretions and obviating pulmonary complications; all the secretions are enhanced; the patient is refreshed and invigorated, and *fights the battle of life with all chances in his favor.* How different is the aspect of a case under the expectant treatment, and how different is the effect of pure antipyretic medication! The temperature may, indeed, be reduced, but the stimulating effect upon the nerve centres and secretion, except on the perspiration, is absent. Vinay,* who has made some creditable investigations on the subject, tells us that antipyrin does not relieve the delirium, which is in accordance with my own observation; it does not, like the cold bath, increase the flow of urine, by which noxious elements are eliminated. He has also confirmed Vogl's observation that convalescence is much shortened, because there is a rapid gain of weight when the fever has been treated by cold baths. Kairin, resorcin, and antipyrin† diminish the excretion of urea and nitrogen; hence they diminish the excretion of the *materies morbi* through the kidneys, while baths increase it. The liver in patients dying after treatment by antipyrin is from six to twelve and one-half grams heavier than in those dying after cold baths. This is confirmed by Dr. Porter,‡ who found that antipyretics produced

*Lyon Médicale, 1888.

† According to Jacubowitch, Jahrbuch für Kinderheilkunde, 1885, and other authorities.

‡ New York Medical Journal, July 30th, 1887.

granular and fatty metamorphosis of the liver and kidneys. Indeed, there is an entire absence of good effect upon the circulation after antipyrin, an effect which is marked after the cold bath.

In the discussion of this subject, at the instance of Dujardin-Beaumetz, by the Paris Congress of Therapeutics a few years ago, Lepine stated that his investigations showed conclusively that all antipyretics, the effect of which is so palpably soothing to the nervous system, act by inhibiting the activity of the protoplasm; they destroy chiefly the red corpuscles, either by converting the hæmoglobin or by attacking the cell structure itself; they act as poison to the protoplasm. Desplats, though favoring medicinal antipyretics in fevers of short duration, favored most decidedly the strict cold bathing of Brand in continued fevers with a tendency to adynamia or ataxia. Stokvis and Semmola spoke of medicinal antipyretics as dangerous remedies. Semmola thought that whatever comfort is induced by them is purchased at the expense of weakening the patient.

The matter stands quite differently with the Brand method, which even in the modified and emasculated forms which prevail is far more effective.

Dr. Shattuck, Jackson Professor of Practice in Harvard University, says* it is certain that the modified and feeble bath treatment practised in this country cannot compare in results with the strict Brand method, because the former still shows a mortality of ten per cent.

Dr. Horatio C. Wood, who, as Professor of Therapeutics in the University of Pennsylvania may be regarded as a safe counsellor, says with reference to Brand's method: "I have no doubt that very many persons in the United States have died of typhoid fever whose lives would have been saved if the American medical profession had risen above the opposition of the laity and above its own prejudices."

Juhel-Renoy, the late eminent Parisian physician, claims that even in old people the only effectual treatment is by the cold bath, from which he has obtained such marvellous results that they amounted to "resurrections" in some cases.†

Dr. H. A. Hare, Professor of Therapeutics in Jefferson Medical College,‡ furnishes a judicious exposition of this subject. On page 62 he says: "The writer feels sure that antipyrin should be given in typhoid and other low fevers of a continued type only when the cold pack [with which he evidently includes bathing] cannot be used, or at the end of the cold application, to prevent the temperature from

* Boston Medical and Surgical Journal, p. 604, 1894.

† Bulletin de Thérapie, p. 530, 1895.

‡ Boylston prize essay on "Fever: Pathology and Treatment by Antipyretics."

bounding upward after its depression. No fever can resist the cold bath. Cold bathing is a power for good, before which every other measure must stand aside."

Professor Gerhardt opened his course of lectures in the Berlin University on medicine in the fall of 1896 by a lecture on "Prognosis of Disease," in which he stated that the "prognosis of typhoid fever has been changed by treatment, the mortality of this disease having been reduced by the Brand cold-water treatment to one-fourth its former rate."

Since the fact has been demonstrated that *cold baths are antifebrile remedies*, while *antipyretics are simply antithermic agents*, the superiority of the former over treatment by antipyretic medication is thus made clear.

A mixed treatment is advocated by Liebermeister and Ziemssen. The latter, who is one of the stanchest defenders of the cold bath (not, however, as an antipyretic alone), regards the gradually lowered bath as better adapted to the exigencies of private and civil practice, while he concedes that the results of Vogl and others, in military practice, leave nothing to be desired. Liebermeister has until very recently insisted upon the cold bath as an antipyretic to produce remissions in the fever, and has prescribed quinine to render these more enduring. Naunyn, on the other hand, uses a modified and more temperate bathing, rejecting all antipyretic medication.

Testimony of Eminent Teachers.—In the fourth Congress of Internal Medicine (1885), eminent clinicians expressed almost unanimously the opinion that "until we obtain a specific curative agent for typhoid fever, such therapeusis is to be preferred as is capable of diminishing or removing the effects of the morbific agents, and that this aim is most surely fulfilled by hydrotherapy; that medicinal antipyretics act only against temperature elevation, but do not, like the bath, produce a modifying effect upon the fever process." Fielehne, Liebermeister, Jacksch, Strümpell, Rossbach, Heubner, Jürgensen, Bamberger, were among the speakers on the occasion, and were instrumental in producing a reaction in favor of the bath, which was about to be swept away in the antagonism which antipyretic medicines in typhoid fever had justly evoked. (See Corroboration by American teachers, pages **160** to **162.**)

Character of Statistical Evidence.—There is a statistical bureau in Berlin which sifts carefully all statistics pertaining to medicine. In 1887 Guttstadt, who is its censor, said in a lecture before the Verein für innere Medicin in Berlin: "An important factor in the diminution of mortality is the more successful treatment now used, *especially* Brand's method."

As corroborative and explanatory of the reasons of the superiority

of the bath treatment, a valuable lesson is inculcated by the unique reports of Dr. A. Vogl, who is the chief of the garrison hospital at Munich. He has collected from the records of that hospital all the cases of typhoid fever treated in it for forty-seven years, giving details of treatment, autopsy findings, and other valuable data in 8,325 cases. The gross results are noted in the table given above. But the most important deduction may be drawn from the fact that since 1875 two methods of treatment were pursued at the different stations of this hospital. In Station I. the combined method, consisting of baths at the temperature of the room, with three or four grams of quinine daily, and sodium salicylate was practised; in Station II. the methodical Brand bath of 60° to 65° F., for fifteen minutes whenever the temperature reached 103° F., no medicine being used. The barracks in which this treatment was executed are so well ventilated, as I have observed from personal inspection, that their temperature in winter averages about 45°. The long room is heated by iron stoves, is open near the roof, and is so well supplied with windows that it resembles a florist's hot house. Two tubs, of ordinary zinc, stand at its upper end, under the faucet, and to these the patients are carried. Such management seems heroic indeed, but the results are astounding:

Results.	Combined Treatment.	Strict Baths.
Number of cases	667	221
Mortality	7.6 per cent.	2.7 per cent.
Average stay in hospital	40.7 days.	47.3 days.
Average duration of fever	1.9 week.	1.8 week.
Percentage of complications	82	65.2
Average number of diarrhœas a day and person.	1.9	0.7

The reports of Vogl are altogether a most remarkable therapeutic statement, because they offer unimpeachable testimony to the effect upon the same type of patients (soldiers of about the same average age and condition of previous health) under depleting, expectant, and water treatment, and also striking evidence on the difference between a combined water and medicinal (antipyretic) method and the systematic Brand (antifebrile) method, and a modified Brand method with colder water. The numbers are sufficiently large to entitle them to respect, and the long period of time during which these observations have been made by various independently acting medical officers must exclude all possible errors resulting either from personal bias or variations in the type of the disease. These statistics are therefore the most unimpeachable existing in medical history.

Effect on Nutrition.—Vogl has confirmed the important fact, first

brought out prominently by Brand, that the capacity for enjoying and digesting semisolid food is greatly enhanced by the cold-bath treatment. Drs. George Peabody and Austin Flint have made the same observation in Bellevue Hospital. The former even allows solid food in the third week of the fever, and the latter has informed me that the appetites of his patients are difficult to appease after using the bath treatment. How different the condition of the stomach is under the expectant or antipyretic treatment every experienced physician knows but too well. As Brand graphically says, and I can confirm from personal observation: "While under the water treatment the tongue is moist, pale, without fur; the pharynx is free from pain; the stomach and intestines are free from catarrh, the latter showing only swollen glands, we find under other treatment the tongue hard, brown, and dry; saliva absent; swallowing painful; stomach and bowels utterly incapable of digesting, their mucous lining covered with ulcers; the bowels distended;—and in this condition the school demands that the patient be well nourished. What a singular demand! The digestive organs are in so nearly a normal state under the bath treatment that I often ask myself the question if it may not be safe to give more solid food, in order to appease the hunger. I find in *Virchow's Archiv*, 1889, pages 95 and 303, an essay by Hösslin, who demonstrates that even in fever and diarrhœa, so long as these do not reach a very high temperature, as is usual in typhoid fever, the nutriment is almost completely taken up; that there is, therefore, no reason for giving fever patients less food because it is not digested and absorbed. He regards it as necessary to offer typhoid patients the largest possible quantity of concentrated food, as milk, meat, eggs, flour preparations, etc., all, however, in minced or liquefied form."

Tripier and Bouveret give bouillon, extract of beef, coffee and tea with milk, one-half pint after each bath. During the time of relative apyrexia they allow rolls, rice, cream, tapioca, chocolate, four soft eggs daily, etc. As soon as the temperature is nearly normal, they allow roast chicken, bread and milk, lean meat, rice, baked brain, white lean meat, a little boiled beef, finely ground, etc. Vogl gives from the first day coffee, meat broth with a little flour and eggs, milk, one bottle of red wine daily; later, bouillon and eggs, so that patients receive daily fifty grams albumin, forty-five grams of fat, and two hundred grams of carbohydrates, a food quantum that could not be permitted to patients who are not bathed. Brand says the most important element of nutrition, besides the food, is a good stomach, and that this may be obtained by the systematic bath treatment.

The bedside observations of the strict bath advocates are so rich in demonstrations of its beneficial effect upon all the functions which con-

tribute to the maintenance of strength and endurance during fever that I would fain cite them, did space permit.

I have endeavored to show as briefly as possible the reasons the results are more favorable under the cold-bath treatment first suggested by Brand in 1861. The latter is thus demonstrated to be the ideal treatment for typhoid fever, and whenever a departure is made from it Jürgensen's opinion, given at the congress in London, is sustained. He said that "whenever he attempted to deviate from the rigorous cold-water treatment, he was compelled to return to it, in order to obtain the best results."

Personal Experience of Physicians.—Dr. W. G. Thompson confirms the testimony of Ziemssen and Vogl, derived from personal experience, of the beneficial effect of cold baths upon themselves when they had suffered from typhoid fever. Vogl and Thompson say that they should not be deterred by the protests of the patient from rigorously executing the plan of three-hourly bathing so long as the temperature is 103° in the rectum, or when the sensorium is deeply depressed even with a lower temperature. "Even sleep should not prevent resort to the thermometer and bath, if temperature and pulse urgently demand it."

Aim of the Cold Bath.—The object of this treatment, it must be finally understood, is not to subdue the temperature, but to vivify and energize the vital organs, and thus insure a vigorous resistance to the toxic influences arising from the infective processes. This is the great aim to be kept steadily before us; it is clear and evident from the *rationale* of its action. The latter has been entered into with some detail (pages 141–154) in order to carry conviction to those minds which are prejudiced sufficiently not to be satisfied with the empirical demonstration afforded above. The searcher after truth justly demands a reasonable explanation of the action of a therapeutic agent before admitting the latter to his confidence when the issues are so vital.

Objections Urged against the Brand Method.

Many objections to the strict execution of Brand's method have been urged. Some of these are too puerile to require notice; others are so absurd and unphysiological that their inconsistency with the known principles of heat regulation needs but to be pointed out.

Objection I. This is an example of the *ad captandum* objections sometimes found in our literature: The editor of a popular medical journal, who does not believe in cold bathing in typhoid fever, therein agreeing with many other physicians, does not hesitate to give expres-

sion to his disbelief as follows: "If the fact that a typhoid patient is too hot is sufficient cause for sousing him in cold water, why shall we not also relieve a starving man by a liberal allowance of food, and revive a man dying of thirst by unlimited amount of water internally? 'Look at the increased renal elimination,' triumphantly shouts the immersionist, who uses the bath not to reduce temperature, but to improve phagocytosis and nutrition. He overlooks the fact that this treatment checks perspiration, drives the blood from the skin to the already congested and poisoned viscera, and leaves only the choice between diuresis, diarrhœa, and death. The immersionists plunge almost every case of typhoid that comes into their wards, including anæmic girls, flabby women, debilitated men, for whom cold bathing should be prescribed with the greatest caution (not more than twice daily), if they sought advice for the general conditions of weakness uncomplicated by typhoid."

The well-informed physician need not be reminded that patients are *not* soused in cold water because they are too hot; that the increased renal elimination is *not* due to "driving the blood from the skin to the already congested and poisoned viscera;" that the effect of the Brand bath is really to congest the skin, as shown by the redness produced, and thus to unload the congested viscera; that the kidneys are stimulated to increased "elimination of poisons" through improved cardiac action. Whoever has bathed "anæmic girls" and "flabby women" for typhoid knows that most of them react well under properly administered baths, and that their power of resistance is enhanced by them, if carefully adapted.

Objection II. Being educated to regard the expectant plan of treatment as the best, many physicians are loath to abandon the policy of expectancy, whose aim it is to allow the fever to pursue its own course. The annoyance involved in the bath is not in accordance with the expectant plan, whose object it is to avoid all disturbance of the patient for remedial purposes. As long as we had only an inefficient, if not injurious, medicinal treatment, it was wise to avoid disturbing sleep. But in a severe case of typhoid fever it is as important to disturb sleep, if due to stupor, as it is in opium poisoning when stupor supervenes. Indeed, the treatment is somewhat analogous, inasmuch as the object is chiefly to arouse the nerve-centres and keep them aroused (though not continuously, as in the latter) until the toxæmia has passed away.

Objection III. The apparently heroic character of the Brand method may intimidate physicians into the preference of antipyretics in a guarded form. The idea that the reduction of temperature is the leading object of the cold bath, and the much greater facility of accom-

plishing this object by antipyrin and antifebrin, may deter many from adopting the former. The fallacy of this course has been demonstrated; it is happily not so prevalent at the present time as formerly.

Timid persons may be alarmed by the patient's pallor, small pulse, and complaints of chilliness while in the cold bath. But, if it is properly administered, with chafing of the body and limbs, these effects will be counteracted to some extent. Reaction after removal will soon reassure the attendant, and embolden him to order regular repetition.

Objection IV. A careless application of the bath, or the substitution of some other method—packing, sponging, sprinkling, etc.—will fail and cause discouragement. These are not cold bathing.

The only modification of the general cold bath advised by Brand when the temperature reaches 103° is the stimulating affusion in cases threatening heart failure and delirium. This is a warm half-bath, with affusions of 50° to 60° over the head, chest, and back. (One important point is that the tub should always be brought to the bedside to avoid unnecessary disturbance of the patient.)

Objection V. Limited experience. A small experience, personal or from hearsay, which may have been unfavorable in one, two, or several cases, will deter some from adopting the energetic cold bathing. The average experience with cold bathing in England, where it has not found much favor, and in America has been too small to afford a proper estimate of its value. Dr. Bristowe, of St. Thomas' Hospital, may be cited as an example. He says: "My personal experience in this treatment is not extensive, and for some years I have rarely, if ever, resorted to it. I have undoubtedly seen patients apparently benefited and making a good recovery, but I have never felt satisfied that the benefit was real."

During a visit to one of the largest London hospitals in 1896, the visiting physician astonished the writer by replying to the question what he thought of the cold-bath treatment of typhoid fever, that he regarded it as too heroic and preferred the expectant plan.

Our English confrères have evidently not grasped Brand's idea, else their large material would have surely enabled them to see practical demonstrations of its enormous superiority over the expectant plan. The latter is correctly named, because the physician pursuing it is constantly expecting some complications, to cope with which he rarely feels capable.

Dr. Austin Flint published, in 1882, a lecture which exercised a potent influence in this country. He treated seventeen cases in Bellevue Hospital. "In a few cases the cold bath of 80° F., gradually reduced to 65°, was employed, but was discontinued on account of inconvenience." His conclusion was that the antipyretic treatment

neither increased nor diminished the mortality, which was four out of the seventeen cases. His son and present successor, who was the first physician in this country to follow me in adopting the strict Brand method, has accepted my personal suggestions on the proper method of the strict Brand bath, and is *pursuing it with success* in the same wards in which his great father abandoned it.

If we compare these meagre statistics with those offered by Brand and the recent American and Australian figures, their utter insignificance for purposes of deduction becomes apparent.

The true clinical value of the cold-bath treatment is now dwelt upon in many text-books. Strümpell, who has a large experience, says, with his usual fairness: "There is at present no other single method of treating typhoid fever which has so numerous and evident advantages for the patient. We regard it as a duty of every physician who undertakes to treat a severe case of typhoid fever to try his best to have the bath employed."

Objection VI. The difficulty, if not impossibility, of treating patients before the fifth day. Indeed, this can be done, it is claimed, only in military hospitals or in epidemics, when every suspicious case may be subjected to the bath. It has been objected that "this is a very delicate adjustment of treatment when a patient is saved or doomed, according as it is inaugurated on the fourth or fifth day." This is an error. While one day's delay may be of little consequence, a delay of several days may be of serious import. This condition applies with equal force to much of our therapeutic endeavor. *Principiis obsta* is the first principle of rational therapeutics. Disease may properly be likened to a conflagration: the ease of its subdual is in proportion to the stage at which it is attacked. In the severe types of malarial fever which I have seen in the South, for instance, one day's—yes, even one hour's—cinchonization may save the patient's life; its delay may doom him to death or to long-continued invalidism. Brand has demonstrated as clearly as anything can be demonstrated by clinical data, not from his own practice only, but from that of others also, that out of twelve hundred cases treated before the fifth day *not one was fatal.*

The uncertainty of diagnosis here steps in to mar possible success. Before the appearance of the spots, we cannot pronounce definitely whether we have a case of typhoid fever, acute tuberculosis, gastric fever, pneumonia, acute nephritis, or one of the exanthemata. We have the satisfaction of realizing, however, that in the large proportion of cases these diseases may readily be excluded. *But we may easily escape from the dilemma entirely if we adopt the rule to subject every case of fever whose temperature persistently marks above* 103° *for*

several hours to cold baths in a mild form, reducing their temperature from 90°, *at every bath five degrees, until* 65° *have been reached.* Experience has taught me that no harm will ensue from such a course, while much may be gained by thus early inaugurating the battle against the toxic manifestations.

Moreover, these baths may aid us in reaching a diagnosis. In my hospital service I have directed the house staff to bathe at once, and I have by this means been enabled to exclude pneumonia, acute tuberculosis, osteomyelitis, and ordinary remittents. If the case proved not to be typhoid, no harm was done. *The more nearly we approach the high standard of strict bathing, the more nearly may we approach the low mortality.* The earlier the baths are resorted to, the more strictly they are used in accordance with the directions regarding their temperature and frequency, the more completely will the toxic processes be controlled and the mortality be reduced.

In private practice the early preparatory bath is useful in allaying the anxiety of the physician, who is daily importuned for a diagnosis.

Objection VII. Should every case of typhoid fever reaching a rectal temperature of 103° be subjected to the bath? One of my correspondents asks: "If a patient has a temperature of 104° for an hour or two every evening, but moderate fever for the rest of the time, and without 'Functionsstörung,' should you then think it necessary to insist upon the bath?" This is a question that will frequently arise in the mind of the practitioner, who would fain shrink from the trouble, annoyance, and possible criticism of the bath procedures so long as the case presents a mild aspect. It will not be difficult for the attendant to order and insist upon the cold bath, if the patient has a temperature of 105°, with delirium, stupor, etc.; but when he appears to be comfortable, with a temperature ranging between 102° and 103° or 104°, it does seem so glaring a violation of the long-established expectant treatment to disturb his comfort by a cold bath that few men will have the temerity to advise it.

It is a wise practice to bathe under these conditions. The experienced practitioner knows but too well how sadly his prognosis, derived from an early mild course, sometimes fails to be verified, when, in the beginning of the third week, the first sound of the heart begins to fail, the pulse becomes rapid, the lung becomes hypostatic, hemorrhage and perforation ensue, and death closes the scene.

A death from typhoid in the first week from excessive temperature or from failure of the nervous system is rarely observed; the chief danger lies in the infective process, which undermines the system slowly but surely. To meet this danger, the cold bath is our shield and ever-ready weapon. In mild cases, the rise of temperature and

pulse is readily combated by it, the resisting power of the disease being feeble. Hence the temperature rises only at long intervals to 103° F., but, whenever it does so rise, the rule should be inexorable: the bath must be administered. Clinical experience demands it, and if we would receive its benefits we must obey the behest.

Objection VIII. Difficulty of executing the Brand method in private practice. Despite the reiterated statements of Brand, Sihler, Tripier and Bouveret, and of the author, this objection is again and again urged in our medical societies. Brand has told us how a poor printer's apprentice boy was carried through a case of typhoid by his sister and brother, ten and thirteen years old, under his personal supervision. Carl Sihler has graphically described* how, in a practice among artisans and laboring people, he has carried over one hundred cases of typhoid fever to a successful issue, some of them receiving over ninety baths from relatives and friends.

"In the case of a widow with a string of children from two years upward there was no money for a nurse, and a married sister who acted as nurse was very timid. Sihler sent one of his nurses to the house, and after six baths had been given the necessary fortitude and skill for patient and sister were obtained, and everything went ahead smoothly and much to the satisfaction of all concerned."

This picture from life may prove instructive and incite emulation. Even in rural districts the bath method may be carried out with fair success. When practising medicine in Camden, South Carolina, in the seventies the author was in the habit of sending a wooden tub lined with tin to the farmhouses in which typhoid fever prevailed. It was his practice to visit these cases in the evening, the distance being sometimes ten miles, and remaining over night, in order to instruct in and watch the treatment.

From distant Australia we have an example of what may be accomplished by energy, perseverance, and faith. Murtra reports in the *Münchener medicinische Wochenschrift*, Nos. 47 and 48, 1895, one hundred and seventy-three cases of typhoid fever treated by the strict Brand bath in a sparsely settled rural distirct under the most adverse conditions. The mortality was only 5.4. Such a result must serve as a rebuke to the city doctor who has nurses, consultants, and often the comforts and agencies of modern life at his disposal.

I have not infrequently encountered serious opposition from members of the family. My method of overcoming this is very simple. The family is informed that a large proportion of typhoid-fever cases recover under the usual treatment, and that such a result may be anticipated with *probability* in the case; but that under the cold-bath treat-

* Journal of the American Medical Association, July 22d, 1889.

ment, *adopted early, recovery is certain.* Thus the choice is left to the head of the family, who usually elects to place the responsibility on the physician.

Dr. Barker,* of St. Louis "has not found the consent of the family so difficult to obtain as some would have us suppose. To overcome this prejudice, he sends some missionary literature or sends the friends of the patient to some family in which the bath has been successfully used. After a few baths no argument is needed. He begins with a temperature of 90°, to secure confidence, and gradually lowers it."

Dr. A. B. Ball, of this city, declines to treat the case if he is not permitted to bathe.

The nurse who has watched and cared for a case of typhoid with delirium, stupor, involuntary defecation, and urination will gladly accept the toil and worry of the bath treatment as less trying. The relative or friend who has been alarmed by these manifestations will joyfully recognize the different aspect of the case under the cold-bath treatment. Such individuals will not require to be stimulated to the energetic execution of the baths; they will become ardent advocates. Thus prejudice will be dissipated.

Objection IX. Shock. One of the most frequently urged objections to the cold bath is the "shock" this "heroic" procedure may inflict upon the heart. The fallacy of this idea cannot be more logically met than with the hundreds of case records in the New York, Presbyterian, Manhattan General, and other hospitals of this city.

When suggesting the cold baths in consultation I am not infrequently met by objection on account of the patient's feeble pulse. The following table (page 182) giving the summary of a case of typhoid shows that without stimulants, which could not be retained, a heart beating 130 to 140, with a temperature of 104° to 105.6° F., was kept in good condition, being reduced to 116 or 120 by baths of 76° for twenty minutes with friction. Such records are the best reply to the objection that cold baths are contraindicated in heart feebleness. This patient became cyanotic whenever the bath temperature was below 76° F., and yet she had practically no stimulants, because she vomited them.

As germane to this point it may be of interest to quote from a brief report in the *Medical Record,* November 7th, 1896, of a discussion on the subject, the following: "Dr. Simon Baruch upheld the Brand treatment and pointed to the charts shown by Dr. Thompson as proof that the bath was the best heart tonic. The temperature fell and the heart's action always became slower and stronger. Further, the bath was eliminative, for the urinary secretion was increased and with it the poisons in the circulation. The *great bugbear was shock,* and re-

* Therapeutic Gazette, 1894.

action was wanted for its stimulating effect. Dr. Thompson confirmed the statements made by Dr. Baruch in response to Dr. Dudley's assertion that the bath was not eliminative and was weakening to the heart."

Objection X. Danger of colds and lung troubles. The possibility of these being induced by the cold bath is still a superstition in the lay mind which, unhappily, has not yet been entirely removed from the

TWENTY-FOUR HOURS' RECORD OF CASE OF MRS. G——. AGED 40.

Date.	Highest Temperature.	Lowest Temperature.	Highest Pulse.	After Baths.									
				Lowest Pulse.	Nourishment. Ounces.	Water. Ounces.	Sleep. Hours.	Stools.	Urine (mostly lost with stools). Ounces.	Baths. Degree.	Number of Baths.	Duration of Bath. Minutes.	Stimulants. Ounces.
January 23d.....	102	99	..	..	0								
January 24th....	104.4	101	..	..	0	..	..	..	..	..	1	..	$\frac{1}{4}$
January 25th....	105.1	103	130	116	15	..	5½	4	17	76	5	20	$\frac{1}{4}$
January 26th....	105	103	132	116	10	..	9	4	7	70	5	..	2½
January 27th....	105	103	130	116	10	..	5	4	7	70	5	10	
January 28th....	104.6	102	130	114	17	..	5	8	7	70	7	12	½
January 29th....	104.8	102	140	116	27	23	5¾	4	8	80	6	20	4½
January 30th....	104.2	102	140	120	28	24	5	3	17	78	6	20	
January 31st.....	104	103	128	114	34	27	8½	6	4	80	5	20	
February 1st....	103.8	102	130	120	49	14	10	3	12	80	6	20	
February 2d....	104	102	121	110	40	25	8¾	4	18½	80	5	20	½
February 3d....	103	102	124	110	44	13	7	5	7	80	2	20	
February 4th...	103	101	122	114	47	22	7	9	6	80	1	20	
February 5th...	102	101	122	108	48	13	5½	5	12				
February 6th...	102	101	118	108	56	14	8	..	31				
February 7th...	102	101	114	106	59	4	4½	2	14				
February 8th...	101	101	106	104	60	4	7	2	19				
February 9th...	101	100	106	94	48	..	8¾	2	16				
February 10th...	101	99	100	94	48	18	7	3	19				
February 11th .	100.6	99	106	94	55	16	5½	3	18				
February 12th...	100.6	98	94	88	45	11	9	4	12½				

medical mind. This objection has also been abundantly answered by clinical demonstrations. I have never seen more "cold-threatening" conditions than exist in the military hospital of Vogl, in Munich. If a combination of cold air and very cold baths do not produce bronchitis, pneumonia, and pleurisy in typhoid fever, the bath alone may be regarded as free from such accusation. "The fear of cold from the baths or cold air in typhoid fever is unfounded," says Vogl.

On the contrary, so far from producing lung complications, the numerous cases detailed *in extenso* by Brand, Vogl, Tripier and Bouveret, and others go to prove that we have in the cold bath the most effective treatment against pulmonary complications, when they occur during typhoid fever; only when these occur in far-advanced

stages of the fever, with great adynamia, the cold bath should be exchanged for that of a milder temperature and more brief duration.

Objection XI. The exacting technique of the Brand method demands the subjection of the physician's judgment to a routine rule. The question has been asked: "Is the rule to bathe every three hours in winter, at 65° F., whenever the temperature reaches 103° F., absolute, and not to be modified to adapt it to each case?"

I should rarely deviate from the rule, except in the beginning, when the patient's peculiarities may be noted; because *this rule has been established by deduction from large clinical material*, carefully gathered by numerous observers in different localities, in private, hospital, and military practice. Until the physician has, by his own observations, discovered a more effective mode of treatment, he would do well to follow Brand's rule. Prejudice against this method should not weigh against the accumulated observations of reliable practitioners. This would be only fair to the patient. It must always be borne in mind, too, that the object of the bath is prophylactic; its aim is not a mere reduction of temperature, but a suppression of the violence of the febrile movement until it has spent its force. Whoever expects to throttle the fever by the bath will surely be disappointed, for its course is as steady and inexorable as is any law of nature. The temperature will almost invariably fall one or two degrees after each bath, only, however, to rise again to within a fraction of its former rate when three-hourly examination is made. But from day to day there will be a gradual yet steady diminution of the average temperature, which indicates that the resisting-power of the system is gaining sway over the disease. This is the usual effect of the systematic cold bath, administered without fear and without favor, but it is not to be expected from modifications of the Brand bath. Whenever we attempt to substitute another form of hydriatric procedure, to raise the temperature of the bath water, to shorten the duration of the bath, or otherwise to change the rule, we must expect a change in the result. If the case comes under treatment late, the resisting-power of the disease will be greater; hence the result of the bath will deviate from that here depicted. The type of severity of the disease, too, may also modify the bath.

Care should be taken that the opposite error of reducing the bath temperature below the Brand rule be not committed. This may be illustrated by a recent report* of Vogl, describing an epidemic in 1893. Although this treatment is claimed as a strict (?) Brand method, the results were not so favorable as in previous reports, for the following reasons, which, in my opinion, offer some valuable lessons. He writes:

* Münchener medicinische Wochenschrift, No. 40, 1895.

"The number of cases admitted to the garrison hospital was four hundred and twenty-six; the number of deaths thirty-six—8.4 per cent mortality. An epidemic of influenza had preceded the typhoid epidemic and was still prevailing to such an extent that most of the soldiers suffered from a combination of these toxic agencies. As a result there existed a tendency to hemorrhage which, in its extent, was unusual, and an involvement of the central nervous system which was more pronounced than had been observed in any previous epidemic. A toxic affection of the cardiac ganglia which produced great slowing and asthenia of the pulse seemed to be prevalent. All these seemed to diminish the resisting-capacity of the patients in this epidemic, and doubtless account for its fatality despite the adoption of the Brand [?] method, which consisted of the regular administration of baths at 12 R. (59° F.) for fifteen minutes every three hours whenever the patient's temperature reached 102° F. in the rectum, accompanied by a daily bottle of red wine, strong black tea with cognac after each bath, soft-boiled eggs, flour-and-egg soup, one and one-half to two and one-half quarts of milk. Ten thousand baths were administered during this epidemic."

Although Dr. Vogl is satisfied with the mortality of 8.4 per cent, because of the serious type of this epidemic, this result compares unfavorably with his previous results, which never exceeded 5.2 per cent in any one year and averaged 2.7 per cent. Vogl finds the explanation of this unwonted fatality (which is much less than is usual under non-hydriatric management) in the coexistence of influenza, which in the initial stages even produced great irregularity of the pulse, etc., and other manifestations of cardiac incompetency, which render the treatment by bathing ever a serious problem. Nevertheless, the bath treatment furnished evidence of the invigorating effects of the baths, inasmuch as their cessation was always followed by failure of cardiac action and nerve tone, and their resumption by improvement, during the long existence (five or six weeks) of the infective process.

In view of the great ability of Vogl and his valued labors in this field, I would prefer to pass this remarkable report without criticism, but, from my standpoint, the increased mortality of this epidemic may be partly due to *a deviation from* the Brand method. A bath of 59° F., six degrees below the minimum temperature advised by Brand, probably demanded a greater response on the part of the weakened heart than it was capable of rendering without damage. Be it understood that this is no contradiction of the position assumed by Brand, and so often confirmed by the author, that the cold bath is the best heart tonic in typhoid fever. The reader should bear in mind that this tonic effect is prophylactic rather than direct, and that, as has

been emphasized (page 183), in advanced stages of cases which have not had the benefit of early bathing the baths are not so efficient, and the temperature should be chosen with great care. The patients here reported, began with hearts already enfeebled by toxæmia from influenza, a condition almost analogous to that existing in the third week of typhoid. The innervation of the heart was unequal to respond to the demand made upon it by very cold baths. I believe that this is one reason why the latter were not so efficient in converting the severe type into a milder form, as may be done by the strict Brand baths, and I offer it as illustrative of the warning that whenever we deviate from the exact technique of Brand our results will also deviate from those of Brand.

Objection XII. Sentiment. This objection may be found not only among lay people but also among some physicians. The *Medical Record*, of November 18th, 1895, contains a specimen of the latter, which perhaps represents the sentimental side of the question. This author's horror of the bath treatment is really affecting. He says: "At present, bathing, according to the method of Brand, is enjoying an enviable popularity as a method of reducing temperature and preventing complications.

"Much testimony to the efficacy has been presented, but rarely has any one taken the pains to describe in print the piteous and ineffectual appeals to be spared the distress of further Brand baths, of patients who, in spite of a continuance of the baths, died. Such cases never occupy a conspicuous place in scientific reports of the modern antipyretic treatment. The pathetic side of the story never appears in statistics."

Such an "argument," offered in lieu of statistics or clinical data, scarce requires refutation. But as such innuendo may serve to intimidate some practitioners in whose breasts "the milk of human kindness" abounds, I propose to analyze its merits.

Dr. J. C. Wilson,* Professor of Practice in the Jefferson Medical College, says: "As a rule the patients did not object to the baths; when they did so, the objections ceased after a few baths had been administered."

Dr. W. Gilman Thompson describes his personal experience, having been treated by cold baths for an attack of typhoid: "It is not agreeable, at any time, to be taken out of a warm bed and suddenly immersed in cold water, but the after-effect was so soothing and the favorable influence upon all the symptoms was so pronounced that the temporary discomfort was easily endured."

The pathetic side of the story has evidently not been experienced by these careful observers.

*Medical News, December 6th, 1890.

The same writer claims that the Brand bath will "never be generally adopted in rural districts and in private practice in cities." I am satisfied that the intelligence of the community will force even reluctant and sentimental physicians everywhere to save the lives of their dear ones, so soon as they become well informed on this subject. Already the lay journals have taken up this subject, and they will continue to probe it. In our large cities the best teachers of medicine are converts who a few years ago were sceptics. When men like Delafield, Draper, and Peabody, teach it in one school, and Loomis and Gilman Thompson in another, and when it is daily practised with brilliant results in the New York, Roosevelt, Presbyterian, St. Luke, Manhattan, and Austin Flint's and Peabody's services in Bellevue Hospital, the bright young men being educated at these schools and hospitals will not allow sentiment or irrational therapy to guide them. There is need of more positivism in medicine. Between two positive methods like the Brand method and chemical antipyretics, it did not require much time to decide. Intelligent physicians are abandoning the latter, and many who have the courage of their convictions are adopting the former even in private practice. Dr. A. B. Ball informs me that he has encountered no serious objection in private practice, although his ultimatum is the bath or a change of attendants. I have treated the wife of a physician who had witnessed similar treatment of another patient in his household; I have thus treated a case in a fashionable summer hotel without trouble; I have treated three members of the same family by baths in three successive years; and I have seen the same tub used by four different families, each obtaining it from the other at my suggestion. "Piteous appeals" did not deter even these lay people from again permitting the use of the bath. Sentiment and pathos must yield to logic and common sense, in medicine.

At the meeting of the British Medical Association in 1896, much opposition to the cold bath in typhoid fever was manifested on sentimental grounds, which were met by Dr. Osler, who stated that were the treatment even more heroic and unpleasant he would not hesitate to adopt it, *because it saves lives* that would otherwise be sacrificed. This testimony from a man who said three years previously* that "the results of the treatment have been so excellent as almost to compel its use in hospital practice, but the difficulties attending it are such as to render its use in private practice scarcely feasible," is more convincing, because it is an evidence not only of this clinician's well-known fairness, but of the effect of increased experience in the method.

Objection XIII. Complications. It has been asserted that the cold

* Johns Hopkins Hospital Reports.

bath increases the tendency to intestinal hemorrhages by driving the blood from the periphery to the enfeebled intestinal vessels. Tripier and Bouveret met only four cases of hemorrhage among two hundred and thirty-three patients treated by the cold bath; of these two were fatal, and none of the deaths showed any connection with the bath. They conclude that their own experience proves that *intestinal hemorrhages are less frequent under hydriatric management.* Brand, who has studied every phase of this subject with an eye singly to the elucidation of the truth, has sifted the histories of hundreds of cases for this purpose. He has gathered 4,995 cases of typhoid fever, in which 155 hemorrhages were noted, 35 patients dying from the latter. Hence the frequency is 3.1 per cent, and the mortality 0.6 per cent. On the other hand, among 4,890 cases not treated by water, he discovered hemorrhages 271 times—5.6 per cent. Goltdammer, who is not so warm an enthusiast on the efficacy of strict cold baths as Brand, furnishes larger statistics (nearly 20,000 cases), from which he concludes that the cold bath has no influence in producing intestinal hemorrhages. Vogl noted among 251 cases treated by the strict cold bath only 2 cases of bloody stools.

All evidence, therefore, tends to prove that, so far from being influential in the production of hemorrhage, the cold bath actually renders it less rare and more mild and tractable, if resorted to very early in the disease, and the reason is not far to seek.

"That the alteration in Peyer's glands will not go beyond the stage of infiltration, if treatment is instituted before 'the fateful fifth day,' is another prediction that raises dubious questionings," says a writer in the *Medical Record.* I reiterate the reply made to this doubting Thomas, because it is a doubt which is but the legitimate offspring of the experience with the expectant treatment hitherto in vogue. Fortunately for the patients, but unfortunately for our pathological enlightenment, the opportunities for autopsy are exceedingly rare in cases treated by the strict cold bath. Only two cases, in which death occurred from other causes, but which had been bathed before the fifth day, furnish evidence on this point. One case is reported in *Lyon Médicale,* No. 14, 1886, and another by Brand, in 1883. In the former, the patient dying on the twenty-first day of a typical typhoid, there was found no loss of substance, old or new, in the intestine. In the latter, also fatal on the twenty-first day, there were no ulceration, no cicatrix, no pigmented spots; only fresh infiltration. If diarrhœa, meteorism, hemorrhage, and a dry, red tongue are indications of ulceration of the intestinal glands, the absence of these symptoms in the large proportion of cases treated by the strict cold bath must be accepted as logical evidence of the absence of ulceration. Vogl's testimony on this point is strikingly

conclusive, and must carry conviction, because it emanates from the comparative experience of many years in the same class of patients—soldiers. He says: "The diminution of intestinal symptoms is a very evident effect of the cold bath; a few trials will convince any one of its success. Among 221 cases there was a daily average of only 0.7 per cent of diarrhœal stools; while in the cases treated with a combination of baths with medicinal antipyretics the average was 1.9 per cent of diarrhœa. Never was it necessary (in 251 cases with carefully written histories) to resort to opium and bismuth; meteorism, with tense abdominal walls, was observed only in cases received late; it was diminished by the baths." If inappropriate diet is capable, as we know, of aggravating the intestinal symptoms, and if proper diet is capable of preventing or ameliorating them, is it unreasonable to accept the proposition that the bath influences favorably the local process, which is but one of the manifestations of the general infection?

When intestinal hemorrhage is severe and accompanied by general symptoms, such as pallor, small pulse, cold extremities, subnormal temperature, the bath should be discontinued. A slight discoloration of the stools need not deter the attendant from continuing the baths. Brand has continued them in six cases with good effect, and I have seen no harm from them in one case. Brand distinguishes the congestive hemorrhage which occurs mostly before the fifteenth day, and which does not forbid the bath, from that occurring later and due to diseased action in the blood-vessels proper. If the hemorrhage is pronounced rest is imperative, and this alone requires abstention from the bath, and the temporary substitution of ablutions given without disturbing the patient.

The bath may be resumed as soon as the hemorrhage is stayed. Indeed, this should be a rule in all cases in which the bath has been suspended for cause, for to it we may intrust the invigoration of the patient, which alone can tide him over the ever-present dangers due to the fever processes.

Objection XIV. Relapses. It has been charged that relapses are more frequent after the bath treatment. This is probably true, but may be explained by the fact that *more cases survive to relapse.* If sixteen more patients were saved by the Brand method than by the expectant plan, then out of each hundred there are sixteen more cases liable to relapse. Applying the usual percentage of relapses to these sixteen surviving cases, we have a ready explanation of the apparent increase of relapses after cold bathing.

Contraindications to the Bath.—*Menstruation and pregnancy* are regarded by the inexperienced as contraindications to the cold bath in typhoid. That this is an error is constantly exemplified by the ob-

servation of those who bathe systematically in typhoid, and this the author can positively confirm. I have frequently bathed menstruating women, and Dr. F. H. Daniels carried a woman in the seventh month of pregnancy successfully through a case of typhoid fever with the Brand baths in the Manhattan General Hospital.

Pleurisy indicates the cessation of the baths, because it demands rest. If, however, the temperature be persistently high, with nervous symptoms threatening, these must be combated by the bath, even though pleurisy be present. Brand has never observed pleurisy in his 335 cases; Rolet, in 1,005 cases, only four; Mollière, only one in 234 cases. According to Betke, the mortality from this complication, which is rare in the cases treated by the bath, is only 0.2 per cent in 5,075; while in 1,420 cases treated medicinally it was 1.4 per cent. I have had one death from it in the Manhattan General Hospital. (Bath was begun too late.)

Severe cough and paroxysms of dyspnœa are not rare, when patients feel the first shock of the bath; but these symptoms soon subside. Tripier and Bouveret mention five cases in which it persisted so as to require cessation of the baths. In some cases the oppression of breathing is voluntary; the patient either imagines it, or he simulates it in order to alarm the attendant and prevent a continuation of the bath. By reassuring such patients their apprehension may be overcome. If cyanosis and syncope occur, the bath must be discontinued, but in severe cases this should not deter us from renewing it. The graduated bath, or the wet pack, sometimes helps these cases. The cough produced by the shock from the cold water is advantageous, as it relieves the bronchial tubes of mucus and stimulates pulmonary circulation.

Syncope and fainting have been charged as causes of death due to cold bathing. A large experience readily disposes of this bugbear. Death from sudden heart-failure is not an unusual occurrence in typhoid fever; the cold bath is, as I have shown, the best weapon against it. Körber has shown that of eight hundred and seventy-four cases of typhoid treated by cold baths only ten were fatal immediately after the bath, and these were very desperate cases. "What may be especially dwelt upon is the fact," says Vogl, "that in thousands of baths not a single time was collapse to be observed, either before, during, or after the bath."

In my own experience also not a single case of collapse has been observed.

Perforation and peritonitis contraindicate cold baths, because the latter involve disturbance of rest, which is very important.

Not only has the claim that these serious complications are some-

times due to the bathing been refuted by abundant and convincing statistics, with case histories, but the fact has been established that they have been reduced in frequency. Murchison's statistics of 1,271 cases give 196 cases of perforation (11.38 per cent). Brand's 4,884 cases give 12 perforations (0.24 per cent).

Nephritis.—A paper on "Urea Estimation in Typhoid Fever," by Dr. James Tyson,* refers to a patient with typhoid fever who had albuminuria and hyaline casts three days after admission. He gave milk and other liquid diet. The patient was tubbed five times in one day and the secretion of urine and urea was increased thus:

Day of Disease.	Urine.	Urea.
28th	2,100 c.c.	29.8 per cent.
29th	2,100 "	24.7 "
30th	2,280 "	32 "

The albumin fell to one-twelfth per cent by bulk and finally disappeared, as did the casts. Cough grew less. There were no tubercle bacilli. An otitis media developed in both ears, but there was no defect in the hearing. The nephritis was mild.

Stagnation of blood in the kidney is dangerous; therefore the *Brand method is not contraindicated in this passing nephritis.* Of sixty-nine soldiers treated by Vogl five had nephritis and all recovered, and of sixty-nine others not treated by baths by the Brand method nine had nephritis and five died. My observation is entirely in accord with that of Tyson and Vogl.

Free perspiration does not contraindicate the bath. The patient should be dried with friction before being placed into it.

Bedsores (if large) forbid the bath, because disturbance of the patient interferes with a strict antiseptic treatment. General ablutions and cold compresses should be substituted.

Erysipelas does not present a reason for discontinuing baths, so long as there is no extensive destruction of tissue accompanying it.

Pain.—Severe aching of the leg muscles is often complained of so much that the bath is not repeated by timid practitioners. This is a mistake. Good friction will prevent this cramp. Sometimes wrapping the leg in a thick flannel band, wrung out of hot water before the bath, prevents cramps.

Late cases, viz., cases coming under treatment after the second or third week, do not forbid the bath. When the nervous system has been sustained by early bathing, the patient not only bears cold baths with impunity in the later stages, but improves constantly under their invigorating effect. If the case comes under observation in the middle

* Medical Record, 1896.

or last period of typhoid fever, the baths demand a more cautious and brief application and higher temperatures. The effect of such baths will not be so striking, and the prognosis cannot be expressed as being so favorable. Hospital histories demonstrate that many desperate cases, which under medicinal or expectant treatment were lost, now recover under judicious hydriatic treatment. The condition of the heart is the chief index to the bath, or rather to the kind of bath. To react from a bath of 65° F., a certain integrity of the central nervous system and of the heart-muscles is required. This is almost surely impaired by a long-continued febrile process which has not been moderated by cold baths, even if no actual organic degenerations have been developed. Hence the graduated bath of Ziemssen or the wet pack is more applicable, or a warm bath with cold affusions followed by friction. These may restore the lost stamina and enable us to resort to the cold bath, if the symptoms demand it.

The author has endeavored to cover every point in the discussion of this important subject and to meet every objection and possible difficulty which may occur to the inexperienced.

CHAPTER VII.

THE WARM FULL BATH.

Distinction between the cold and warm full baths is made in describing the technique of the full bath, because the methods of applying these baths differ as materially as does the *rationale* of their action.

Technique.—The warm bath is prepared by filling a large tub three-fourths with water at a temperature above that of the body, proper provision being made by placing vessels filled with very hot water between the feet of the patient, but not in contact with them or by adding hot water to the bath for the purpose of maintaining the temperature. It may be noted here that it is much more difficult to accomplish the latter than it is to maintain the temperature of a cold bath, since the warm bath is usually twenty or more degrees above the temperature of a room, while the cold bath of any decided duration is rarely over five degrees below the temperature of the room. It follows that the water of the warm bath will cool off quite rapidly during the procedure, if the above-mentioned provision be not made.

Moreover, in a bath which is a few degrees below the normal body temperature, friction is not only unnecessary but harmful, since its object is a calming effect.

Rationale.—Heyman and Krebs have shown that the warm bath exerts an effect upon the peripheral sensory-nerve terminals, which are now regarded by physiologists as the outposts of the entire nervous system, conveying all impressions directly to the brain. These investigators hold that the nerve terminals are rendered succulent, and thus become blunted, and they substantiate their claim by demonstrating that this slow imbibition of water by the nerve endings and their surrounding structures reduces their sensibility, while a withdrawal of water from them enhances the latter. In the lukewarm bath endosmosis fills these structures with water, either by direct absorption or by the cessation of insensible perspiration. Kölliker also has shown that succulence of the nerve terminals decidedly diminishes their irritability. A nerve which has been lying in tepid water remains for a short time somewhat irritable, but loses its sensitiveness to excitation more rapidly than a nerve exposed to the air but protected against desiccation by evaporation.

Heyman claims that cerebral disturbances are apt to cease when perspiration is abundant; but this has not been substantiated by clinical experience. In infectious fevers, for instance, an abundant perspiration is often without the slightest effect upon the delirium and insomnia. Nevertheless, observation teaches the calming effect of a tepid bath, from 95° to 100° F., and would thus confirm the claim that a removal of exciting influences from the nerve endings, which take constant cognizance of the latter, is the real cause of this sedative effect.

If this physiological fact were always borne in mind, *warm baths followed by gradual cooling of the water would not be recommended for tonic purposes.*

Oliver* offers observations made with his ingenious arteriometer and other instruments of precision, to ascertain the influence of baths upon the vasomotor system. Hot immersion baths (100° to 105° F.) quickly reduced the radial calibre and blood pressure by reason of the rapid dilatation which takes place in the arterioles of the cutaneous surface. To this dilatation may be ascribed the increase in volume in limbs observed immediately after the immersion of the body. This enlargement rapidly subsides. In one example the initial volume of 1,640 c.c. was raised by the hot bath to 1,744 c.c., which fell in five minutes to 1,680 c.c., and in ten minutes to 1,664 c.c. The enlargement was obviously due to a temporary turgescence of the vessels of the skin. Warm immersion baths (96° to 100° F.), for instance, enlarged the radial calibre, though after a certain time the peripheral vessels became relaxed and full, the radial artery being consequently reduced in calibre.

In a full bath of 90° to 100° F., given to one of the attendants at the Hydriatric Institute, I found the pulse not materially affected. It became somewhat more rapid at the time that the bath was entered, increasing slowly in fulness and firmness as the body became fully submerged. After a long immersion at a temperature of 100° F., the pulse became more frequent, soft, and compressible. These changes were rapidly compensated after the bath was left.

The calming effect of a warm bath is decidedly pronounced. In my own experiments the respiration was reduced by ten per cent in a bath below 100° F.

It must, however, be borne in mind that the effect of a warm bath is in accordance with the previous temperature in which the individual has been placed. When, for instance, a bath of 80° F. is entered after undressing in a temperature of 60° F., such a bath would feel much warmer than it would after undressing in a temperature of 80° F. or

* London Lancet, June 13th, 1896.

over. A bath of 99° F. would, if continued twenty-five or thirty minutes, gradually chill the patient, because the water would become cooler and the individual would have lost much of his reactive capacity. When issuing from such a bath it is important that the patient should be thoroughly dried, placed between cotton sheets and supplied with artificial warmth to aid reaction.

When the temperature of the bath is raised above 105° F. the effect is quite different, because its *modus operandi* is different. There is no longer a primary relaxing effect upon the peripheral vessels, but an intense stimulating effect upon the vasoconstrictors, which very soon fatigues the latter and eventuates in a dilatation of the vessels, filling the skin with blood, which, being heated, raises the internal temperature decidedly. The pulse rises in frequency, becoming feeble if the temperature is raised to 115° and the bath is prolonged; collapse threatens; but removal from the bath is followed by a feeling of comfort and lightness.

Baelz, of Tokio, has furnished accurate observations on the hot bath. Residing among a people with whom hot bathing is a daily practice, there being four hundred thousand hot baths given daily in Tokio alone, he had exceptional opportunities for studying their effects. The temperature adopted by the Japanese is usually about 130° F.; Europeans indulge in baths of 104° to 109°. The head is usually bathed in hot water before the bath is entered, in order to relax and dilate the cerebral vessels, and thus prevent cerebral anæmia when the cutaneous vessels become greatly dilated. This is also aided by the sitting posture usually assumed. Palpitation of the heart and a decided sense of great heat are regarded as a signal for removal. The first effect of such a bath is a cutis anserina and pallor of the skin, lasting a few seconds; the pulse becomes slower and afterward more rapid. At first the respiration is not much affected; later it becomes purely thoracic. The temperature of the body rises slowly to 104° and over, this effect being due to heat retention combined with direct absorption of heat. It occurs rapidly, often within six minutes; but it returns to normal in half an hour after the bath. The arteries become relaxed, the temporal artery assumes a dendritic form as in arteriosclerosis. The pulse is full; its curve is high. Prolonged stay in the bath produces vertigo and nausea. The consumption of albuminoids is not increased by the hot bath. On leaving the bath, abundant perspiration ensues. The Japanese apply cold affusion before leaving the bath. It is a common error to suppose that colds are easily taken after hot baths. According to Baelz, this is impossible. While a warm bath relaxes the vasoconstrictors and thus predisposes to cold, the very hot bath produces a paralysis of the cutaneous vessels, which lasts some

time and prevents their contraction when exposed to cold. This is proved by the fact that the Japanese run naked on the streets after their hot baths without taking cold. Nor does such a bath produce tenderness and consequently debility. On the contrary, it seems to stimulate and tone them up; but there is usually a slight loss of weight after continuous use. The sense of warmth produced by the Japanese hot baths is claimed to be so enduring that it is regarded as an economical method of keeping the body warm in winter in dwellings which are not heated.

The distribution of blood in the body is decidedly affected by hot baths, according to the experiments referred to. The hotter the bath, the greater is the turgescence of the cutaneous vessels and, *pari passu*, the more contracted must the interior vessels become. That an anæmic condition of the brain ensues, as demonstrated by Schüller, is proved by the sense of pressure on the head experienced in a hot bath and the frequent occurrence of vertigo when rising from such a bath.

There is a decided difference of susceptibility to heat in different parts of the body; the feet are more sensitive than the hands, and the male sexual organs are more sensitive than is any other part of the body.

The effects of *warm* (below but near the temperature of the body) and *hot* (above the body temperature) baths differ also, as may be supposed, according to the extent to which the body is submerged.

Topp* confirms the view of Baelz that the feeling of *bien aise* after hot (110° F.) baths taken after great muscular exertion is due to removal of fatigue products by the increase of oxidation.

Therapeutic Indications.—The *warm* bath offers a potent means for reducing the temperature, assuaging pain, and relieving nervous debility, without materially interfering with any of the functions, in all the pyrexias of infants and very young children. There is no remedial agent which can compare with a full bath of 98°, reduced perhaps to 90° for eight minutes, with gentle friction, for these purposes. The pronounced involvement of the nervous system in the febrile conditions of infants and very young children demands a measure which calms these threatening symptoms without interfering with the secretions. Care should be taken in drying the patient carefully and furnishing quiet surroundings to encourage sleep after such a bath; also in watching that the child does not expose its body by uncovering or restlessness. In this day of facile resort to antipyrin and its congeners, the following large statistical evidence may be of value. In

* Therapeutische Monatshefte, February, 1894.

the *Jahrbuch für Kinderheilkunde* (xxxii., 142) Eroess reports the results of his observations upon the use of antipyrin, quinine, and warm baths in the pyrexia of very young infants: "Among four hundred and thirty-one cases of fever during the first ten days after birth, one hundred and forty-five were of short duration, the remainder continuing for several days; in one hundred and eighty-four it was continuous, and in most of the others irregular. In forty-four per cent it was attributable to gastro-intestinal disorder, in thirty-four per cent to some disorder connected with the navel. Antipyrin was given in doses of from one grain to two and one-fourth grains, repeated, if necessary, in an hour. The effect was good, as was that of quinine. *Better results were obtained from the warm baths than from either drug.* The temperature of the bath was 95°; duration, ten minutes; in weakly children, five minutes. Upon the general condition the result was very satisfactory. Sleeplessness and irritability usually disappeared, and the child fell into a quiet sleep, from which he awoke apparently improved. When the temperature is very high, a warm bath is an agent of the greatest value."

There are few febrile diseases of children in which I do not prescribe such baths, and usually with the most satisfactory results.

In cardiac affections the warm bath is usually regarded as contra-indicated, but the injurious effects are often due to improper execution of the bath. It should not be of so high a temperature as to heat the blood; nor should the patient dress in the room in which he has bathed and which contains much moisture; nor should he make great efforts in drying or dressing himself.

Hoffman says justly that all these faults may be avoided, if the pulse and temperature are watched. With due regard to these precautions, the warm bath is an excellent remedy to regulate cardiac action, and as a method of saving labor for the heart it has a great future, because it may be continued indefinitely. An unavoidable danger from the warm bath lies in its action upon the skin. The perspiration is greatly increased, the epidermis becomes succulent and better adapted for giving off watery vapors; hence there is a tendency to cooling off after the bath, which may amount to a sense of chilliness. A rapid contraction of the cutaneous vessels takes place. Thus, while it is our desire to relieve the heart, these decided variations in blood pressure make an increased demand upon it. If to avoid this we carefully cover the patient, we incur the danger of fixing upon the cutaneous surface a layer of air which is saturated with vapor, which maintains the dilatation of the cutaneous vessels and justly inspires the patient with the fear of taking cold. The tone of the vasomotors is diminished in these persons. Under normal conditions the vasomotor sys-

tem provides for the proper distribution of blood in the whole body, by preventing excessive contraction as well as dilatation. This equilibrium is disturbed by the warm bath, and a certain period is necessary for restitution of the normal tone of the surface vessels. In the healthy heart a cold affusion readily promotes the latter. But this cannot be regarded as a quieting procedure in abnormal cardiac conditions and is advisable only for persons having vigorous hearts. Hence it becomes important that the patient's cutaneous vascular tone be restored gradually. This may be done by rendering the skin slowly more bloodless by means of gradually drying with warm cloths. This may seem a trivial matter, but just such trifles render treatment effectual or harmful. Moreover, too active friction should be avoided in these cases, and woollen clothing should be worn. The latter not only protects the skin, which has been rendered tender and sensitive by the warm bath, but encourages by its roughness a certain amount of hyperæmia, which conduces to an increase of vascular tone. In advanced conditions of cardiac disease still greater care is necessary in the use of warm baths. So long as there is no venous stasis, they may be used with advantage.

In *cerebro-spinal meningitis* such good results have been observed in isolated cases that the application of these baths should not be omitted. Aufrecht* reports the case, occurring during a fatal epidemic, of a laborer, twenty-five years old, who had lain in a somnolent condition for ten days. A spontaneous cure was out of the question. The low temperature and small frequent pulse impelled Dr. Aufrecht to resort to hot baths. The patient received altogether twelve baths of ten and twenty minutes' duration. After the first few baths an improvement was noted. The sensorium gradually cleared up; stiffness of the neck and pain were diminished; he began to call for vessels when prompted to urinate or defecate; the abducens muscles resumed their normal function and condition. When the baths were discontinued after nine had been administered, headache, great restlessness, and delirium returned. These symptoms disappeared, however, after three more baths were given.

Voroschitsky† reports two cases of cerebro-spinal meningitis which were cured by hot baths. One was that of a man twenty-five years old, of tuberculous habit, but he was well until September, 1894. He presented the characteristic signs of meningitis, intense headache, vomiting, stiffness of the neck, general hyperæsthesia; pulse, 60; temperature, 37.8° C.; no ocular symptoms. These manifestations became aggravated; the pulse became irregular and slower, and great adynamia en-

* Therapeutische Monatshefte, 1894, No. 8.

† Gazette Hebdomadaire Russe, 1895, No. 4.

sued. In this condition the first warm bath was given, which produced slight amelioration of the general condition, but which on repetition decidedly improved all the symptoms. After the eighth bath recovery was almost complete. The baths were given daily for ten minutes; temperature, 32° R. (104° F.).

A second case, more serious on account of cardiac feebleness, also ended in recovery. The author attributes great importance to the warm baths, because he had employed the customary medication in both cases without the slightest effect upon the progress of the case.

Wollisch* reports seven severe cases of cerebro-spinal meningitis. Being encouraged by the report of Aufrecht and another of Voroschitsky, he applied *hot baths* in one case and was induced by the favorable result to apply them in six others. In all seven cases (children from five to ten years) the symptoms were pronounced. Stiffness of the neck was prominent; the disease was epidemic. Five cases ended in recovery, two ended fatally. One of the latter was foudroyant and terminated within forty-eight hours; the other patient died in a later stage, the baths having been administered during the first two weeks and all other therapeutic measures having been impossible of execution.

The entire course of the disease was rendered mild by these baths. The favorable influence on the heart and nervous system was well marked. The baths were administered in a somewhat different manner from Aufrecht's method. The patient was put into a bath of the temperature of 90°, and gradually hot water was added until the temperature of the water reached 102°. During the bath the ice bag or Leiter's coil was applied to the head.

The transportation from the bed to the bath should be conducted most carefully and as quickly as possible. If a great deal of pain is present in the spine, the patient must be lifted out of the bed by means of the sheet on which he lies, and with it lowered into the bath. The head should not be touched during transportation. After the bath the patient is wrapped in a woollen blanket and has a light cover thrown over him; no drying or rubbing of the body is to be attempted. In this envelopment the patient is to remain an hour, when he may be removed. The time of day for the bath is unimportant, but the very early morning hours or late evening hours should not be selected.

Besides the bath it is necessary to be provided with good, cooling apparatus for the head, neck, and spine. The diet should consist of nourishing meat preparations, even when diarrhœa comes on. The

* Therapeutische Monatshefte, March, 1896.

author also ordered his patients wine and cognac (in milk); also beer, as much as they would take, and came to the conclusion that alcohol maintains its place also in this disease as a tonic and hypnotic of the first rank.

The question as to the manner in which hot baths act he was not in a position to answer, but he thought it not improbable that the hyperæmia of the skin produced by the bath was followed by a diminution of blood in the brain and spinal cord, and hence the bath acted like venesection without the loss of blood from the body. Furthermore it is reasonable to suppose that the sweating which usually follows diminishes the formation and hastens the excretion of toxins. At least it is certain that the hot bath, even in the presence of fever, does not raise the temperature of the body, but on the contrary diminishes it. In not a single case did he observe any dangerous influence of the bath on the heart's action. Even in a case in which he had ready for instant use cognac and camphor, expecting a depressing influence from the hot bath, no bad symptom occurred. On the contrary, his observations have satisfied him that the action on the heart is rather that of a tonic and a regulator of the heart beats. Lastly, he would recommend the use of the hot baths in cases of cerebro-spinal meningitis even when no other benefit was to be gained than the relief of pain and the calming results which follow.

In *menstrual disorders* the warm bath is an old domestic remedy. The temperature and duration not being stated, it follows that those who attempt to obtain the results lauded by others usually fail. Soranus, of Ephesus,* who paid special attention to gynæcology, recommends and describes the preparation of baths and half-baths for dysmenorrhœa and amenorrhœa, followed by rest in bed. A more modern author, Graily Hewitt,† says: "The warm bath in which the patient remains half an hour is perhaps one of the most effective remedies for the relief of the great pain, and in many cases its effect in producing the flow is not less marked, so that it possesses not only palliative but also curative properties."

With regard to temperature I have found in amenorrhœa, without recognizable constitutional or organic defect, the half-bath in water of 95° gradually raised to 100°, for half an hour, the water reaching to above the navel, useful, especially if preparations are made in advance to secure rapid drying and getting into a warm bed. Such baths, alternating if anæmia be present with hip baths of three minutes' duration, followed while the patient is in the tub with affusion over the shoulders with water at 75°, are exceedingly valu-

* Quoted by Herzl, in Winternitz, "Festschrift."

† "Pathology and Treatment of Diseases of Women."

able. The warm and cold baths are to be alternated on succeeding nights.

For *dysmenorrhœa* the hot half-bath, 100° raised to 115° for twenty minutes, often acts like a charm.

Topp recommends *hot* baths in *bronchitis*. Drs. A. Jacobi and Leonard Weber, of this city, laud it in the bronchitis of children, and in the same disease Baelz attributes a specific effect to baths of 104° to 110° F., three or four times a day. In *nephritis*, *rheumatism*, various exudations, uterine colic, they are very useful. These hot baths are contraindicated when the heart is weak and whenever internal congestions are threatening. Atheromatous patients and cases of angina pectoris require special warning.

The Continuous or Hammock Bath.

This valuable therapeutic agent is prepared as follows: A large bath-tub is placed in a pleasant room convenient to the water supply. By an arrangement of buttons or a bar along the outside of the edge of the tub, the edges of a sheet may be secured by means of tapes. The sheet is in this manner suspended within the tub so that its lower portion clears the bottom of the latter when the patient is lying upon it as in a hammock. A very deep tub being required in order to make the patient comfortable, and such tubs not being readily obtainable, the author would call attention to a device which he has applied successfully for the purpose of improvising a continuous bath. Having a case requiring the latter, in the husband of a lady who had been treated for typhoid by cold baths given in an ordinary tin tub, which was neither deep nor strong enough to admit of the addition of a hammock, the latter was constructed of a strong piece of sheeting, the edges of which were securely fastened by tacks to a frame of boards, four inches wide, seven feet long, and three-fourths inch thick. This frame was placed upon two benches (carpenter's horses) at each end. Cross-pieces of the frame allowed the projection of six inches of the long lateral bars at each extremity of the tub. The latter was placed beneath the hammock high enough to allow it to be just free from the bottom.

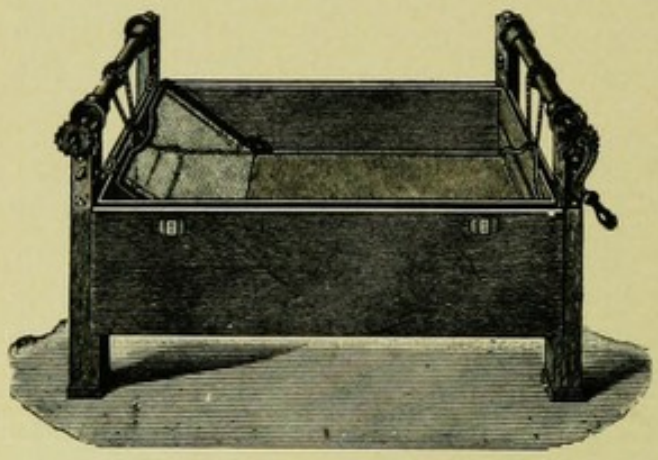


Fig. 46.—Hebra's Continuous Bath.

The tub is now filled with water at 100° F. and the patient is laid upon the suspended sheet with a rubber pillow for his head. He is made as comfortable as possible, the fact being borne in mind that we expect him to remain in this tub for several hours, days, and possibly weeks.

The first sensation experienced by the patient after entering such a bath is one of slight chilliness, which subsides very soon and gives way to a sense of comfort, provided the temperature of the water is not permitted to sink below 95°. The latter is assured with a good supply of hot water and proper arrangements for adding it to the bath and for removing the cold water. The tub should be covered with blankets, placed on supports laid across it, to exclude the air as much as possible and to protect the patient against exposure. Such a bath is usually continued for a large part of the day and night, the patient being carefully removed for the purpose of urinating and defecating. If he cannot sleep in the bath he may be placed in an adjoining bed for that purpose, he having of course been previously dried. If the necessities of the case demand his sleeping in the bath, careful watch should be kept to prevent his head slipping down into the water. The constant attendance of a nurse is usually required.

Before he is placed in the bath the patient's skin should be anointed with mutton suet, to prevent puckering and peeling, which sometimes ensue from prolonged saturation.

To Riess, who has studied this unique bath method thoroughly in a large number of cases in the Berliner städtisches allgemeines Krankenhaus, from 1874 to 1876, we owe all that is known of its application for the treatment of internal diseases.

Rationale.—The physiological effects upon the organism which may be expected from lying in a bath of from 94° F. to 95° F., either continuously night or day, or for a number of hours, are of a negative character. There is neither a thermic irritation of the sensory cutaneous nerve endings, nor any change in the cutaneous vessels, blood pressure, cardiac action, or respiration. In every case in which Riess applied the continuous bath he made careful temperature, pulse, and respiration measurements, which demonstrated that the last two usually fluctuated only for a short time after the bath was entered. The most reasonable explanation of the effect of the continuous warm bath is to be sought in the diminution or removal of those cutaneous irritations (rapidly changing temperatures, etc.) which are in operation in the ordinary contact of the body with air, and the resultant effect of this freedom from communicated irritating influences upon the inner organs, especially the nervous system. The regulation and quiescence

of important functions, especially of the activity of the central nervous system, ensues as a natural result.

Therapeutic Indications.—The clinical results obtained by Riess in his extensive observations are in accord with this *rationale*. The continuous bath is useful in serious disturbances of the central nervous system, especially of the spinal cord. In those conditions of *paraplegia* of the lower extremities, paralysis of the bladder and intestines occurring frequently in locomotor ataxia, myelitis, and similar diseases, it is especially useful. Despite the greatest care, *bedsores* occur and progress to serious proportions in these cases, compelling resort to the continuous bath, which has proved to be the most effective remedy for this serious, discomforting, and painful trouble. It was during the treatment for bedsores that Riess obtained with great satisfaction the most surprising results in the production of improvement and retrocession of organic nervous disease, such as spinal pains, excentric pains in the extremities, contractions which often rendered any position in bed painful, reflex spasms, and similar manifestations.

The same effect was noticed in *chronic meningitis*, apoplexies resulting in contractions, and in hemiplegia, tumors of the brain, etc. Besides the symptoms enumerated, general hyperæsthesia, and especially cerebral excitement and delirium, are most favorably influenced by this bath.

Prolonged submersion in water of neutral temperature exercises a calming effect upon the irritability of the brain, and offers a basis for favorably influencing these diseases of the nervous system, in which therapeutic efforts are usually so fruitless. The regulation and removal of peripheral irritations probably explain these effects; the theory of imbibition and succulence of the terminal nerve fibres of the skin seems to be unnecessary to account for the latter. But not alone are the principal symptoms improved in these nervous diseases; in a not inconsiderable number of cases the continuous bath appears to exercise a directly beneficial effect upon the retrocession of the pathological processes, as far as this is possible. "In about one-half of such *cases of spinal and cerebral organic diseases*, which exceeded one hundred in number and which were subjected to these baths for several weeks, *the improvement, not only of the symptoms, but in the disease itself, was undeniable*," says Riess. The motor and sensory paralyses, ataxia, and related symptoms receded under the baths, although they had been but slightly influenced or remained unaffected under the use of other therapeutic measures which had been applied during many preceding months. In those cases in which complete retrocession was possible, as in incipient inflammatory conditions and in exudations capable of absorption, the application of continuous baths apparently con-

tributed greatly to the cure. In this manner are probably explicable the cures of central paralyses which are claimed to result at thermal mineral springs; indeed in many of these a prolonged stay in the warm piscines is prescribed by the resident physicians with good effect.

Riess mentions a case of compression myelitis and other cases of desperate character, as illustrations of what may be accomplished by these continued warm baths.

Cystitis.—In this disease the treatment by irrigation is much more successful when combined with the continuous bath. Riess mentions five distinct cases, of which three ended in recovery. Five cases of *obstinate sciatica* yielded to the continuous bath. In chorea he obtained partial results. In multiple neuritis the pain was relieved. Anasarca arising from heart and kidney trouble yielded especially good results, although in these cases there was a decrease of urine. The baths should, therefore, not be used when the latter is scanty.

In obstinate cases of *articular and muscular rheumatism* in which all other treatment had failed, daily baths of twelve hours' duration afforded good results. In almost all cases he obtained an improvement of the general nutrition.

Chronic diarrhœa seemed to improve decidedly.

Typhoid Fever.—For the treatment of typhoid and other fevers Dr. Riess also recommends the hammock bath, with an array of statistics and clinical data which demand careful consideration. It consists of immersing the patient in a bath of 88° F. He advises that the patient be submerged whenever the rectal temperature reaches 102° F., and that he be allowed to remain in the bath usually during the day only, but, if necessary, day and night, until his rectal temperature registers 100° F. He is then removed, and again placed in the bath when he registers 102° F. If the temperature falls too slowly, or rises in the bath, an occasional short bath of 60° F. or a moderate dose of antipyrin was used.

This method is certainly much more free from trouble and more agreeable to the patient, when he becomes accustomed to it, than the cold bath, and may thus be substituted for the latter in some instances.

Riess* appeals to his clinical results in eight hundred and nine cases treated in the Allgemeines Krankenhaus zu Friedrichshain. Although a mortality percentage does not prove much, because many hospital cases could not be saved by any treatment, he does claim that he can show the lowest mortality of any hospital in the city, and in his own hospital the mortality has been reduced from 10 per cent to 8.5 per cent; 12 deaths were caused by pneumonia, 4 by hemorrhage, and 10 were uncomplicated. The *duration* of his cases was decidedly

* Monograph of author, and Archiv für klinische Medicin, 1889–90.

influenced, he claims, contrary to the accepted doctrine with regard to the course of typhoid fever. Although most cases came in after the eighth day, the average stay was 17.9, including 740 cases that ended in recovery. Three hundred and one cases, coming in before the sixth day, remained fifteen days; the others, 17.7. In 341 cases, which came in before the sixth day, the duration of fever averaged 15.5 days; 399 cases, admitted later, averaged 19.9 days—certainly a much shorter average duration than is usually observed in so large a number of cases. Among the deaths there were 10 uncomplicated, 18 pneumonia, 12 severe throat affections, 12 perforations, 3 intestinal hemorrhage, 3 purulent pleuritis, 3 chronic pyæmia during convalescence, and of the remainder one each of gangrenous phlegmon, gangrene of the lung, noma, hemorrhagic nephritis, dysentery, pelvic tumor, and old heart lesion.

Hence, only 1.2 per cent died without some complication; 34 per cent of those dying were admitted before the sixth day of illness; 65.2 per cent after the sixth day—the average date of the admission of the fatal cases being, therefore, 9.5 days after inception of illness.

The effect of this treatment upon individual symptoms must be carefully studied. Upon the cerebral disturbances these prolonged baths seemed to act more favorably even than short cold baths. If this had not been the case, it would have been impossible to detain somnolent and delirious or violent cases in the bath without a much greater number of nurses. The fact was, however, that *these cerebral symptoms receded without exception after the first prolonged bath;* the actual status typhoidus disappeared permanently on the second or third day.

Influence upon circulation was also favorable. Only during the first quarter-hour did the heart action seem embarrassed, the pulse becoming small. And this should be remembered, not to discourage the attendant, because it very soon becomes stronger and slower.

Lung complications were never aggravated, but on the contrary were improved, and rarely occurred in cases admitted early. The intestinal lesions, too, were favorably influenced; diarrhœas diminished so rapidly that they never interfered with the continuance of the bath. Complications were diminished. There were only 2.6 per cent of intestinal hemorrhages, and 1.6 per cent of perforation peritonitis; of which latter cases one ended in recovery. There were 5.5 per cent of pneumonia, 2.1 per cent of throat affection, and other complications or sequelæ were very rare. Only furuncles and subcutaneous abscesses were increased somewhat (3.4 per cent).

Riess concluded, therefore, and with justice, that the treatment

of typhoid fever by the permanent baths has an especially favorable effect, because it does not reduce the temperature rapidly and does diminish the severity of other symptoms, shortens the duration of fever, and reduces the mortality to a low point. Riess furnishes in connection with this essay, read before the Science Congress at Heidelberg in September, 1889, six temperature charts, which graphically illustrate the method and its results. I select one of these, giving the temperature and duration of baths and remissions.

Siefke, a nurse, aged twenty-nine years, became ill in the hospital; he had continuous baths from the second to the eighth day, after which he was normal. He was put into the bath with a rectal temperature of 39.2° C., and remained in it fourteen hours; when his temperature reached 36.4° he was removed. In four hours the temperature rose to 39.4°; he was put into bath for ten hours and removed at 37.2°. In four hours it reached 39°; after eight hours in the bath it was 37°. After three hours out of the bath it registered 38.8°; a bath of nine and one-half hours brought it to 37.8°. Out of the bath for an hour it rose to 38.6°; a bath of ten hours reduced it to 37°. After three hours it rose to 39°; a ten-hour bath brought it down to 37.2°. After six hours' it rose to 39°; an eight-hour bath reduced it to 37.4°. In three hours it rose to 39°; an eight-hour bath reduced it again to 37.4°. In four hours it rose to 38.6°; he was now kept in the bath for twenty-two hours, at the end of which time the temperature fell to 37°. He was removed for four hours, and the temperature rose to 38.8°. In the bath eight hours, it fell to 37.4°; out four hours it rose to 38.8°. In the bath six hours, it fell to 37°, after which it remained normal on the eleventh day.

Although this method of bathing presents many advantages, it has not won my approbation. Its superiority over the Brand bath lies in, 1, its abortive power, for that it certainly shortens the disease is proven by three of the cases; being in nurses and servants residing in the hospital, the beginning and ending of the fever could be positively determined; 2, in its being less heroic and disturbing and more comfortable; 3, in requiring less nursing. But its inferiority to the Brand method lies in the fact that its mortality is far above that of the latter.

I am disposed to believe, from the experience of Brand, Vogl, Jürgensen, Wilson, and my own, that of the "thirty-four of those dying who had been admitted before the sixth day of illness" most, if not all, would have been saved by strict cold bathing; and a large proportion of the other cases (averaging less than ten days ill when admitted) might have been saved. Still the results are so far better than those of the fatal expectant treatment that it would

seem ungrateful to this courageous and original clinician to cavil at his excellent method.

The observations of Riess have been confirmed by Dr. Barr, of Liverpool,* whose mortality in fifty-five successive cases was only one. Barr treated twenty-five of his cases by continuous immersion in water at 93°, when their body temperature was 100° or over; the water temperature was raised as the patient's temperature approached the normal. Although this is a very small experience, it offers confirmation of the value of the hammock bath in typhoid fever.

Cantalamessa† furnishes the report of one hundred and twenty cases treated by the hammock bath at 87° F., in some cases gradually reduced to 75°; duration, five to eight hours (in one case eighteen hours), with five deaths, two being from perforation very shortly after the beginning of this treatment. There was at first decided improvement of the circulation and respiration. Urine was increased, though sometimes diminished because of the smaller quantity of water taken by reason of thirst being lessened; the urea was reduced fifty per cent. Relapses were more common, probably for the same reason as after the Brand bath, viz., that more cases recovered to relapse.

Localized Continuous Baths.

Technique.—In domestic practice a deep pan may be extemporized. Dr. Frank Hamilton, of Bellevue Hospital, who was an enthusiastic advocate of the submersion treatment of surgical cases, devised an apparatus which affords a neat and comfortable method of applying hot water continuously to the extremities.

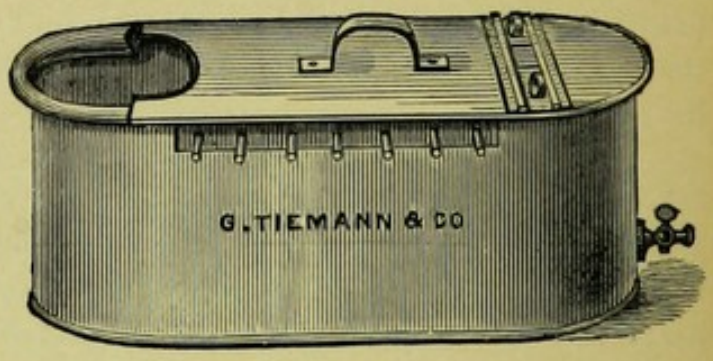


Fig. 47.

Fig. 47 represents a bath for the upper extremities.

For the lower extremities (Fig. 48) a zinc bath is used also, somewhat larger, the floor being in the form of an inverted roof, the apex of which is below; the base being represented by the open top of the bath; this latter is also provided with a movable cover. The apex is supported by a wooden frame and horizontal board. This bath is, like the arm bath, provided with pins for suspension of the limb and with a stop cock.

* "Treatment of Enteric Fever," London, H. K. Lewis, 1892.

† Gazzetta degli Hospidali, Naples, March 7th, 1895.

In the case of the foot bath, when it is found uncomfortable to project the foot from the side of the bed, the portion of the bed upon which the body reposes is elevated by mattresses, and the bath is placed on the uncovered foot of the bedstead.

The water should be kept at such a temperature as to feel warm to the hand of the attendant, and this is found to be about 95° F. Sufficient uniformity has been attained generally by changing the water three times daily.

Antiseptics may be added to these baths and thus prevent the occurrence of sepsis, which is so frequent in lacerated wounds.

Therapeutic Indication—Erysipelas.—Dr. Achilles Rose relates* cases of erysipelas treated by the continuous warm bath, showing the

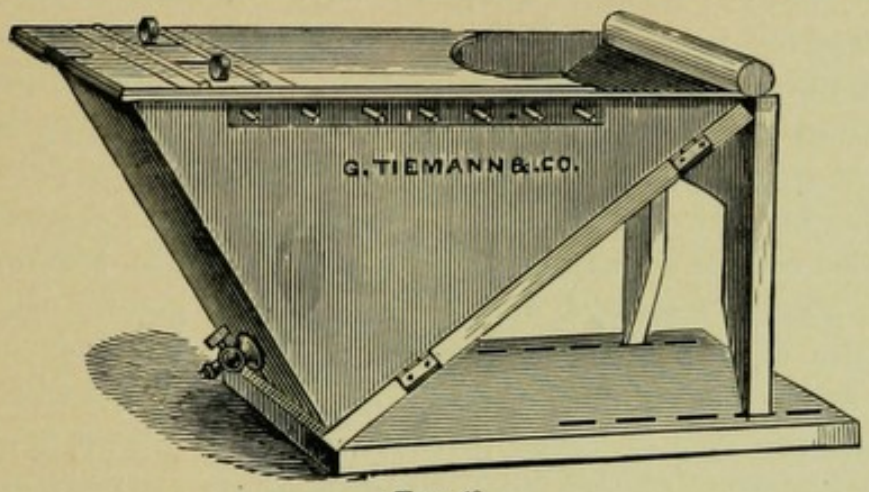


FIG. 48.

powerful effect of the warm bath on this infectious inflammation, how the temperature was thereby promptly reduced, and how the whole course of the disease at once changed for the better.

Polyarthritis.—Hueter recommends in polyarthritis synovialis acuta (rheumatismus articulorum acutus), after the acute stage has passed, and also in polypanarthritis (arthritis deformans), therapeutics which aid absorption and excite circulation, and praises as the best means to this end permanent warm baths, either for arm or leg, in tubs of proper size and shape, or general baths, as the case may require. He states that this therapeutic measure in polyarthritis synovialis chronica, as well as in polypanarthritis, has not been surpassed by any other method of treatment.

Recent Wounds.—When secondary hemorrhage is at all liable to occur, the limb is dressed, according to Dr. Hamilton, for a few hours with either warm or cold fomentations, and is left reposing in bed; but neither sutures, adhesive plasters, nor bandages are applied. At the expiration of this time either the bath or the

* Medical Record, 1893.

warm-water fomentations are commenced, and thereafter employed systematically. The patient is at liberty at any time to lift the limb from the bath, and he generally does this pretty often, to see how it is progressing.

Warm-water fomentations are regarded by Hamilton always second in value to submersion in the prevention and cure of inflammation, and they are reserved, therefore, for those examples in which submersion for one or another reason cannot properly be employed.

Fomentations are to be employed after the fourteenth day in all those cases in which submersion was used at first; occasionally when the patient is weary of the confinement of the bath, the limb is taken out and fomented during the night.

"No treatment hitherto adopted," says Dr. Hamilton, "under our observation, has been attended with equally favorable results.

"The phenomena usually observed in cases of recent lacerated or incised wounds, when submerged, are a sense of comfort, yet not absolute relief from pain. On the second or third day the parts adjacent are swollen but not much reddened; the integument generally assumes a white and sodden appearance, and with only slight tenderness. On the fifth, sixth, or seventh day the swelling is greater than usually accompanies other plans of treatment, and with the inexperienced is likely to excite alarm; but it is found not to be attended with increased tenderness, and it pits under pressure, showing that it is a condition of œdema chiefly. At this time the granulations are generally covered with lymph, or some exudate of a whitish color, which might easily be mistaken for a diphtheritic deposit. At the end of fourteen days or thereabouts (the period at which in most cases we substitute fomentation for submersion) the limb is still œdematous and the granulations are abundant, sometimes presenting a fresh red appearance, and at others covered with the white exudate."

Position of Injury.—The lower extremities can be completely and permanently submerged only to a point three or four inches below the knee, and the upper extremities to a point a few inches above the elbow; consequently, submersion is limited to those portions of the extremities which are below the points mentioned.

Character of Injury.—Submersion in warm water demonstrates its superiority over other plans, especially in the case of a laceration or contusion of the hand or of the foot, when the integument and flesh are extensively torn—provided the limb is submerged without closing the wound—that is, without sutures or bandages; indeed, sutures are inadmissible when this plan is adopted, since the œdema, which almost inevitably ensues, would break away the sutures.

Mere contusions, without external lesions, have been treated almost

constantly at St. Francis' Hospital by this method; and the results have been in all cases satisfactory, and occasionally they have progressed toward recovery in a manner to excite surprise."

In *severe sprains* Professor Reclus, of Paris, finds after trying all other methods that the best results are obtained by plunging the joint into warm water and gradually raising the temperature of the latter to 118° and as far as 130° F., according to the patient's tolerance. The bath is continued for ten minutes, when the joint becomes red, the vessels become engorged, and pain and tenderness disappear. The absorption of blood and lymph is so much facilitated that subsequent massage becomes more effective. The bath, followed by massage and a rubber bandage, may be repeated morning and evening with great advantage.

These practical observations of well-known physicians and surgeons on a method of treatment which is valuable but not sufficiently appreciated may induce the reader to apply it in appropriate cases.

CHAPTER VIII.

THE DOUCHE.

Most of the hydriatric procedures hitherto described demanded the aid of an assistant, whose hands applied the water directly to the body. The douche is the only procedure in which a mechanical effect is brought about without direct intervention of a second person, who is replaced by the force derived from atmospheric pressure. It is applied by means of a rubber hose, which at its proximal end is connected with the water supply, and to which at its distal portion is attached a nozzle, which may be supplied with tubes ranging from one-sixteenth to one inch in diameter. A variety of douches may thus be produced; the fine or coarse jet douche or the fan douche. The latter is formed by placing the index finger of the hand holding the nozzle upon the upper border of the outlet, producing an expansion of the otherwise solid jet into a fan-shaped stream, which is played upon the patient like a broad water brush or fan. The jet and fan douche are the *douches mobiles* of the French. Other forms of the douche are the rain douche, commonly known as the shower bath, which issues from a rose a few feet above the patient (the reservoir supplying it being elevated fifty or sixty feet); the circular bath or douche, commonly known as the needle bath; the ascending douche, applied upon the lower part of the body from below, in the sitting-posture.

The stationary douches are in great favor in Germany, where the *douche mobile* is not so popular.* The modern douche utilizes all mechanical contrivances by which water may be delivered under more or less atmospheric pressure from a reservoir, which in cities feeds the ordinary water supply or into which it has been pumped. It may be furnished with pressure also by steam or hot-air pumping-apparatus.

The French have improved this hydriatric procedure, and really

*In the Archiv für Balneologie und Hydrotherapie, No. 2, 1897, Müller furnishes one reason for the neglect of douches in Germany in the fact that the apparatus for administering them in most hydrotherapeutic establishments is very imperfect. "Whosoever would compare the douche to the 'Guss,' which reminds one unpleasantly of the theological water cure, should study the technical arrangements of a French institution. From America also have recently come some descriptions of apparatus which show great progress."

have made it the chief among all their applications. Charcot's name is well known as connected with this application, because his phenomenal success in utilizing the valuable knowledge, acquired by his countryman Fleury and others, in this branch of the art, has added to the great fame he has justly acquired as a diagnostician and practical neurotherapist. Charcot's douche is really a jet douche applied to the spine, and Fleury's douche consists of the shower and jet douches combined.

Hydrotherapy is, as the French represented by Duval, who is the most voluminous author on the subject, term it, a perturbating action. The disturbing effect, produced by the more or less violent impingement of water upon the skin, is due to the same elements which in other procedures have been shown as necessary for the evoking of reaction, viz., the mechanical and thermic. The mechanical effect is enhanced by the height from which the stream falls and the size of the outlet. It depends upon the pressure under which the water is delivered, upon the size of the stream, and upon the distance of the patient from the attendant.

The douche filiforme of Lauriat is a pump supplied with an arrangement for great pressure, and connected with the finest possible outlet tube. That this fine stream may be made to penetrate the skin and produce destruction of tissue and consequent bleeding, the author has frequently demonstrated. This hydriatic toy is not so useful as a therapeutic means as it is for the demonstration of the fact that strong pressure may endow a stream of water with destructive power equal to the actual cautery. In proportion to the pressure applied we obtain an erythematous redness like that produced by a mustard plaster, or the destructive effect referred to. This affords evidence of the great flexibility of this hydriatric procedure. The latter is enhanced by the thermic effect, which again affords great latitude by reason of the varied temperatures which may be used. In this respect the douche differs from other procedures. It may be administered at a lower temperature than the latter, because the mechanical effect, being simultaneous, promotes reaction and thus furnishes the most stimulating of all hydriatric applications.

Here, too, the law referred to above is fully exemplified, viz., the colder the water and the more brief its application, the more complete the reaction. As we are enabled by the douche to overcome the paralyzing effect of any low temperature by the stimulus of the mechanical effect, we possess in this procedure a most powerful therapeutic weapon. This explains the great success of the French with the douche.

There are other advantages connected with it. The brevity of its application, which should never, at low temperatures (below 55°), ex-

ceed one minute, and should usually occupy only from ten to thirty seconds, upon any one part, saves much time and renders it much less disagreeable. The cold water, not reaching the entire body at once, does not produce a painful impression, as would be the case were the individual immersed in a tub of water at the same temperature. The rosy hue of the skin, which frequently ensues immediately upon the impingement of the douche, indicates at once that the chief end of hydrotherapy is being evoked, viz., reaction.

Rationale.—The *rationale* of the douche may be explained upon the general principles laid down in the first part of this work, and need not be reiterated here. But we have an enhancement of the mechanical effect produced by the percussion and vibratory influence of a stream, which, being more or less divided, impinges in rapid succession upon different parts of the surface. This active thermic irritation must arouse the vasomotor system more energetically than do other forms of bathing.

It is not necessary to dwell upon the fact that every physiological indication is fulfilled by the douche. The nerve centres are aroused, the respiration is deepened, the circulation is invigorated, the secretions are increased.

The local action of the douche is also valuable. It is practically a thermic massage. It excites intensely the neuro-vascular structures; hence it is an admirable sorbefacient of pathological products. In the form of the Scotch douche, which consists of alternating streams of hot and cold water, it is especially applicable for this purpose. Its effects are enhanced, as in other procedures, by preceding applications of warmth, with or without moisture. The French are fond of using the hot-air box bath; the Germans prefer the dry pack, by which the sensitiveness of the skin is enhanced, as in other procedures, and with it the reactive capacity—auxiliaries which will be referred to later.

By variations of temperature and pressure, by changing the aperture of the nozzles, by increasing the number and form of the streams, as in the spray and fan douche and rain bath, *the mechanical effect* may be as materially modified as the thermic effect may be by increasing or reducing the temperature of the water. The experiments of Maggiora and Vinay* show clearly that hydriatic procedures exert a very considerable influence upon the muscular system by reason of their thermic and mechanical effects; that cold chiefly produces an enhancement of muscular power; that warm applications diminish the latter if they are not combined with mechanical irritation. A rain douche of 50° F., under a pressure of two atmospheres, increases threefold the sum of work the muscles are capable of doing. The Scotch

* Detailed in Blätter für klinische Hydrotherapie, January, 1892.

douche, oscillating between 98° and 53°, doubles the capacity of the muscles. Even douches of tepid water enhance the power of resisting

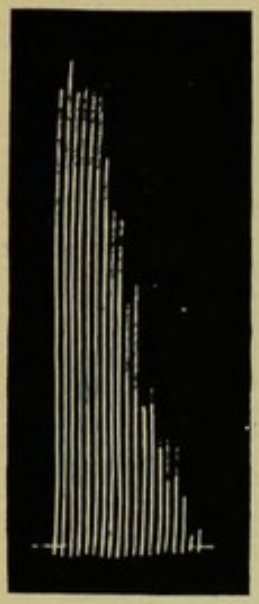
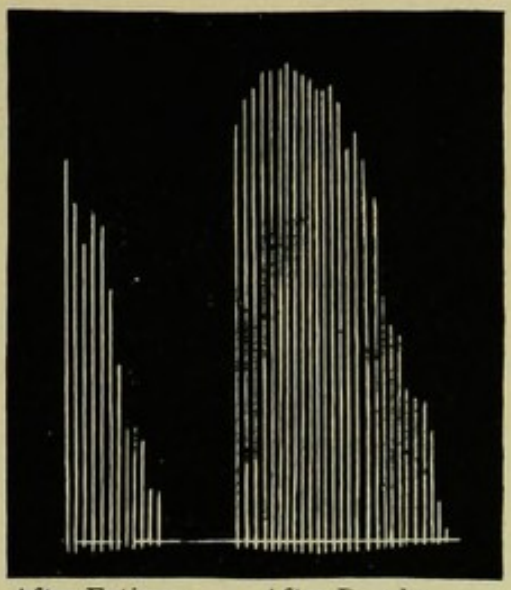


FIG. 49.—Fatigue Curve after Warm Bath following Muscular Fatigue.

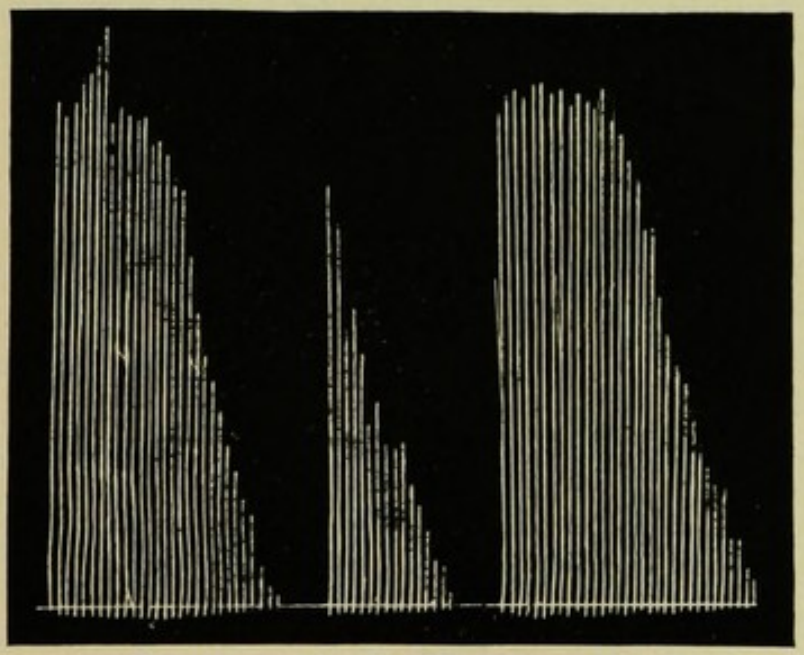


After Fatigue. After Douche.

FIG. 50.—Fatigue Curve before and after Warm Douche following Fatigue.

fatigue in the muscles and increase the actual work which muscles are capable of doing, while a tub bath of the same temperature is without decided effect. This is graphically shown by the "fatigue curves" (Figs. 49 and 50).

A hot rain douche administered at 106° F. for ninety seconds produces a disagreeable sensation, to which the patient soon becomes accustomed; there ensues a less pronounced effect upon the muscular capacity than from the fan douche, probably because the latter impinges upon every part of the body successively, while the former strikes only the upper part of the body from above. It is clear that the mechanical effect of the douche compen-



Normal. After Ten Minutes' Massage. After Douche.

FIG. 51.—Fatigue Curve before and after Cold Douche.

sates for the loss of muscular capacity arising from warm-water applications. Thus far the experiments have shown only the enhancement of muscular capacity. *The effect of the douche upon muscles*

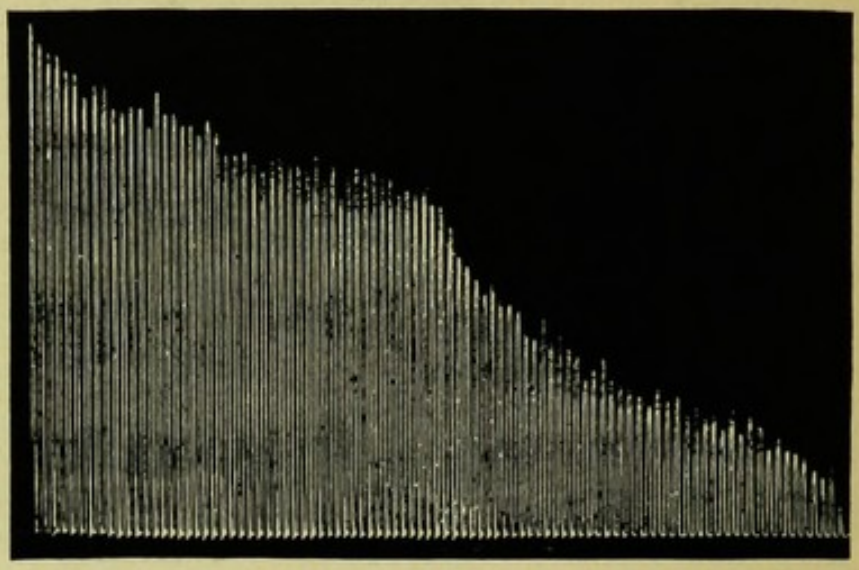


FIG. 52.—Fatigue Curve of the Left Hand after a Rain Douche (Shower Bath), 50° F., under pressure of two atmospheres.

already fatigued has also been investigated by Vinay and Maggiora in a later work.* In this series of observations the individual's normal curve was first taken. He was then subjected for five or ten minutes to severe muscular exertion, after which the "fatigue curve" was again registered. Now a douche was administered and the curve was again noted. How effective a cold douche is for the purpose of counteracting fatigue is well shown by the subjoined diagrams (Figs. 51, 52, 53).

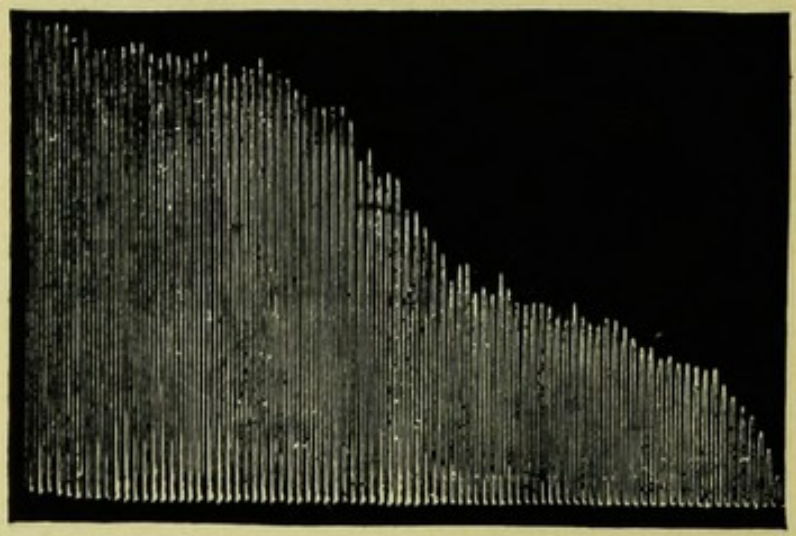


FIG. 53.—Fatigue Curve of the Right Hand after Rain Douche, 98° F.

All these experiments demonstrate clearly the *rationale* of the douche in that the pressure under which it is delivered adds a powerful element which is absent in most other hydriatric procedures.

The diagrams Figs. 49 and 50 show the inefficiency of the *warm bath* as a restorative, and the value of the douche for this purpose.

* Blätter für klinische Hydrotherapie, June, 1893.

It will be noted that the mechanical irritation produced by the douche endows even warm water with capacity to restore a fatigued muscle.

Figs. 50 and 51 illustrate the difference of effect upon muscular power between the cold and hot douche.

These experiments were made with the ergograph of Mosso, which registered the muscular resistance automatically.

We have thus a basis for the well-known refreshing and invigorating effect of the douche, which in France is so advantageously resorted to by men and women of feeble muscular fibre, by people who lead sedentary lives or lose their vigor in the whirl of fashionable dissipation. To endow feebly muscled children and youths with strength, to invigorate the lax fibre of those men and women who have neither time nor inclination to indulge in normal exercise in the open air, there is certainly no measure more valuable than the cold douche, carefully adapted to each individual in duration, temperature, and pressure. I do not refer here to diseased conditions, but simply to abnormal feebleness of muscle and the incapacity for normal work. The full corroboration of these views by so scientific and exact an observer as Dr. W. B. Oliver* is interesting and may arouse attention to a method of bathing which possesses much value. Dr. Oliver says: "The influence of temperature *per se* is greatly modified by the mechanical agency of percussion and vibration, so that when the water is divided into innumerable fine jets, which impinge at different times over the entire surface, or when it is applied in the form of a travelling douche accompanied by a vibratory form of massage, the vasomotor system is much more powerfully affected than by any form of still bathing. The therapeutic advantages of this form of cold bathing are very considerable, for it can be made to furnish all the tonic effects of cold bathing along with an agreeable temperature that may be adapted to individual requirements. A most intelligent appreciation of the curative value of this and similar forms of tonic bathing now prevails at many health resorts, where in times gone by a course of bathing simply meant soaking in hot water with the consequent impairment of the vasomotor mechanism. The massage douche and needle bath is the form of bathing best adapted to counteract the enervating effects of city life, with all its attendant worries and anxieties, and were it established in our large centres it would, I am persuaded, prove to be a boon to many sufferers from nervous exhaustion, and would become even more popular and valuable than the Turkish bath."

The *Scotch douche*, which consists of more or less rapidly alternat-

*Croonian Lectures on "The Blood and Circulation," London Lancet, June 27th, 1896.

ing streams of hot and cold water played upon the same part, is applied for the purpose of enhancing the temperature effect of the douche. Its effects upon the healthy organism have received special study in Russia, the results of which are summarized by Professor Storoscheff, of Moscow.* It may be stated that the pressure of the Scotch douches in these experiments did not exceed one and a half atmospheres (twenty-two and a half pounds), which is much less than the obtainable pressure in the Hydriatric Institute (thirty-five pounds); their duration was never less than one minute, the maximum being four minutes; the temperature ranged between 113° and 59° F.

"The experiments were made on two soldiers and lasted twenty-seven days, the mode of life being monotonous and nutriment consisting of bread, milk, bouillon, and roast beef. The consumption of nitrogen was increased (25 and 23.8 per cent); assimilation of nitrogenous elements was increased (3 per cent); body weight increased; mouth temperature diminished 1–1.3° C., and remained somewhat lower (0.2°) after an hour. The pulse diminished 10–16 beats, and continued 6–10 beats slower for half an hour. The respiration was slowed 4–8 inspirations, continuing 2–6 slower for half an hour. Sense of location was diminished, *i.e.*, the arms of the æsthesiometer had to be extended 8–11 mm. The electrical excitability became more pronounced, as proved by the diminution of the number of milliamperes of the constant current required for the production of muscular contractions; fifteen minutes later 1.09 milliamperes less were required for exciting the accessory nerve of Willis and the facial nerve. This effect lasted sometimes for half an hour. In order to obtain the minimum contractions of a muscle from the faradic stream fifteen minutes after a Scotch douche, a weaker stream sufficed. These effects may have been due to a diminution of resistance in the skin after being treated by the Scotch douche. Signs of pressure produced with a coin (modified procedure of Fleming) were observed in thirty instances. The evidences of pressure generally disappeared much more rapidly after the douche than before it, probably due to increased resistance of the compressed skin. The sense of touch was tested with Sieveking's æsthesiometer, and the temperature sense with Nothnagel's thermo-æsthesiometer, both showing decided diminution after the douche, the latter falling 1.8° C. and the former thirteen millimetres, due to reduction of nerve excitability."

The latest investigation of the effect of the douche is that of Carl Heggelin.† Heggelin concludes as follows:

"1. Every cold or hot douche calls forth an increase of blood pressure.

*Blätter für klinische Hydrotherapie, November, 1893.

†Inaugural Dissertation, 1894.

"2. This depends (*a*) upon the individuality of the animal; (*b*) the force of the douche, the stronger increasing it more; and (*c*) its duration, which also increases it; (*d*) the first douche is the most effective.

"3. The duration of increased blood pressure depends (*a*) upon the individuality of the animal; (*b*) upon the temperature; lasting longer after cold douches.

"4. The after-effect of the douche, especially after frequent repetition, is a sinking of blood pressure (minimum, 2 mm. Hg.; maximum, 70 mm. Hg.), which continues for some time.

"5. Occasionally apparently spontaneous rises of blood pressure occur after the douche.

"6. Even after section of the vagus the blood pressure is increased by douches."

Upon the heart similar effects are produced. Each douche improved cardiac capacity, which depends upon the age of the animal (the younger the more favorably influenced), and upon the number of douches, the first acting better than the subsequent. The duration of the favorable influence upon the heart depends upon the same factors.

Heggelin makes the following practical deductions from his experiments on animals. "Brief douches (ten to fifteen seconds) generally act better than those of longer duration; the general conditions should always be carefully observed when douches are used for a long time. The action of the heart certainly is improved by the douche; not only its power but the utility of its contractions is enhanced. In diseases in which a rise of blood pressure is to be avoided, the douche should not be used (aneurism, atheromatous conditions, etc.). It should be carefully applied in aged people suffering from respiratory troubles, because the rise of blood pressure in the left auricle, which sometimes is pronounced, may easily induce stasis with dyspnœa, hemorrhages, etc."

From Heggelin's investigations may be deduced the lesson how important it is to avoid a careless prescription of the douche—the nature of each special case, the conditions of each individual, his reaction to the douche, must be carefully considered. "We must individualize and control."

Therapeutic Indications of the Douche.—In all those diseased conditions in which the *loss of muscular vigor is the result of feeble digestion*, of depreciated nerve tone, or even of organic disease, the douche in its numerous modifications offers a method of restoring vigor which is often surprising by reason of the rapidity and completeness of the result. There is no hydriatric procedure that can approach it in improving the general circulation, as well as the tonicity of the smaller vessels and of the tissues. It deepens the respiration, and thus gives rise to the exchange of gases which enhance tissue change. As

Pospischl says: "The mechanical massage produced by a good fan douche sets the diseased structures into a vibration which cannot be overestimated and is not to be approached by ordinary manual massage."

It may be used in feeble subjects who are able to stand, because it does not abstract much heat; and may be preceded by the dry pack or brief hot-air bath, which accumulates upon the surface all the heat to be abstracted and thus forestalls any actual heat loss. In *hypertrophies of the liver and spleen*, in *chronic rheumatism*, *malarial fever* with and without cachexia, in many psychoses, the superiority of the douche over all other procedures has been observed by the writer. Its application in some of these affections will be referred to at greater length.

In *enuresis* of children, I have observed great benefit from the circular douche in the New York Juvenile Aslyum. Dr. Prendergrast reports* eighty cases of enuresis which he has observed in an orphan asylum. "The usual treatment had failed, when one of the sisters suggested cold water. The child was made to stand in an empty tub, while cold water was allowed to run for several minutes over his shoulders and back from an ordinary watering-can. The child was dried, rubbed, and put to bed. Sponging with cold water had no effect.

"Eighty per cent of the cases were completely cured, while others were improved, without any other special attention to diet, etc. The boys were from six to twelve years old; some of them also suffered from enuresis during the day. This large experience and simple treatment are worthy of imitation, even if we cannot construct a plausible theory for the favorable effect of the latter."

In *anæmia and chlorosis;* in *neurasthenia* of the depressed type; with introspection and melancholic ideas; in gastric and other troubles, requiring a heightening of muscular energy; in all those conditions in which an elevation of nerve tone is demanded, we have in the douche a most powerful weapon for good, and I may say also for evil. Like a two-edged sword, it may inflict damage when carelessly used. It should never be administered without the prescription of a physician, who should designate the duration, temperature, and amount of pressure of a douche, whose effect is governed not only by these, which may be mathematically measured, but by the constitutional peculiarities of the patient and by modifications impressed by the existing disease.

This brief review of the mechanism, *rationale*, and therapeutic indications of the douche offers the principles for its application which would enable the intelligent physician to adapt it to the various diseases in which an improvement of assimilation and hæmatosis, elevation of depreciated nerve tone, equalization of perverted nerve force, absorption of pathological products, or increase of tissue change is demanded.

*New York Medical Journal, June 11th, 1896.

An *imperfect mode of douching* may appropriately be referred to at this point. With the fact lost sight of that the chief element contributing to the value of the douche is the pressure with which we are enabled to deliver it, the procedure is not infrequently prescribed in domestic practice. The patient or nurse is directed to attach a "sprinkler" to the bathroom or washstand faucet, and allow the spray to play upon the spine, back, or entire body. The writer's observation that such a procedure may be borne only by the most robust, and that therefore it is entirely unadapted to patients of feeble circulation or depreciated nerve tone, is doubtless shared by many. His first experience with a warm bath followed by such a cold spray was obtained in midsummer, the cold water being about 70°. Ten minutes after the spraying, he found himself unable to turn his head or move his right arm without severe pain. Then a brief but sharp attack of myalgia was inaugurated. Since that time patients have often related a similar experience, or stories of chilling, which led them to conclude that they "could not bear cold water." The reason is plain. In the second stories of most New York, and probably also in other city houses, the water pressure is not over ten pounds; in the third story it may be only three or four pounds. The stream issuing through a sprinkler would therefore be a "drizzle;" the mechanical effect being slight, reaction is not developed, the result being chilliness and depression rather than warmth and stimulation. Except in large apartment houses receiving the water supply from tanks upon the roof, private city residences do not furnish sufficient pressure for a good douche. Moreover, a douche cannot fulfil its purpose with any degree of satisfactory result unless a thermometer be so arranged as to facilitate the proper admixture of warm and cold water, and to indicate the temperature after admixture. Properly to adapt the douche to each case and the varying phases of the case, a pressure gauge is also necessary. Such an arrangement being rarely found in private houses, the douche should be administered in institutions only. In this respect, therefore, this procedure differs from others, as ablutions, packs, and the various baths, all of which are more conveniently administered at the patient's home, if a properly instructed attendant can be obtained.

Having observed that many patients have been discouraged by the improper use of the douche as well as of other procedures, and others have been led to regard themselves as possessing an idiosyncrasy against "cold water," the author deems it important to reiterate his warning against imperfect hydrotherapy, whenever opportunity offers, in a work which aims to become a practical guide to the general practitioner in the judicious therapeutic use of water.

CHAPTER IX.

THE HIP BATH.

This method of applying water to the lower part of the trunk is sometimes termed a sitz bath, from the German *sitzen*, to sit, because the patient sits in a tub of water which covers the pelvic portion of the body, usually as far as the umbilicus.

The hip bath is prepared as follows: An oil cloth, covered by one or more blankets, is spread upon the floor; a tub, shaped as indicated in Fig. 54, is so placed that its posterior border stands upon a line with the posterior edge of the outstretched blankets; water of the prescribed temperature having been prepared in pails, the tub is filled to one-half its capacity. The patient, having his head covered with a damp turban, is now seated in the tub, with his lower extremities passing over the anterior edge of the tub. To prevent pressure, the popliteal surface of the knee should be made to clear the edge, and be placed at a sufficient angle with the thigh to be comfortable. If the patient be of short stature, a small stool or other support for the feet may be made to raise the lower extremities sufficiently off the floor to permit the knees to clear the edge of the tub. The upper blanket is now snugly wrapped around the feet and legs, because the latter, being outside of the tub and not subjected to friction, are liable to become cold. A hot-water bag placed within the blanket wrap may add to the patient's comfort, if he be inclined to chilliness.

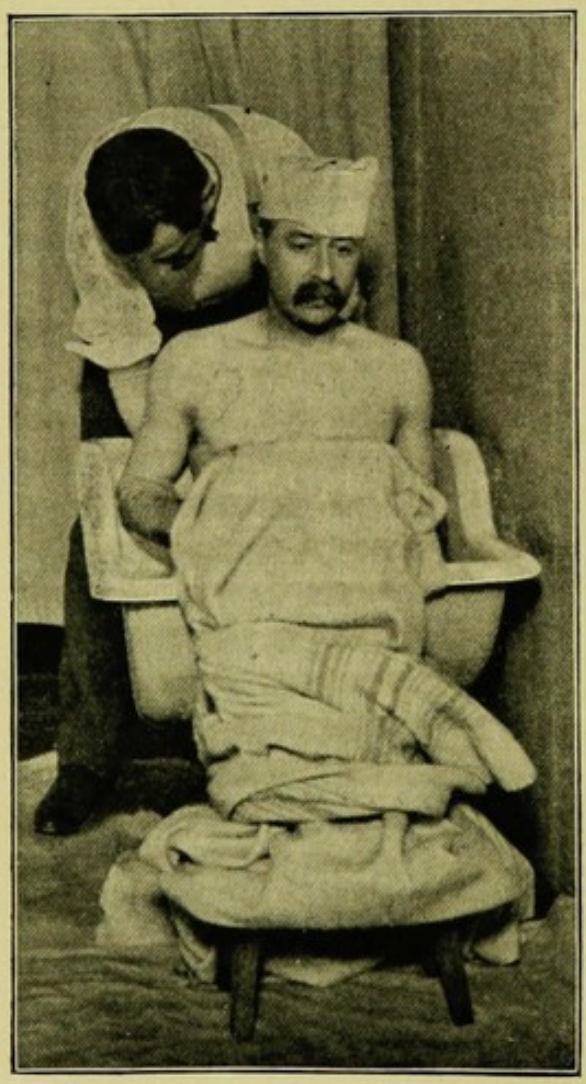


Fig. 54.—Hip Bath.

If the patient is very sensitive, or water of a very high or a very low temperature is to be used, it is advisable to allow the water in which the patient is seated to be of five or ten degrees lower or higher temperature in the beginning, in order not to shock or disturb him; but this is scarcely necessary. A sufficient quantity of water of the proper temperature is now rapidly added in such manner that it flows into the tub without touching the patient, while he is made to use active friction of the lateral and anterior submerged parts of the body. The entire preparation of the bath should be accomplished quickly, to prevent discomfort. Unless otherwise ordered by the physician, the attendant should apply friction during the entire bath, passing his hands with or without a washcloth or a bath glove over the entire lumbar and lateral regions, while the patient applies friction over his abdomen and thighs.

A badly executed hip bath will chill the patient or render him otherwise uncomfortable. The nurse should therefore carefully attend to an exact execution of the above directions, especially with regard to the comfortable posture of the patient and active friction.

Rationale.—The exact and interesting experiments made by Drs. Schweinburg and Pollak, under the guidance and at the suggestion of Professor Winternitz, afford a rational basis for deducing the therapeutic effect of hip baths. The individual was placed into an empty tub, in order to avoid errors arising from change of pressure, and covered with blankets. Dudgeon's sphygmograph was secured to the radial artery in a comfortable position of the arm; the carotid pulse was counted, and the blood pressure of the temporal artery was recorded. Now water at the desired temperature was poured into the tub. Thus the observations were made before, during, and after the hip bath. The results were as follows: The hot hip bath (104°–113° F.) produced almost without exception slight increase of the pulse rate and occasionally considerable reduction of blood pressure, while the cold bath (50°–54.5°) produced a slight diminution of the pulse rate and occasionally considerable elevation of blood pressure.

According to Winternitz, the sitz bath is a potent factor in influencing the circulation of that immense vascular area comprised in the intra-abdominal vessels. This system of vessels may be compared to a reservoir of flexible dimensions, whose mission it is to receive temporarily all blood from other parts, to which it is again returned when needed. The capacity for changing their calibre and area renders the intra-abdominal vessels a kind of safety valve for regulating the pressure relations in the entire vascular system, as has been shown.

Any procedure, therefore, which may powerfully influence these vessels must be potent for good as well as for evil. It has already been

mentioned in the first part of this book (page 43), that the pletysmograph distinctly registers an increase of volume in the upper extremities when an individual is placed in a cold sitz bath. There is a rush of blood to the head, manifested by the usual symptoms. Otherwise the effect is the same upon the respiration, circulation, tension, etc., as from the impact of cold water upon any other part of the body. There is no other method by which blood may be driven to the upper portion of the body. All the effects of this bath may be traced to a reflex excitation of the sympathetic nerve.

Hip baths from 50° to 60° F., of from ten to twenty minutes' duration, excite the vasomotor nerves of the abdominal organs, contracting these vessels, diminishing their calibre and contents, and, as a result, the intestinal secretions and peristaltic movements (see Schüller's observations, page 37).

The therapeutic indications based upon this *rationale* of the action of the hip bath are readily deduced. In all conditions of hyperæmia of the intra-abdominal organs, in diarrhœa and dysentery, hip baths may be of great service. Brief dipping of the lower abdomen into cold water, on the contrary, produces hyperæmia of the organs, increasing the tone of the intestines, enhancing their functional activity, while prolonged hot or cold hip baths (of one or two hours' duration) produce a relaxation of the intra-abdominal vessels and a corresponding effect upon the blood distribution in neighboring parts. Winternitz insists, and I am able to corroborate this clinical observation, that there is no remedy which is so efficacious in the most obstinate diarrhœas as a cold hip bath which has been preceded by an energetic wet sheet rubbing. The latter increases the cutaneous vascular area, while the hip bath of 50°–66° F. excites the sympathetic, contracts the intestinal vessels, and diminishes peristaltic action, if prolonged.

In diseases of the urinary and sexual organs, brief cold hip baths are useful, when there is a sluggish circulation or stasis from chronic congestion or inflammation, while in active pathological conditions they are contraindicated. Hence, in impotence, spermatorrhœa, subacute and chronic ovaritis, in atonic conditions of the uterus and its ligaments, in amenorrhœa and passive menorrhagia, these baths are indicated, as also in passive congestions of the brain, lungs, and liver, in gastric and intestinal ailments, constipation, etc.

The most striking results have been observed by the author in those cases of *profuse menstruation* which drag on from month to month, leaving the patient exhausted and anæmic and thus establish a vicious circle which maintains the drain. When curetting has failed or is not indicated, the flow being maintained by a feeble local and general circulation, hip baths of five or eight minutes, in water at 85° F.,

with constant friction, followed by affusions or preferably by the circular bath and then douches at the same or a lower temperature, far excel all medicinal agents. It is the author's custom in such cases to order the hip baths on the fifth day of the menstruation, when the latter arrives at a distinct period, and to continue it daily until the flow has ceased. If no distinct period exists, the hip bath should be ordered after the flow has become profuse and it should be continued until the flow ceases. Not only will the drain be thus checked, but the tonic effect of such a bath will counteract the depreciated systemic condition and restore the patient's health and spirits. Most women object strenuously to the cold hip bath in menstrual disorders. It is therefore wise to forestall their fears by reassuring them of the necessity and great value of brief hip baths in these conditions.

Contraindications.—Cold hip baths are especially contraindicated in all irritable conditions of the uro-genital organs with frequent emissions. It is a serious and common error to suppose that the ordinary cold hip bath is calming or depressing to the pelvic organs. It is certain that a very *brief* dip of the pelvis into cold water increases the energy and pressure of the portal circulation. The *prolonged* cool hip bath, on the contrary, reduces temperature for the time, and tends to prevent reaction and consequent stimulation. Such a hip bath may aid in relieving inflammatory conditions, if it be of ten or twenty minutes' duration and of 50°–90° F. In cystitis, urethritis, uterine hemorrhage, and prostatitis, in diarrhœa, dysenteries, these prolonged hip baths are exceedingly useful. When a decidedly calming effect is desired the warm hip bath of one or two hours' duration, 95°–100° F., is a long-established remedy for vesical tenesmus, menstrual pains, etc.

But the most valuable pelvic antiphlogistic hip bath is produced with water at 70°–80° F., with friction. The author has found a gradually cooled hip bath, beginning at 90° and gradually adding ice-water from a pitcher so as not to touch the body until 80° are reached, useful in chronic utero-vaginal trouble, when not connected with pus formations.

An excellent practical article by Misiewitz* summarizes the effect of hip baths as follows: "Brief cold hip baths, whose effect is excitant and productive of intense reflex hyperæmia, are indicated in *paralysis of the muscular fibres of the bladder and intestines;* in *prolapsus ani, spermatorrhœa, prostatorrhœa, impotence* of men arising from muscular debility and cutaneous anæsthesia; in *weakness of the uterine ligaments;* prolapsus uteri; *leucorrhœa* due to chlorosis, and *menostasis;*

* "Klinische Untersuchungen über die Wirkung der Sitzbäder bei Krankheiten des Urogenital-Systems und anderer Organe der Bauchhöhle," Wiener klinische Wochenschrift, 1895, No. 12.

some forms of *passive hemorrhages ; liver hyperæmia ;* muscular atony of gastric and intestinal coats, manifested by constipation, flatulence, etc.

"Cold hip baths are contraindicated in conditions of excessive irritability, active hyperæmia or inflammation of the pelvic organs; in increased sexual irritability, pollution; in vesical and rectal tenesmus; and in active menorrhagia.

"The prolonged cold hip bath possesses entirely different properties; it reduces the temperature of the abdominal canal for a considerable time, quiets the centres controlling the abdominal organs, diminishes tissue change, and does not so much cause blood to accumulate as it enhances the tone of the arteries; it facilitates venous flow and regulates the normal circulation. It is therefore indicated in hemorrhages from the urethra, bladder, intestines, and uterus; in infectious and chronic catarrh of the uterus; in hemorrhoids, perimetritis, peri-orchitis; in gonorrhœa, prostatitis, periproctitis; in obstinate or bloody diarrhœa; in inflammation of the adnexa and uterine ligaments. The prolonged hip baths are contraindicated in the muscular contractions, observed in so-called uterine colic and in acute cystitis and intense tenesmus. In these cases, when tonic and spastic contractions of the muscles and vessels are produced by excitability of the vasomotors, warm and steam baths are indicated. The latter are therefore most effectively applied in tenesmus of the bladder, urethra, and rectum; in vesical spasm produced by sexual or dietetic excesses; in menstrual and uterine colics; in contraction of the ureters and nephritic colic; and in menostasis of the catamenial period.

"The effect of prolonged lukewarm (?) hip baths (72° F.) resembles the effect of cold hip baths (50°–63°). They do not produce excessive reaction and they reduce the abdominal temperature for a considerable time. They calm the terminals of the sensory nerves and produce a slow and equable exercise in the muscular coats of the vessels. Antiphlogistic action is, *par excellence*, the chief indication for the prolonged lukewarm hip bath in *catarrhs of the urethra* and its adnexa; in blennorrhœa, *leucorrhœa*, and uterine infarction; in *metritis, cystitis, proctitis, hemorrhoids, oöphoritis, colitis,* and *typhlitis.*"

In constipation with anæmia the favorable results of brief hip baths are occasionally striking. Seated in a bath of 85°, daily reduced two degrees until 60° is reached, the patient's abdomen is well kneaded and rubbed. After removal from the tub, an abdominal douche followed by a general fan douche enhances the effect of the hip bath in the constipation of anæmic women.

CHAPTER X.

IRRIGATION.

The application of water upon diseased surfaces and in cavities has been aptly termed irrigation, because the contact of the water with the surface treated is brief and its action chiefly local.

The most convenient apparatus used for this purpose is the ordinary fountain syringe, which is now made sufficiently large to hold the quantity of water required for any purpose, and which may be replenished when necessary. In order to obtain the required pressure the reservoir is suspended from a sufficient elevation for the purpose indicated. In gynæcological cases the rubber bulb syringe is preferred by some, for reasons which will be referred to later.

The *technique* of irrigation differs in accordance with the purpose for which it is applied, and will therefore be described under the following heads:

1. Lavage. 2. Enteroclysis. 3. Irrigation of the genito-urinary canals. 4. Miscellaneous.

Lavage.

Lavage is a term applied to the irrigation of the stomach. Its technique differs in infants and adults.

The method of introduction in infants is as follows: A No. 8 Nélaton or Jacques catheter, connected by a piece of glass tubing to the tube of a fountain syringe containing a quart of water at 95° or 100° F., to which a level teaspoonful of salt or bicarbonate of sodium has been added, is gently but firmly pushed through the pharynx or nose into the stomach of the child, while the latter is held upright in the nurse's arms. In young infants this is not a difficult procedure, as they will aid it by sucking the tube. In older children it is so difficult sometimes that it is better to avoid it. The procedure should not be applied in the presence of the mother or of anxious friends, because it occasionally produces a distressed and cyanotic appearance of the baby's face, which, however, is evanescent and does not denote harm, but may interfere with the measure in many instances. The catheter may be introduced separately, and after being lodged in the stomach may be connected with the fountain syringe containing the boiled water. The infant usually vomits the water received, but it is better

to disconnect the catheter from the syringe and allow the water containing products of fermentation, mucus, and undigested curds to escape through the tube. The tube should be firmly held near the mouth to prevent its being washed out by the gushing water. When the procedure is finished the catheter should be pinched between the thumb and forefinger of the right hand, and withdrawn rapidly; its distal end is then held over the basin and the pinching hold relaxed, in order to empty its contents. This precaution is necessary and important, because it prevents the possible flow of the fluid and solid matter contained in the catheter from the open end of the latter into the child's larynx.

Therapeutics of Infantile Lavage.—Next to proper regulation of diet and hygiene, the mechanical effect of gastric irrigation is a valuable remedial measure in obstinate affections of the gastric and intestinal tract. For the removal of the ingested and multiplying bacteria from the gastro-intestinal canal of an infant with summer diarrhœa, irrigation by a soft-rubber tube, as introduced by Epstein and earnestly advocated by Seibert, offers a valuable resource in obstinate cases, even after failure of the most reliable remedies.

Lavage for Adults.—The method of applying lavage differs somewhat when the patient is an adult. The patient is seated upon a chair with another chair in front of him. A large towel, sheet, or, better still, a rubber apron is secured by tapes around the neck and allowed to cover the entire front of the body, in order to protect the clothing. A long, soft, but firm rubber stomach tube, with an open end and one eye near the latter, and from two to six quarts of water being in readiness, a basin is placed upon the chair in front of the patient. Artificial teeth, if present, are removed. The patient is requested to sit upright with his head thrown back. The physician, standing on his right, dips the lower end of the tube in warm water (oil is unnecessary and injures the tube eventually). Holding it like a pen between the thumb and forefinger, he introduces the tube over the tongue, without touching the latter, until it strikes the back of the pharynx. The patient is now told to swallow and to bend his head forward. In the first effort gagging may ensue, but an abundant mucus is soon secreted in the throat which lubricates the tube. The patient should be reassured, if he complains of feeling choked or distressed, by informing him before the unpleasant symptom occurs that this is the usual effect, and that if he will keep his mouth well open he cannot choke, because there is ample room in the pharynx for even a larger tube. The physician must refrain from sharing the patient's excitement, and by calm demeanor reassure him when he, as is often the case, protests that he is utterly unable to obey instructions. Several attempts may

be required, and these should be made with perfect calmness and without flurry or appearance of disappointment on the part of the physician. In many hundreds of instances I have rarely failed. It is a common observation to find some patients who at first declared it impossible to swallow the tube becoming so expert that they execute the entire process without any assistance. Sometimes an obstruction is met with at the cardiac orifice which checks the onward passage of the tube. If an assistant will pour warm water into the funnel at this moment, the spasm will relax and the tube pass steadily down. At times it is necessary to move the introduced portion back and forth. This, however, should be avoided, because it produces gagging. It will be found that each introduction is more free from trouble and distress. The tube being introduced to the line mark usually found upon it (the distance, however, may be measured in each case by laying the tube along the curve of the proposed course from the mouth to the xiphoid cartilage), the patient, or, better, an assistant is asked to hold it lightly but securely *near the teeth*, the mouth being held open. Having ascertained that the tube has not entered the trachea (an accident which I have observed), water is now poured into the tube through a funnel connected with it. If vomiting ensues, the patient is quietly asked to lean over the basin and allow the vomit to flow out around the tube. He should be informed before the beginning of the procedure of the probability of vomiting, and should be assured that he may readily do so without removing the tube. If the irrigation be done too early after a meal, or if undigested food or large quantities of tenacious mucus obstruct the fenestra and lower opening, the water should be made to flow from a greater height by holding the funnel up. Sometimes it may become necessary to remove the tube, clean it, and reintroduce it. This renders the process more troublesome, especially if it is the initial effort. Hence it is advisable to make the first irrigation six or seven hours after luncheon, or before breakfast, when such stoppage is not likely to occur. After about a pint of water has entered, the funnel, still held firmly, is turned down into the basin, for the purpose of forming a siphon. This should be done quickly, *while the water is still flowing*, in order to establish perfect siphonage. A neglect of this simple point may defeat the proper emptying of the stomach. If the water does not flow out readily, the tube may be introduced farther or withdrawn a little. When the stomach has been well irrigated and the water returns free from mucus or particles of food, the thumb and forefinger should grasp the tube firmly in front of the patient's teeth, and withdraw it rapidly. Bardeleben has reported a case of "Schluck-pneumonie" from neglect of this precaution.

During the whole procedure the patient requires reassurance. I have sometimes succeeded in inducing timid patients to make the attempt, after a failure, by allowing them to witness the introduction in a well-drilled person. This is rarely necessary, however; patience, calmness, reassurance, gentleness, and skill in manipulation and overcoming obstacles will surely succeed in nearly every case.

This description has been somewhat minute, because experience convinces me of the value of the details, which the reader will do well to master.

Rationale.—The action of lavage upon the stomach is chiefly local. The large quantity of water flowing into the gastric cavity from a height of three or four feet, which furnishes nearly two pounds' pressure, laves the mucous lining and removes tenacious mucus from its walls. Fermenting material and undigested food and detritus are removed by the outflowing stream, cleansing and purifying the organ. Distention by the rapidly entering stream stimulates the muscular walls to peristaltic effort and thus aids the siphonage. In dilatation of the stomach very large quantities may be retained, and the organ may thus be paralyzed; hence the precaution not to exceed one pint without making an effort to remove it.

When cold water is used, the effect is the same as when it is applied on the cutaneous surface—a neuro-vascular excitation causing contraction and subsequent dilatation of the gastric vessels, and a stimulus to the local nerves. This is verified by some recent investigations by Lusini,* which furnish the interesting discovery that lavage produces a general effect also upon the system. These experiments were instituted in patients suffering from chronic gastric catarrh, with and without dilatation of the stomach, as well as in healthy individuals. A series of irrigations with from two and one-half to twelve litres of ordinary water was made before breakfast, at 9 A.M. and 4 P.M. Every observation was divided into three periods—before, during, and after irrigation, and each person was tested for seven days. The quantity of urine was not increased, no matter how large the quantity of water employed. Absorption of water was extremely slight. The acidity of the urine was diminished, not only immediately after the irrigation but also for an entire day subsequently; sometimes the urine attained a neutral reaction. The quantity of chlorides was diminished in proportion to the quantity of water poured in. The phosphates were slightly increased. In most cases the daily quantity of urine was diminished after lavage, when the latter was continued for some time, especially in gastric dilatation. The N constituent

*Transactions of the Accademia di Fisiocritici in Siena, 1896, quoted in the Deutsche Medizinal-Zeitung.

of the fæces was also reduced below the normal. The weight was increased in the healthy as well as in those suffering from stomach troubles. Their general condition was improved, appetite increased, and digestion was regulated. Lavage exercised a favorable influence upon intestinal disinfection, as evidenced by reduction of the indoxysulphate of potassium. Lusini concludes that lavage improves the digestive and absorbing powers of the digestive tract and favors the accumulation of nitrogenous reserve substances; it also acts indirectly as an agent for disinfection of the organism.

Therapeutic Indications.—Lavage is used for diagnostic as well as curative purposes. Its value as a diagnostic agent in dyspepsia has so frequently come under my observation that I regard its diagnostic importance equal to its therapeutic value. There is no disease that perplexes the physician more than do the various types of dyspepsia. To diagnosticate an ordinary gastric catarrh or a neurosis of the stomach from other forms of gastric trouble is not devoid of difficulty. When a case of chronic dyspepsia presents itself, it is my custom to bid the patient to eat a full meal at 12:30 P.M. and present himself at 5:30 P.M. for exploratory irrigation of the stomach with tepid water. The stomach should be thoroughly washed out, even if several quarts of water are required, but no larger quantity than one pint should be introduced at once. The washings should be carefully inspected, when it will be readily discovered if the patient has masticated the food thoroughly and if portions of food have remained undigested. Thus a clew will be afforded the physician to the actual digestive powers of the patient, and the latter obtains a valuable guide for future conduct. If the washings contain mucus, it is important to distinguish between stomach and throat mucus. The former is a thick, tenacious, brown mass, which floats upon the surface of the water like the scum on the surface of a pond; the throat mucus is thin, transparent, stringy, and may be quite abundant, being the result of irritation by the tube of the pharynx and œsophagus. The quantity and quality of the stomach mucus indicate with some accuracy the condition of the gastric mucous membrane. Its rapid or slow disappearance under renewed irrigations and treatment indicates the character of the disease affecting the mucous lining and the progress of the case under treatment, much more reliably than any other treatment of the usually hypochondriacal patient.

Gastric Catarrh.—In the treatment of mild or recent cases of gastric catarrh in which lavage for diagnostic purposes has shown the presence of tenacious mucus, undigested food, and fermenting material, a daily lavage is a valuable adjunct. In cases of long-standing gastric catarrh, the most unpromising type that comes under the physician's care, the diagnosis may be at once established, but their treat-

ment by irrigation is not so successful as in those of recent origin. As an addition to hygienic and dietetic management, lavage is useful, however, inasmuch as it frees the stomach thoroughly from accumulations of fermenting material and tenacious mucus, and prevents the over-distention by gases, which paralyzes the motor functions of the gastric walls and forms an almost insurmountable obstacle to recovery.

The time at which these irrigations are most useful has been discussed with much earnestness and even with some acrimony, so greatly do observers differ upon this subject. Riegel and others insist that this lavage is most successfully applied at bedtime, because it enables the stomach to be restored to a nearly normal condition, free from fermenting material and particles of undigested matter, during the night. There is doubtless good reason for his preference in the fact that in Germany supper is usually a light meal; but in this country, especially in cities, where the last meal is the largest (dinner), and is taken three or four hours before retiring, much good nutritive material would be lost by this practice. In this country, therefore, it is desirable to resort to irrigation in the morning, except in cases which are under constant supervision, in which the interval between the last meal and the irrigation may be made longer and the meal of less substantial food. The time must depend a good deal upon the individual case. When, for instance, we have a case characterized by accumulation of large quantities of tenacious mucus, which interferes with digestion and demands large quantities of water, I am in the habit of washing the stomach a short time before dinner, directing the patient to make his luncheon of some light broth or hot milk at noon. Five hours suffice for digestion; if the stomach contents have not been disposed of in six, it is probable that they will be propelled into the bowel undigested, and will, therefore, be lost to nutrition. Hence a luncheon at twelve or one, and lavage at six, are most suitable for business men and women.

Professor Fleiner* refers to lavage as follows: "In almost all cases lavage is of great service to the empty stomach even in the morning. Regular irrigations, which really can be executed only in institutions, produce an excellent appetite. The changing distention and emptying of the stomach act upon the walls of the stomach like local gymnastics. Motility is rapidly improved, atony disappears, the stomach empties more rapidly, fermentation and abnormal formation of acid cease; also nervous pains in the stomach, upon which irrigation acts like a warm douche, being relieved."

In malignant disease of the stomach, gastric lavage often serves to

* "Ueber die Diagnostik und Behandlung motorischer Störungen des Magens," Münchener medicinische Wochenschrift, No. 43, 1895.

prolong life and give comfort. This was illustrated by the case of a busy lawyer under my care, in whom the products of decomposition produced an offensive odor in the washings and were mingled with such enormous quantities of mucus that six or eight quarts of water were required for complete cleansing. He had vomited, prior to treatment, every other day for months, and thus, being partly freed from the accumulations, managed to attend to his large and exacting business. There was not a particle of hydrochloric acid in his stomach, according to frequent analysis. The motor power was so far in abeyance that particles of food were recognized in the washings twenty-four hours after he had partaken of it. This case was completely *relieved of symptoms*, requiring only biweekly washings. It proved to be a case of pyloric stricture of malignant character, for which the patient was operated upon and to which he finally succumbed. Lavage served to make life tolerable and to prolong it.

When the motor function of the stomach is impaired without other organic involvements, as in anæmia or other conditions which depreciate the general muscular and nerve tone, lavage should not be resorted to habitually. A weekly or biweekly evacuation suffices for diagnostic, prognostic, and therapeutic purposes, while other appropriate treatment is resorted to for the restoration of the general condition.

Dilatation of the Stomach.—The complete emptying of the stomach, as often as may be indicated, may restore the contractile capacity of the stomach walls, just as the catheter does in ischuria occasionally, and thus lavage may aid in restoring its lost shape and size.

In all cases of this kind, not due to actual stricture but simply to gastric catarrh, with excessive fermentation, and mucus, which encourages the formation of butyric acid, gastric irrigation five hours after meals, either before dinner or breakfast, is perhaps the most valuable therapeutic resource we have, if cautiously introduced.

In *nervous dyspepsia* we may be urged by patients who have already used it to frequent irrigation, on account of the alleged gastric fulness of which they complain; it is wise to resist these appeals. An occasional irrigation cleanses the stomach of possible accumulations, rare though they be, and exerts a psychical effect which is of some value. The products of fermentation require only occasional removal in these cases. The use of small quantities of ice water in lavage acts as a douche upon the stomach walls, and aids other means, such as electricity, etc., in restoring its tone. Rosenheim reports from Leyden's clinic* on the value of douching the interior of the stomach with fine streams of warm water, plain or medicated, which are delivered with considerable pressure. He has found a douche of water of from 95°–

*Therapeutische Wochenschrift, August, 1892.

110° F. an excellent calmative and gentle stimulant in nervous dyspepsia, moderate catarrh, and other stomach troubles, which often yielded in a remarkable manner in a very short time.

Gastralgia.—The most frequent etiological factor of this distressing malady is the presence of fermenting remnants of undigested food. Whether they or some disturbance of the nerve supply be the cause, an irrigation with hot water in large quantities is one of the most valuable measures. The following description of a case treated in Kussmaul's clinic illustrates the value of this simple procedure. "A woman, twenty-two years of age, suffered after three years of dyspepsia from agonizing gastralgia, which failed to yield to all remedies, including electricity, wet compresses, blisters, etc., and was relieved only by morphine. Becoming habituated to the latter, she gave up work, and entered the clinic in a miserable condition—feeble, emaciated, pale, her abdominal wall covered by cicatricial knots from hypodermatics, etc. Diet, rest, etc., were unavailing; morphine was still required. Her stomach was now irrigated with warm water every morning, while empty. The water returned almost clear and a little acid. This was continued with relief of pain and renewal of appetite. Carbonized water, mixed with plain water at 100° F., was now substituted, two or three litres being used. In three weeks she could eat beefsteak, etc., and take a walk. Warm baths at night, of ten minutes' duration, were now administered with great benefit. The morphine injection gradually became less necessary. To aid in obtaining spontaneous actions of the bowels, faradization was produced by introducing a wire electrode through the tube into the half-filled stomach, and placing another electrode upon the outside for five minutes. In four weeks she was entirely restored." In cases in which the soothing effect of warm irrigation is desired, it is self-evident that the warm water should be allowed to remain in the stomach for several minutes.

Ileus.—From whatever cause it may originate, intestinal obstruction presents one of the most terrible exigencies of the physician's life. It creeps upon the patient with slow but inexorable grasp, and one remedy after another is exhausted, until collapse ensues. Happily the modern physician does not trust so long to the hope of spontaneous relief as did his predecessor. During the past thirty-five years of the author's observation, he has never encountered a disease that has so deceived and baffled him with false hope. To-day surgical technique is so perfect that an abdominal section has lost its terrors, and the surgeon is more frequently invited to step in than formerly. Nevertheless, we wait too long, adhesions occur, the patient's strength wanes, and when collapse ensues our surgical colleagues too are helpless. It is fortunate that we have in gastric lavage not only a palliative for the patient's

sufferings, which no one can realize who has not stood at the bedside of such a patient, but a remedial agent which has been effective in many cases reported by Kussmaul, Leube, Henoch, Ewald, Curschman, Senator, and others. Indeed, gastric lavage has proven so valuable as a palliative in the author's hands that a note of warning not to trust too long to this measure may be instructive. In a case occurring in my service in the Manhattan Hospital, the stercoraceous vomiting and the terrific straining incident to a case of ileus were so thoroughly removed by two gastric irrigations that the house staff was lulled into a false sense of security, from which the sudden collapse of the patient aroused it. Laparotomy was done by Dr. Wilkie, who found several bands constricting the small intestine and one invagination.

The first case of ileus successfully treated by gastric lavage was reported by Kussmaul. The patient was admitted in March, 1882, after he had been unsuccessfully treated by all the usual methods for eight days. The stomach was thoroughly washed out, feculent masses were evacuated, and the irrigation was repeated every three or four hours until the water came away clear. Then the patient fell asleep for the first time, and on awakening passed a thin yellow stool. No further treatment was necessary; recovery was complete in five weeks.

A second case occurred a year later. Here, again, all remedies had been exhausted for nine days without result. Laparotomy was determined upon, but Professor Lücke, the surgeon, requested Kussmaul to see the patient before operation. One large irrigation of the stomach removed immense masses of feculent matter, and was followed by sleep, which had been denied the patient even under large doses of morphine.

The publication of these cases aroused so much attention that gastric lavage was at once added to the remedies for ileus.

In an article by Hassenclever* this author gives the histories of six cases, of which five were greatly relieved by irrigation of the stomach and one was saved. He regards this procedure as a decided enrichment of our therapeutic resources in ileus.

In a discussion of Professor Bardeleben's paper on "Ileus" at the Berlin Medical Society,† Professor Henoch said that, inasmuch as an exact diagnosis of ileus is often impossible, it is the duty of the medical attendant to resort to gastric lavage. He had observed only one case, but the result was so remarkable that it made a strong impression

* "Die Behandlung des Ileus mit Magenausspülung," Berliner klinische Wochenschrift, November 5th, 1885.

† Berliner klinische Wochenschrift, 1885, p. 458.

upon him. *He would therefore always regard it as a great sin of omission* not to practise lavage in the early stages of this malady. Henoch advises not to await collapse before an operation is resorted to, but to do the latter if the stomach irrigation, administered several times, has failed to produce the passage of flatus or fæces.

Professor Senator agreed with Henoch, and met Surgeon Hahn's objection to the irrigations on the ground of their being only palliatives by the logical argument that opium and morphine would have to be rejected on the same ground, and thus the operation would be done without trying any other measures. He advises that irrigations be used every five or eight hours. If the condition of the patient grows worse, operation should not be delayed.

Dr. J. Wolff thought that, despite the fact that ileus is rarely cured by irrigations, the latter should never be neglected, "because in the most pitiable cases they produce so delightful an effect, even though transient in most cases, that humanity alone demands this relief for our patients. Moreover, the surgical demand for cleanliness is fulfilled by cleaning the stomach of fæcal matter, and the chances of recovery from an operation are increased by the comfort to which the patient is transported by the irrigations. Even a patient suffering from carcinomatous stenosis, who had vomited fæces for three days, was placed in such a comfortable condition that she retained large quantities of bouillon, milk, and wine for several hours."

Curschman* reports one hundred and five cases of ileus, of which thirty-five cases were cured. Stomach irrigation proved of extraordinary value in many cases.

Pollok reported in detail † seven cases of ileus treated by lavage.

The reports of a large number of cases of acute intestinal obstruction which have been relieved by lavage, combined or not with intestinal irrigations, may be found in our literature. Pollok refers to Wignolle, who cites ten cases with nine recoveries from prolonged obstruction (pseudo-estranglement); in these lavage proved palliative and curative.

Rationale.—The observations of Kussmaul, Oser, Ewald, and others would seem to establish that the favorable action of lavage in intestinal obstruction depends upon removal of feculent matter from the stomach, which by reason of the insufficiency of the pyloric orifice permits a continuous flow from the intestine into the stomach and thence out through the tube. Thus the pressure above the constricted part of the intestine is relieved, which favors spontaneous reposition. The great distention of the stomach and bowels by a feculent mass to which

* Berliner klinische Wochenschrift, p. 386, 1885.

† Wiener medizinische Wochenschrift, No. 51, 1892.

they are unaccustomed may induce an abdominal irritation of the splanchnic fibres. Intestinal activity is inhibited by reason of the relaxation of the muscular coats. Lavage permits peristaltic action to be restored; abdominal pressure is relieved by it and the circulation of the affected parts is restored. That the removal of the stagnant contents of the stomach and upper intestines is sufficient to open the canal below is demonstrated by those cases in which enterostomy of the ileum has served to open the intestinal canal lying obstructed below it, and by those cases in which prolonged obstruction was suddenly removed after enormous quantities of fecal matter had been vomited.

Krimmel has shown* by observations on the living subject, after the abdominal cavity was opened, that lavage causes peristaltic action in the stomach which extends to the duodenum and jejunum, giving evidence of a reflex effect.

There is *no doubt, therefore, that the palliative and curative action of lavage may be explained on as rational principles as that of any other remedy or remedial agent.*

From these data it is evident that no case of intestinal obstruction may be regarded as properly treated unless gastric lavage every three hours has been tried several times. It is important, however, not to trust too long to the apparent cessation of the symptoms and the great relief afforded to the patient. A surgeon should be called in early to watch the case and interfere at the proper moment.

One point in the technique of lavage in these cases is very important—the firm pinching of the tube and its rapid withdrawal to avoid the entrance of fæcal or other matter into the larynx, which during vomiting has produced schluckpneumonie in these cases, according to Bardeleben.

Cholelithiasis.—In the fearful pain sometimes occurring in this disease, lavage has been found very useful. In a recent case in the author's family, not only was relief obtained, but a number of small calculi were seen in the stools on the following morning after lavage.

Kussmaul has reported two cases in which similar results were obtained.

The removal of fermenting material, mucus, and undigested food from the stomach doubtless contributes much to the comfort of the patient, and prevents the formation of gall stones by keeping the duct unobstructed. Despite clinical observation, however, it is difficult to account for its effect on the *passage* of gall stones.

Forced feeding and medication may be accomplished by lavage through the nose. I have introduced a large dose of castor oil and later calomel into the stomach of a child suffering from eclampsia with

* Deutsche Medinische Wochenschrift. 1890.

intervening coma, by pushing a Jacques velvet-eye catheter through the nose into the stomach. The same method may be pursued for feeding or medicating refractory children and insane adults.

Enteroclysis.

This is a term applied to the introduction of large quantities of water into the large intestines by means of long rectal tubes adapted to the purpose. This procedure is also known as intestinal irrigation, because the water introduced is intended to act chiefly as a distending and cleansing agent, to be again ejected by the patient. Such an irrigation cannot be accomplished by the ordinary enema of warm water, which usually consists of smaller quantities introduced by a short rectal tube, which act as an irritant and produce an immediate evacuation.

Technique.—The largest Nélaton catheter or a small lavage rubber tube or a horse catheter, with firm walls, having been thoroughly cleaned with boiling water, is attached to a clean fountain syringe containing one or more quarts of water that has been boiled for half an hour, and in which half a drachm of chloride of sodium has been dissolved for the purpose of rendering it less irritating to the mucous membrane. The patient is placed on his back on a bed or a sofa, or, if an infant or child, upon the abdomen in an attendant's lap, upon which a piece of rubber cloth has been laid, covered by a warm towel. The lower part of the rubber cloth is placed within a small tub, to act as a gutter for the returning outflow. The floor should also be protected against the usual projectile gush of the latter. The tube, anointed with vaseline and firmly held between the thumb and index finger of the right hand, is introduced into the anus, water having previously been allowed to flow until it runs warm, and gently but firmly pushed into the intestinal canal. It is well to use the two fingers of the left hand as a guide or railway for the soft and yielding tube, and to hold the latter with the right hand only half an inch from the anus in order to give firmness and support. Whenever the tube meets an obstruction it should be withdrawn a little and gently persuaded to pass upward. By allowing the water to flow and distend the bowel, introduction is sometimes greatly facilitated. Remembrance of this point has frequently saved me the mortification of abandoning the introduction. Sometimes the tube is more readily introduced when disconnected from the syringe. When the upper part has reached the transverse colon, or cannot be introduced farther, it is held quietly until about a quart of water has been passed. There will be little distention, because the pressure of the child's body upon the nurse's lap will usually aid in expelling the water as rapidly as it is introduced. If it does not

return it may be allowed to run out through the catheter, which must be detached for the purpose; older children may be placed upon the commode.

The procedure is almost painless. Very young infants will cry, but older children require to be quieted by being amused with playthings. Care should be taken to avoid doubling up of the catheter in the rectum. This is evidenced either by entire stoppage of the flow or by its immediate return through the anus. It is usually due to tenesmus. It is better to desist than to make repeated efforts to overcome this doubling up.

Dr. Robert C. Kemp* has devised a double-current rectal irrigator, for which he claims the advantage of completely plugging the

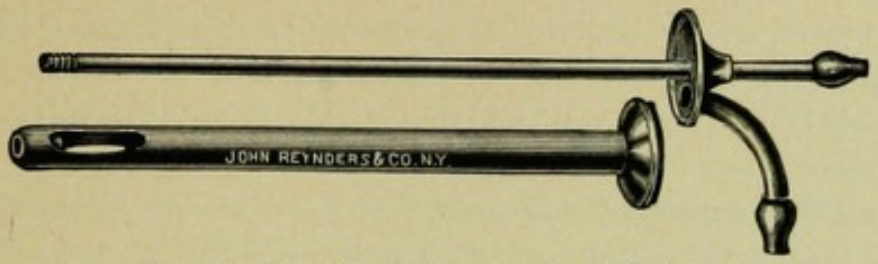


FIG. 55.—Kemp Double-Current Rectal Irrigator.

anus, allowing the water and gas to run off readily, thus preventing overdistention of the bowels. Although it is somewhat complicated, its ingenious construction admits of its being readily cleaned.

Rationale of Enteroclysis.—Fluids introduced into the rectum, with careful occlusion of the anus, and aided by the position of the patient and sufficient pressure, not only fill the large intestines, but under certain conditions may also, as some authors have shown, pass through the ileo-cæcal valve and irrigate the ileum. Among the best observations on the subject may be cited those of Generisch.† He found that while neither water, oil, nor mercury can be made to pass from the œsophagus through the uninjured intestinal canal of an adult dead subject, through the anus, the result of inverting the flow is quite different. The ileo-cæcal valve is easily penetrated under moderate pressure; water flowing from a height of from seventy to eighty centimetres can be made to pass into the stomach and even through the mouth. The capacity of the digestive canal varies greatly, the large intestine accommodating about three litres, and the stomach and small intestine about the same quantity; *i.e.*, eight or nine litres would fill the entire gastro-intestinal canal. Generisch has convinced himself repeatedly that in the living body water may be propelled from the anus to the mouth. Usually abundant vomiting begins after the seventh litre

* New York Medical Journal, March 13th, 1897.

† Wiener medizinische Presse, No. 39, 1893.

has passed into the rectum, and if the irrigation is kept up vomiting continues until the tube is removed, when the fluid begins to pour from the anus also, only two or three litres remaining.

Enteroclysis is contraindicated in cardiac disturbances, arterio-sclerosis, and advanced pulmonary disease. It is impracticable when pronounced strictures exist in the tract; also in strangulated hernia, and in tuberculous or typhoid ulcerations of the intestines, for obvious reasons. Increase of peristalsis has been proved by Horvath's experiments; he sent streams of water of from 66°–105° F., progressively increased, through the canal.*

The vulnerability of the inflamed intestine to pressure has been tested by Müller.† From five experiments on living dogs and on one dead infant he reached the conclusion that it is almost impossible to rupture an inflamed bowel even if obstructed. Before rupture occurs the contraction of the sphincter muscle is overcome and the water is either expelled or escapes gradually through the ileo-cæcal valve into the small intestine and into the stomach, whence it may be expelled by vomiting. One experiment showed that even in a normal state of the ileo-cæcal valve irrigation of the small intestine is not always possible. Five other experiments proved the permeability of the small intestine.

The action of water flowing through the intestinal canal is chiefly mechanical, *i.e.*, it removes the materials of decomposition and pathogenic elements, which are known to cause and maintain many cases of diarrhœa and dysentery. If the fluid enters only, as is in most instances the case, the large intestines, peristalsis in the smaller intestines is evoked and the flow of bile is increased.

The idea that cold-water irrigations, as practised by Krull in cases of jaundice, increase hepatic action has been demonstrated to be erroneous by Stadelmann‡ and his demonstration is confirmed by others. While investigating the action of cholagogues, Stadelmann incidentally endeavored to ascertain the effect of enteroclysis. He correctly estimates the good effect of enteroclysis in icterus, cholelithiasis, and intestinal disturbances as due entirely to the removal of decomposing and irritating matters, hence to a cleansing and disinfecting action, and not to a cholagogue action.

Diuretic Action.—Dr. W. E. Forest§ offers an interesting series of observations made upon himself, to show that enteroclysis produces a decided diuretic action.

*Malbranc: Berliner klinische Wochenschrift, 1878.

†Prize Essay, Therapeutic Gazette, 1893.

‡Therapeutische Monatshefte, 1891, Nos. 10 and 11.

§Medical Record, September 19th, 1891.

"A large number of experiments were made, all going to prove that a flushing of the colon with hot water, followed by an injection of from a half-pint to a pint of hot water that is retained, is a quick, safe, and powerful means to stimulate the kidneys into action. This method is a more powerful diuretic than any drug. The only precaution to be used in order to retain the hot water is immediately to lie down for a half-hour after receiving the injection.

"The outcome of these experiments proved, first, that from twelve to twenty ounces of warm or hot water can be retained at one time in the colon, and that all of this will be absorbed into the blood; second, that the normal amount of urine secreted by the kidneys in twelve hours may be more than doubled by means of such retained injections; third, that the mere flushing of the colon with a large quantity of hot water (two quarts at least, at one injection) powerfully stimulates the action of the kidneys. Part of this effect is due to the internal application of heat, and part to some of the water being absorbed."

Enteroclysis has been found of great benefit in the treatment of all kinds of fevers. Professor Cantani's plan of large cold enemas has not given the same good results that warm or hot enemas have. As both Debove and Cantani claim that most of the good effect of the internal use of water in fevers is due to the increased elimination through the kidneys, it is fair to assume from the experiments given that a very important auxiliary in these cases to the internal bath by the mouth is the internal hot bath by the colon.

Forrest also gives the details of a case of acute nephritis which is of value in demonstrating this *diuretic effect*. He insists that in all cases in which the water is to be retained the colon should first be washed out by a large warm injection.

The influence of injections into the rectum and colon upon the organism has been studied by Dr. Robert C. Kemp, in experiments conducted at the physiological laboratory of the College of Physicians and Surgeons. I am indebted to him for the following data:

Intestinal Irrigation with Normal Salt Solution, Double-Current Method (see page 240).

First series, to show the effect of rectal irrigation on pulse tension, was made on dogs under morphine and a small quantity of ether. Irrigations lasted from ten to fifteen minutes or more.

These experiments indicate that an irrigation of 110° increased steadily to 120° improves the action of the heart, increasing pulse tension, while cold acts as it does externally, as a temporary stimulant,

increasing blood pressure; but its subsequent effect, if continued, is depressing.

Second series, demonstrating the effect of irrigation on animals that had been bled.

Dog; morphine; slight ether. Manometer, left femoral; kymograph attached. Average blood pressure, 155 mm.; 509 c.c. of blood gradually withdrawn from the right femoral artery; pressure falls to 112 mm.; *animal* nearly *moribund.*

Intestinal irrigation with normal saline solution at 110° F. and rapidly increased to 120° F. In *ten minutes* the blood pressure rose to 140 mm. and remained steady, and the heart action rapidly improved.

Third series, demonstrating effect *on temperature.*

Dogs; morphine; slight ether. In some animals clinical thermometers in the left common iliac, the tip lying flush with the wall of the abdominal aorta; in others clinical thermometers in left common carotid, the tip lying flush with the wall of the arch of the aorta. These animals were all dissected later to demonstrate that no clotting occurred which could interfere with the experiments. In addition, in some of the animals, a manometer with kymograph attached, was connected with the femoral artery, opposite the common iliac, in which the thermometer was inserted. Incisions were made in the axillæ and clinical thermometers inserted, to secure the body temperature before and after irrigation. The dogs were all *uncovered* and in a room about 72° F., to avoid errors.

These experiments show that *hot irrigation* with saline solution, at 110°–120° F., when prolonged, *increases* the body temperature and also the blood *temperature.* The increase of blood temperature may be possibly due in part to the mere contiguity of the hot solution to the great vessels. This would seem in part to be true, as the body temperature did not seem to increase as greatly as one would suppose it would do, from the increase of temperature in the blood. This heated blood, however, would be of great value as a stimulant to the heart.

Fourth series, demonstrating effect on *renal secretion and intestinal absorption.*

Dogs; morphine, ether slight; laparotomy; ureters catheterized. One ureter attached so that drops strike a lever and register on a kymograph. In some manometer and kymograph also attached to femoral artery to show pressure at the same time. Irrigation with normal saline solutions from 101°–120° F.

Temperature, 110°–120° F. Increase of secretion in *ten minutes. Marked increase of pressure.* In *twenty minutes* increase of secretion is still *more marked.*

Temperature, 101°–105°. No increase of secretion noted until *twenty minutes*. Practically slight increase in pressure.

Potassium ferrocyanide, five-per-cent solution; 5 c.c. of this in irrigating fluid (one quart). The return fluid is caught again and again, so that the ferrocyanide is continually in the intestine. Urine tested every minute with *chloride of iron* in twenty minutes gives Prussian-blue reaction. Then follow repeated irrigations with ferrocyanide of potassium, five-per-cent, 5 c.c. in each quart of irrigating fluid. In twenty minutes Prussian-blue reaction with *chloride of iron* well marked.

Deductions.—I. In *ten minutes* irrigation at a high temperature, 110°–120° F., stimulates the kidneys to act by heat and by the *effect* on the *circulation*. Pulse tension rises, the heart is stimulated, the circulation is improved, the body and blood temperatures are increased.

II. In *twenty minutes* irrigation at 101°–120° F. causes excretion of urine from the kidneys, actually by absorption of the saline from the intestines. This is shown by increase of secretion demonstrated by the kymograph and by the potassium-*ferrocyanide* experiment.

III. Intestinal absorption occurs in *twenty minutes*, from the large intestine (colon) or rectum.

IV. Irrigation at 110°–120° F. acts in a double way, *i.e.*, by the stimulating effect of the heat on the kidneys and circulation and by absorption. Pulse tension is *markedly increased*. When irrigation is carried on at 101°–104° F. renal secretion is increased only by absorption and in *twenty minutes*. There is no increase of pulse tension, yet we again observed the *increase of renal secretion* and reaction of the potassium ferrocyanide to chloride of iron in *twenty minutes*. It is less rapid and powerful in effect.

V. The rapid absorption from the large intestine (in twenty minutes) has an important bearing on auto-infection.

Fifth Series—Experiment in Hypodermoclysis. This may be properly included under *hydrotherapy*.

Dog; morphine; slight ether; laparotomy; left ureter catheterized. five centimetres of a five-per-cent ferrocyanide-of-potassium solution is added to three drachms of normal saline solution at 104° F. This is injected with a large hypodermic into the right groin. *Urine* tested every fifteen seconds with chloride of iron. In three and a half minutes Prussian-blue reaction noted, which became well marked in four minutes. *Renal excretion increased.*

These careful experiments show clearly that the heart may be stimulated by the temperature of the irrigation, as it is in water drinking; and that the urinary secretion is increased by reason of the en-

hanced blood pressure which ensues at once in the kidneys, but also by direct absorption of fluid which occurs later.

Therapeutic Indications—Infantile Diarrhœa.—The summer diarrhœa of infants offers an excellent field for enteroclysis. If the technique be mastered and properly executed, no other remedy equals intestinal irrigation in removing bacteria, soothing the suffering child, and promoting a rapid convalescence. This subject is fully treated in the clinical portion of the work.

Catarrhal Jaundice.—The author has found an excellent adjunct in the treatment of catarrhal jaundice in irrigation of the large intestine with cold water. He was led to its application in this disease by the publication of Dr. Krull, who treated eleven cases of catarrhal jaundice by simple cold-water irrigations of the intestines. After failure with other treatment, which almost invariably had included the Carlsbad waters, these irrigations succeeded, first, in relieving the constipation, and, later, in re-establishing the hepatic norm. Dr. Lowenthal reports* forty-one cases of catarrhal jaundice, of which all but one demonstrated good and rapid effects from intestinal irrigations. Four irrigations of one or two quarts at a temperature varying from 54° to 64° F., increasing three degrees daily (one quart sufficing for children), were needed on an average for each case. In all the cases fæcal evacuations, sometimes diarrhœa, followed the irrigations; these ceased if the succeeding irrigation was of a somewhat higher temperature. Gray or colorless clay-like masses were evacuated after the first treatment; after the third the fæces became slightly yellowish, and after the fourth usually brown. Gastric pains and oppression, headache, etc., ceased, and appetite returned; the icteric hue disappeared once after the first, twice after the second irrigation. Pruritus, in seven cases, disappeared after from the second to the fourth treatment. The skin began to clear up, but continued dark for a long time.

Other reports of similar results are found in recent literature, confirming the value of this *hydriatric measure*, so that it may be regarded as established.

I can testify from personal experience to its beneficial effect in catarrhal jaundice, and to its failure in jaundice from gall stones. Contrary to Krull's method, I have begun with tepid water and reduced its temperature daily, and this method has recently been approved by Stadelmann, who has investigated the "cholagogue" action of these irrigations. Once in twenty-four hours I place the patient in the knee-elbow position, and pour from one to two quarts of water of 70° F. into the rectum from a fountain syringe. The patient is induced to retain the fluid as long as possible. On the following day the tem-

* Berliner klinische Wochenschrift, 1886.

perature of the water is decreased two degrees, and this decrease is continued until 60° F. is reached. From two to six irrigations are sufficient to produce the desired result. In my own experience the gastric and hepatic pains ceased after the first injection, appetite soon returned, and jaundice disappeared more or less rapidly, but that most distressing symptom, pruritus, was not relieved.

Dr. Robert C. Kemp, who has done so much for the perfection of rectal irrigation, its *rationale*, and its clinical applications, offers the following deductions from his observations for clinical purposes:

When increase of pulse tension is to be avoided in irrigations, the temperature of the water should be 101°–104°.

When a rapid increase of pulse tension is desired, together with improvement of cardiac action, rectal irrigation at 110°, gradually increased to 120° F., is advisable.

Cold irrigation, being a temporary stimulant, increases blood pressure, but later depresses. Hence it should be employed with caution. Irrigation with cold water is dangerous when prolonged. Low irrigation is useful in proctitis, prostatitis, etc.

In *hemorrhage*, irrigation at 110°–120° secures the most rapid result, improves the pulse, and relieves shock.

In *duodenal jaundice*, cold high irrigation for a very short period, alternated with hot irrigation with the glass-tube irrigator, as suggested by Dr. Minor, has proved valuable, as well as in chronic constipation.

Asiatic Cholera.—In this disease, which has baffled the most skilfully devised medication, enteroclysis has proved of great service. It was brought into prominence in the epidemic of 1892, by the efforts of Dr. Elmer Lee, an American physician who visited Russia, Hamburg, and other epidemic centres for the purpose of demonstrating its value. Dr. Lee's method, with an illustration of the ingenious apparatus devised by him, are described in the article on "Asiatic Cholera").

Uræmia and Renal Insufficiency.—In acute conditions with rapid and feeble pulse, irrigation at 110°–120° produces rapid improvement; renal secretion is started up; profuse sweating and bowel action often follow. Irrigations have been given by Drs. Egbert Grandin, William H. Thomson, and others for forty minutes, and repeated every four hours with good results. In one of Dr. Thomson's cases the urine, previously scanty, was increased to forty ounces and a pleuritic effusion was absorbed. In suppression with uræmia, accompanied by high tension and pyrexia, Dr. Kemp has observed rapid increase of renal secretion, bowel action, and sweating, with decrease of tension, a result which my own observation has verified in a recent case.

Cold enemata and irrigation are regarded by Dr. Kemp as dangerous in renal diseases.

Typhoid Fever.—Intestinal irrigations with cold water have been recommended by Cantani for cooling the body. But there is another indication which bids fair to secure valuable results—the cleansing of the intestinal canal. Among the recent writers upon the subject, Dr. T. J. Schuell presents in the New York *Medical Journal* of September 2d, 1893, an excellent argument for the thorough irrigation of the colon in typhoid fever. These injections, to effect the most good, should be employed early in the disease, before the high fever and severe nervous symptoms show themselves. They may be repeated, if necessary, at intervals of three days for the first week or ten days. They should be used warily when the stage of necrosis of the glandular tissue is reached, as the solitary glands of the large intestine are affected in a large proportion of cases.

Having treated several cases of typhoid fever during the summer and autumn of 1892, Dr. Schuell observed that by thorough irrigation of the colon at an early date cases were rendered comparatively light. While they were not materially shortened in duration, they lost the typical typhoid picture, the lassitude, subsultus tendinum, delirium, dry and fissured tongue; and convalescence was uninterrupted and rapid. The contrast between the ordinary so-called disinfectant method and this method of disinfection, which is certainly more rational than sending feeble medicinal antiseptics into the long intestinal canal on the same mission, offers a striking clinical lesson.

Confirmation of the value of irrigation treatment of typhoid fever is furnished by the article of Dr. Hensel-Meseritz,* who maintains that a careful cleansing of the intestinal canal may be very useful, not only in cases of marked constipation but also in plainly marked cases of typhoid fever, when we have temperature of over 40° C., characteristic diarrhœal stools, lung symptoms, and enlargement of the spleen.

In this way baths were avoided and compresses may be reserved for special cases. The entire nursing of typhoid cases was much simplified and the results were surprisingly good.

Dysentery.—This very common disease of infants and adults is usually amenable to ordinary treatment. In cases resisting the latter, irrigation with one or two quarts of water, about 95°, made thoroughly aseptic by long boiling, has proved a valuable auxiliary by removing pathological products, subduing hyperæmia, relieving tenesmus, and thus enabling the inflamed bowel to obtain that rest which in all inflammatory affections is the chief element of restoration. All these effects are due to the mechanical cleansing action of water. They demand careful attention to the details of the procedure, to inculcate which experience has taught me to be necessary. It is important that

* Allgemeine Medizinal-Zeitung, 1896.

the elastic tube be introduced high up, to prevent distention of the rectum and lower colon and to allow the latter to be flushed by the outflowing water.

Dr. Patterson, of Edgefield, S. C., made the ingenious suggestion in 1896 to stretch the sphincter under ether before irrigating; he has succeeded in cases which resisted other treatment.

Confirmatory evidence of the value of this simple hydriatric measure is furnished by a report on the subject in *The Medical Age*, August 25th, 1891. Dr. Peter S. Korytin (Russia) details fifteen successive cases of diphtheritic (nine) and catarrhal (six) dysentery which he treated daily with large warm (30° R. or 100° F.) enemata of six pints either of filtered water from the tap or of a carbolic solution, from ten to twenty grains in six pints of distilled water, which is practically equivalent to plain water. Only one of the patients died, the remaining fourteen making excellent recoveries. The total number of the injections in individual cases varied from one to six. The injected fluid was retained by the patient generally from five to ten minutes, being sometimes expelled in one or two, and in other cases in from fifteen to twenty minutes. The following effects were commonly observed: Abnormal distention and pain speedily subsided; the frequency of stools diminished and tenesmus decreased; the spirits, appetite, and sleep quickly improved; the stools soon became painless, more solid, and free from offensive odor, mucus, blood, sloughs, and shreds, while the temperature became normal. No therapeutic difference whatever was noticed between carbolic and simple enemata. It appears, therefore, that the beneficial results of the treatment should be attributed simply to the thorough washing out of the large intestine.

Intestinal Obstruction.—Colono-enteric irrigation has been found useful in the treatment of intestinal obstruction. Dr. Edwin Pynchen* reports a case of intestinal obstruction successfully treated by continued irrigation in a girl aged fourteen, who had not had an alvine evacuation for three days and had been eating chiefly cheese, crackers, oranges, and grapes, swallowing the seeds of the grapes and also chewing gum.

"The patient was anæsthetized and suspended head downward over a chair which had been inverted, the back of the chair resting upon the floor and the seat being supported by a stool. A fountain syringe, for the continuous pressure afforded, was filled with water at a temperature of 110° F. and raised to the ceiling. A fall of as much as thirty feet for an adult and fifteen for a child is better still, as indicated by the experiments of W. E. Forrest, who found that the intestines of an adult would stand a pressure of fifteen pounds to the square

*Chicago Medical Recorder, 1896.

inch, while in the case of a small child the maximum was about nine pounds, the pressure obtained from a column of water being one pound to each two and a half feet. In the author's case the effect of the water was augmented by forcible abdominal massage and two and a half gallons were thus driven into the intestine. When this amount had been reached, there was a violent gushing of water from the patient's mouth, about a gallon escaping in this way. The procedure was then stopped, and when the patient was sufficiently recovered from the anæsthetic to be placed on a slop jar another gallon escaped per rectum. The child recovered without further trouble and had a normal stool on the second day."

I have recently treated a child of four years who had been unconscious for twenty-four hours, and suffering from eclamptic attacks every ten or fifteen minutes; the stomach was irrigated and a large dose of castor oil administered through a tube passed into the œsophagus through the nose. The castor oil was returned together with a large quantity of bile, when the tube was reintroduced six hours later. Intestinal obstruction, which was diagnosed and concurred in by Dr. A. Jacobi and Dr. Charles Kinch, was removed by a large rectal irrigation administered in the inverted position. The convulsions ceased after a free evacuation and the child became conscious.

Lead Colic.—There is no disease which embarrasses the physician more than lead colic. Frequently obscure in origin, our remedial agents do not reach the cause. Many medicinal agents have been vaunted, but their inefficiency has led us to reach out for additional therapeutic aid. That hydrotherapy holds out some promise is evident from the case of Reisland, published in the *Berliner klinische Wochenschrift*, 1875. The patient had been constipated five days, despite the most active purgation; he was collapsed, with frequent spasms of the arms and legs and vomiting of bile; the face was pale and ashen. The teeth presented a plain lead line; abdomen, hard and retracted; pulse, small (65); temperature, normal. Croton oil and opiates were ineffectual, also enemata. Four and a half litres of warm water were now poured into the bowel with a Hegar's irrigator. The water returned in five minutes, colored by fæces and containing some scybala. The patient obtained so much relief that he insisted upon a repetition. Three litres were introduced, and were followed in half an hour by the same quantity, each injection being followed by fæces and relief from pain. The knee-elbow position was practised during irrigation. The patient became more nauseated, but after the third irrigation he slept well for the first time in six days. The pain returned, and three more injections of three and two and one-half litres brought stools and relief. On the following day the pain and spasms returned, and were again

relieved by irrigation. The patient received one more irrigation of three litres, which brought a good fæcal evacuation, and he was assisted to entire recovery by a dose of *ol. ricini* and *ol. crotoni* and a warm bath. In Kussmaul's clinic at Freiburg this treatment has been used for many years. Whether lead colic be a neurosis of the intestinal muscular coat, or, as Riegel deduced from the effect of amyl and pilocarpine, a spasm of the mesenteric vessels, it is certain that abundant warm injections per anum may avert colic in its incipiency and act as a good palliative. It is very interesting to note that this procedure quickly produces fæcal evacuations, irrespective of the rejected enemata, proving that they induce a normal activity of the intestine.

Irrigation of the Male Urinary Tract.

Irrigation of the bladder has long been in vogue as a remedial or palliative agent in bladder diseases. This is usually done by a double-current catheter attached to a fountain syringe.

An improved device is described by Dr. E. L. Keyes, an eminent authority on this subject. Dr. Keyes justly claims that to wash out the bladder thoroughly it must be somewhat distended.

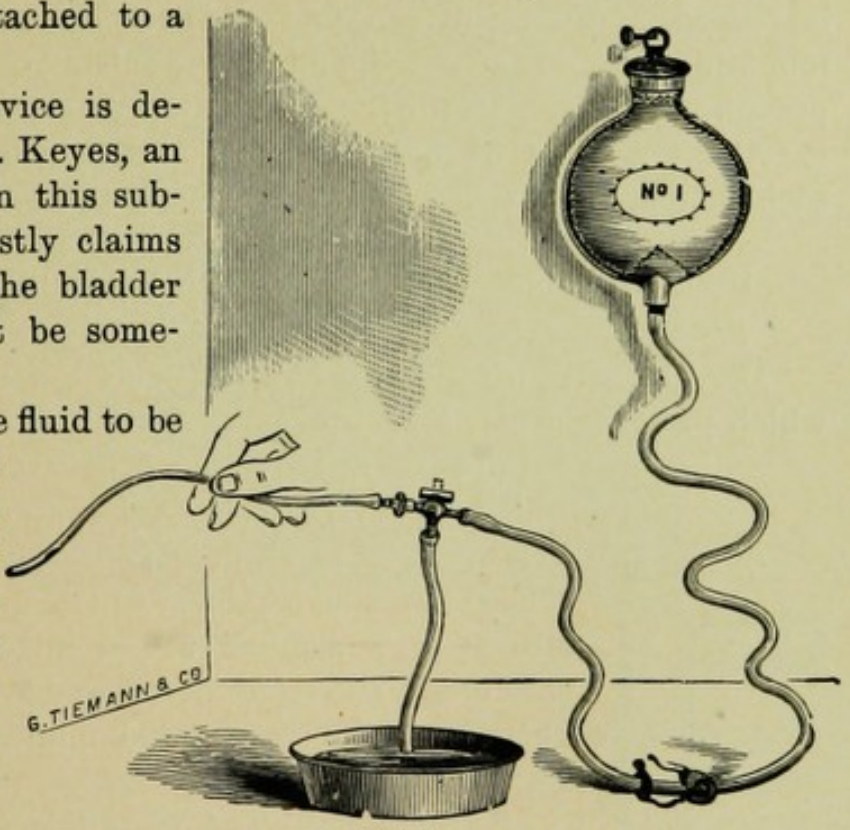


Fig. 56.—Keyes' Bladder Irrigator.

Technique.—The fluid to be injected is eight ounces or more, at a temperature of about 110° F. Some of the heat is lost during the preparation. Standing in front of a stool bearing some receptacle, the patient slowly introduces his catheter, dipped in vaseline, and already attached to the large metallic mouthpiece.

As soon as the urine begins to flow, he immediately couples the large nozzle of the stopcock and the large metallic mouthpiece with which his catheter has been provided, and the urine flows promptly through the short rubber tube into the vase on the stool before him. When the urine has escaped, he turns the stopcock and the bladder

slowly fills with water. As soon as the organ begins to feel distended, he turns the stopcock again, so slowly and quietly that he scarcely perceives the motion.

He may thus wash his bladder very thoroughly four, five, or six times without any change of the instrument or its adjustment, except the simple turning to and fro of a stopcock; and this he does until the water flows comparatively clear from his bladder.

For irrigation of the urethra a useful instrument is that devised by Dr. Lester Keller. It is made of sterling silver, not readily corroded, and easily kept bright. It is made in two lengths—one for the curved and one for the straight portion of the urethra.

A tube is corrugated to permit the liquid to flow back, and, by occasionally rotating the tube very slightly, every portion of the mucous membrane is reached. The openings for the outflow of liquid are behind the bulb, so the liquid cannot enter the bladder.

Technique.—The instrument is introduced until the "tender spot" is passed, and we generally find one; then the tube of an ordinary fountain syringe is attached, and by the raising or lowering of this the pressure is easily governed.

About a quart of water may be used, which may be repeated at each sitting, about twice a week. Usually two or three sittings suffice.

Irrigation of the Urethra and Bladder without the Catheter.

Dr. Daggett, of Buffalo, has introduced a method of irrigation which presents decided advantages over all others, in that it does not require the introduction of a catheter into the urethra, which is usually exceedingly tender in its posterior portion in cases of chronic gonorrhœa. "The apparatus consists of a short stem, which gradually decreases in size in such manner that its introduction into the urethra closes the latter by its wedge shape. This is connected with an inflow and outflow tube, as shown in Fig. 57.

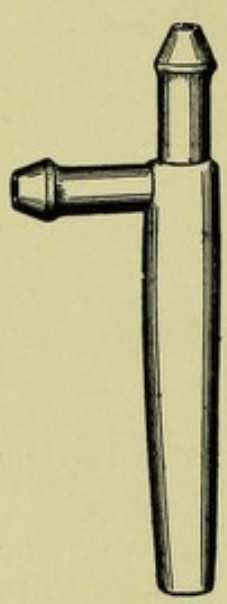


Fig. 57.

"*Technique.*—The materials are a four-quart bag and a tube six feet long with a shut-off within easy reach. The tube is attached to the inlet of this double cannula, its bore being twenty per cent larger than that of the outlet. The nozzle of the cannula is introduced from one inch to two inches, according to the size of the meatus, and is made wedge shaped, in order to fill the varying calibres of urethral meatus. It is sufficiently long to be conveniently held in place by grasping the penis behind the glans, at the

same time drawing the pendulous portion in line with the fixed urethra. The bag is filled with water, at a temperature of 115°, to insure more than blood warmth as it flows, and is made bland by the addition of a little glycerin, mucilage, a few grains of salt or sodium carbonate, and elevated two or three feet above the plane of the pelvis.

"The patient must assume a reclining position—a reversed squatting posture—since flexure and gravity are essential factors (Fig. 58).

"He may do this in an ordinary bathtub by resting his back along the incline at its head, so that the trunk is at an angle of forty-five degrees from the horizontal line, flexing the thighs at right angles with the body and supporting the legs at right angles with the thighs. If there is no bathtub at hand, a hip bath may be arranged for this pur-

FIG. 58.

pose, or the patient may posture himself in a low rocking chair, tilted and blocked (Fig. 58) so that his body assumes the position described, his legs resting upon another chair or upon a stand.

"The nozzle of the irrigator is then introduced, the penis grasped and drawn in line with the fixed urethra, the stop opened, and the water allowed to run, if necessary until the bag is empty; if it has not passed into the bladder, try again. A peculiar feeling gives warning of the passing of the water through the posterior urethra; the return flow diminishes and escapes in a pulsating stream, when a finger of the right hand is placed over the exit to divert the entire flow into the bladder, which at first resents the intrusion and ejects the water after

receiving two or three ounces. Repeat this and the bladder becomes more tolerant each time. Three or four flushings are sufficient at each *séance*, and the *séances* may be repeated three times daily if necessary. The novelty and comfort afforded by irrigation sometimes induce patients to overdo, at the beginning, before tolerance is established. The diminished, pulsating outflow would seem to indicate an anti- or retro-peristaltic action of the accelerator muscle. This process is a coaxing one, in which the gentle pressure of the continuous flow of the hot, non-irritating current and the posture described are essential conditions. The patient acquires a knack at the first success that gives him an abiding faith in his ability to flush his bladder at will."

Therapeutics.—The management of urethral diseases has long been a reproach to the profession. The fact that numberless and diverse formulæ for use in this malady burden our text-books and encumber our journals indicates that the profession is at sea, that our methods are uncertain, and our treatment is empirical. "A steady in- and out-flowing current of hot water, with the patient in this position, is a far more valuable measure in the treatment of stubborn cases of urethritis than the ordinary deep injection, which may be compared to treating laryngitis by rinsing the mouth."

Mechanical cleansing is now acknowledged as far superior to the best chemical agents, for purposes of asepsis and antisepsis. Just as in peri-uterine congestions and inflammatory conditions the steady irrigation with hot water constringes the vessels and aids absorption of pathological products, so must a continuous irrigation of the bladder and urethra, properly administered, produce a similar detergent effect upon parts which a brief injection with some strong medicament fails to affect. When we consider, for instance, the measure recommended by Guyon and others for treating chronic cystitis, viz., the injection guttatim of a strong solution of nitrate of silver, which is expected to be more or less diluted by the urine present in the bladder, we must grant that this is an exceedingly irrational procedure when compared with the thorough cleansing of the inflamed surface by hot water.

Dr. Daggett cites a number of cases, which convey a correct idea of the value of this modern treatment and are well worth studying, and of which the following is an example:

CASE I.—R——, 63 years of age, twenty-three years ago had a very severe attack of cystitis; ill several months, and never fully recovered. He had been confined to his room four weeks; irrigation by double catheter was employed; his condition grew steadily worse. His attending physician proposed cystotomy. He presented all the phenomena of septic infection. His urine was strongly alkaline, offensive, depositing one-quarter part by volume of solid matter, consisting of pus and inflammatory débris. R—— readily learned self-irrigation without the catheter, and cleared his urine in five days and was able to attend his

office. There still remained a tendency to relapse, which was controlled by irrigation. He is now able to evacuate the bladder completely by a good stream.

Chronic Prostatic Hypertrophy.—About thirty-three and one-third per cent of men between the ages of fifty-five and sixty have more or less enlargement of the prostate, and a small percentage of these suffer from urinary obstruction and its attendant evils.

Enlargement of the prostate may impede, but will not prohibit passing a fluid into the bladder by this process. Passing water into the bladder in cases in which the patient was unable to void it without a catheter is made possible by this method.

An interesting phenomenon, developed by this process, is the *restoration of impaired procreative functions.*

After several years' experience and two score cases as they occur in the rounds of a general practice, Dr. Daggett feels warranted in asserting that more than ninety per cent of these patients may be taught to irrigate the bladder without a catheter.

"Success is attained by technique, posture, and perseverance," in these cases as in others in which hydrotherapy is judiciously applied.

The common error, that hydrotherapy deals with cold water externally applied only, is exposed by these effective remedial applications of ordinary warm water.

Vaginal Irrigation.

In the treatment of utero-ovarian diseases, vaginal irrigations have come to be a routine treatment, which is of value just in accordance with the proper execution of the details of the procedure.

Technique.—The chief points to be observed in the preparation of vaginal irrigations are that the following be provided: (1) a douche pan (zinc or porcelain); (2) a fountain syringe holding two or more quarts of water at 110° F.; (3) a proper couch or bed upon which the hips may be elevated. The fountain syringe being suspended from a height of several feet and the douche pan having been warmed, the latter is so placed under the patient that her nates rest on the covered portion. A vaginal tube having openings which direct the outflowing stream forward, to prevent the latter entering the uterine canal, is attached to the rubber tube leading from the syringe and introduced as far into the posterior cul-de-sac as possible

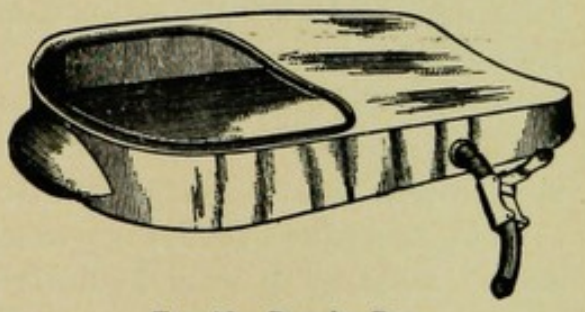


Fig. 59.—Douche Pan.

without causing pain or discomfort. The clamp which prevents the outflow is now opened, and the water is allowed to flow in a continuous stream through the vagina into the pan.

Dr. N. Bozeman* has devised a vaginal irrigator which delivers water mixed with air. He claims that the main feature is the introduction of sterilized air with the hot water into the vagina and the withdrawal of the same by slight suction before it can accumulate there in sufficient quantities to flow over the perineum and wet the patient's clothing and the bedding.

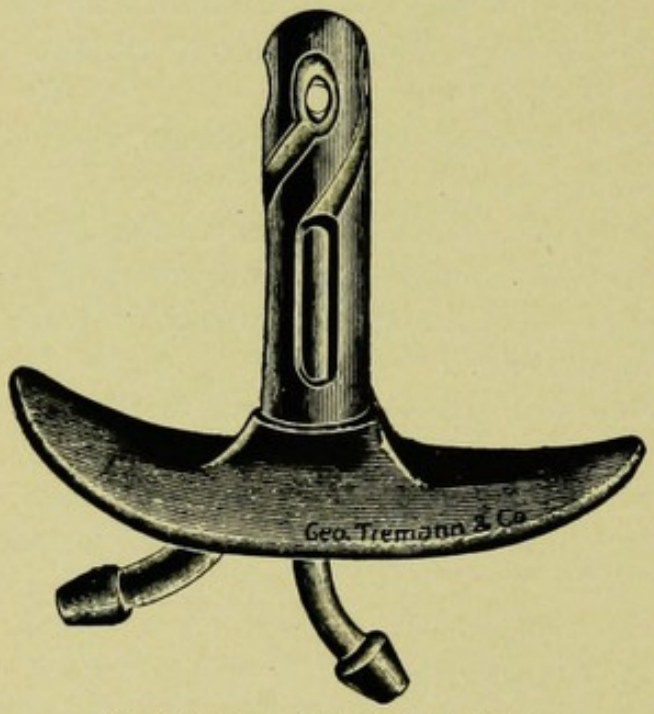


FIG. 60.—Kemp's Vaginal Irrigator.

He has recently simplified this apparatus† by substituting a rubber bag for the glass reservoir.

Dr. Robert C. Kemp ‡ has devised an ingenious double-current irrigator (Fig. 60) for the vagina, which serves without a douche pan.

This appliance is also made of glass.

All vaginal irrigations should be administered with the patient lying recumbent; the upright position on a bidet or closet being imperfect, because the vagina is not distended by the stream. For cleansing-purposes the temperature of the water should not be above 100°; for astringent or antiphlogistic purposes the temperature should be 100°–120°, beginning with 100 and gradually increased by adding hot water, until the patient complains of the heat. In these cases the hips should be elevated and the quantity of water should be large, three or four quarts. The perineum should be anointed and care should be taken to avoid metal tubes and to protect against painful heating of the parts.

The procedure cannot be executed with precision without assistance. Here, as in other hydriatric procedures, the best results may be obtained only from the best technique. Unfortunately the latter is possible only in hospitals and in cases of women able to obtain assistance for each injection. The usual method of self-irrigation is faulty but must in the larger proportion of cases suffice.

Rationale.—Tepid water relaxes the vagina and facilitates cleans-

* New York Medical Journal, May 27th, 1893.

† *Ibid.*, September 29th, 1894. ‡ *Ibid.*, March 28th, 1896.

ing in ordinary leucorrhœa. Hot water on the other hand corrugates the mucous membrane, and drives the blood out of the pelvic veins, as is evident by the blanched appearance of the mucous membrane, relieving congestion. The repetition of the irrigation thus maintains the tone of the pelvic vessels, and by stimulating absorption and removing exudation furthers recovery. A warning against the abuse of these very hot injections, which have come into universal practice, may not be out of place. The frequent repetition of such injections, in conditions not requiring them, must exhaust the contractile capacity of the vessels, remove the natural secretions of the vaginal mucous membrane, and maintain an introspection which counteracts the natural tendency to recovery. Many women, married and unfortunately unmarried also, have been advised to take these injections without due consideration of the therapeutic objects in view.

Therapeutic Indications.—The chief object of vaginal irrigation is, aside from cleansing, the treatment of inflammatory conditions in the peri-uterine and vaginal structures. Surgery has very materially limited these cases, since disease of the Fallopian tubes has been discovered as the frequent source of so-called cellulitis and pelvic peritonitis. There are, however, many cases presenting distressing pelvic symptoms amenable to this simple measure. Indeed, the writer has succeeded in restoring some women to health after himself despairing of them without surgical interference. There is no doubt that the lost tone of the pelvic vessels may be restored by this treatment in connection with other measures—hip baths, glycerin tampons, and general hygienic improvement. It may be well to avoid running into the opposite extreme, by neglecting these valuable measures and resorting to surgical mutilation, which is unwarranted until all other means have been tried. In this day of facile unsexing of women this warning is not without as good reason as is the opposite, referred to above.

CHAPTER XI.

METHODS OF COOLING AND HEATING INTERNAL PARTS.

For the purpose of cooling those organs and parts of the body which are accessible to cold, water may be conducted through rubber tubes from a reservoir to an instrument which lies in apposition with the part to be treated.

The Prostatic Cooler.

This apparatus (psychrophore), devised by Artzberger for rectal cooling, consists of a metallic tube closed at its distal end, having a flattened portion at its bulbous portion, which fits the prostate gland. Dr. Alfred Wiener has modified the instrument, and describes it (with illustration)* as follows:

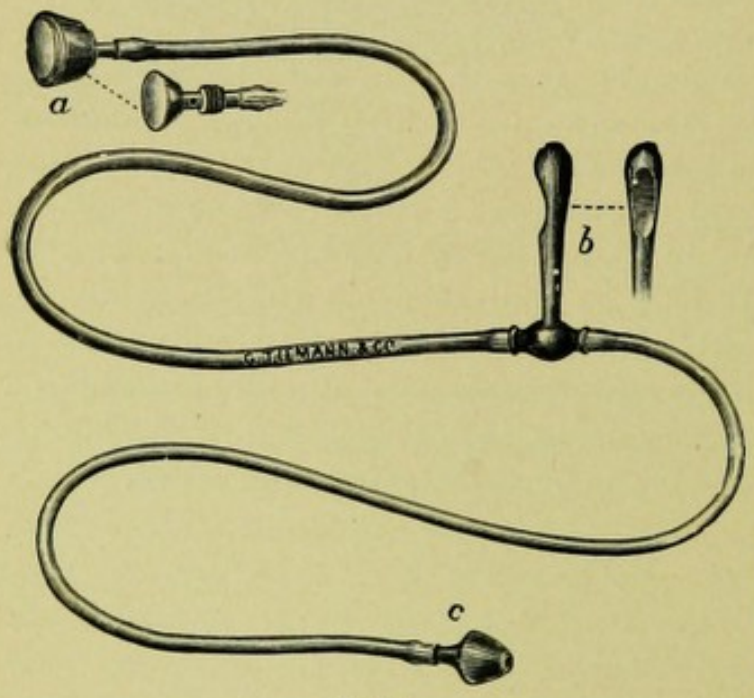


Fig. 61.

"The accompanying cut is a very good representation of the instrument. It is similar to Artzberger's cooling apparatus, which is employed abroad in the treatment of hemorrhoids. The close proximity in which this can be applied to the prostatic portion of the urethra led me to make use of it for this purpose.

"The instrument consists of a simple metallic cold-water coil, constructed in the shape of the letter T. The stem of the instrument (*b*) is narrower at the base than at the extremity, and is about one and one-half centimetres in thickness at its widest part, and one centimetre at the narrowest portion. It is bulbous at the extremity of the stem, and contains a slight concavity just below the head of the

*Medical Record, April 13th, 1895 (Fig. 7).

instrument. Thus it easily adapts itself to the rectum, the concavity fitting itself very nicely to the prostatic portion of the urethra. The application is as follows: The end is connected with a rubber bag suspended immediately above the patient, who is most conveniently placed in the recumbent position with his back to the operator. A piece of tubing long enough to extend from the couch on which the patient is reclining to a vessel on the floor is attached to the stem. Now fill the bag with ice-water, and also put into it a piece of ice to keep the water at the same temperature. The instrument is then introduced into the rectum, well oiled, with the concavity toward the scrotum. The water, which had previously been held in check by a clamp arrangement on the rubber tubing, is now allowed to flow slowly through the apparatus, and into the pail on the floor. Instead of renewing the water each time it flows into the pail on the floor, it may be poured back into the rubber bag. The application should last about ten or fifteen minutes, and should be repeated daily. The patient soon becomes accustomed to the use of the instrument, and learns very rapidly to apply it alone."

Therapeutic Indications.—Sexual neurasthenia offers the chief indication for the use of the prostatic cooler. According to Dr. Wiener, whose observations I have had abundant opportunity to confirm, before and since the publication of his paper, patients in whom the prostatic portion of the urethra is extremely hyperæsthetic, complain of frequent seminal emissions, with more or less exhaustion; the ejaculations are premature, and the erections are imperfect and of short duration, so that intromission is sometimes impossible. In some the sexual desire is very much diminished, in others it is absent. In connection with these local symptoms the patient complains of a number of neurasthenic symptoms, which, together with the former, help to make him a confirmed neurasthenic.

Dr. Wiener cites some striking clinical histories to demonstrate the value of this simple apparatus. One of these histories may be briefly reproduced as an illustration, because such patients are the bane of the physician's life, going from one office to another in search of comfort and restoration.

M. J——, aged 24; married several years; was at one time addicted to masturbation. Three and a half years after marriage he noticed that although he still retained sexual desire he was no longer able to control his erections; he was suffering from five to six seminal emissions weekly, which exhausted him so that he was hardly able to attend to his business properly. A perfect erection was an utter impossibility. This condition, together with a slight catarrhal gastritis, combined to make this patient very miserable. An examination of the penis revealed a state of affairs that one most frequently finds in this class of cases. On passing a steel sound, No. 23 French, a simple spasmodic stricture was found. The prostatic portion of the urethra was so sensitive that the patient was unable

to endure the pain. Treatment was suspended for three days, when a psychrophore was passed alternately every third day during the first week, and every day during the second and third weeks. All sexual intercourse was interdicted; no stimulating drinks were allowed; and the patient was put upon a diet consisting of plain and easily digested food. At the end of three weeks a second examination was made, and the result was so discouraging that the patient would no longer submit to this method of treatment. The sound, psychrophore, and potassium bromide were replaced by cold water through the rectum with the prostatic cooler. The result was astonishing. At the end of the first week improvement had already set in. At the end of the fourth week I could pass a sound without any difficulty. The emissions had ceased entirely. After six weeks of treatment the patient was cured. It is now three years, and he has never had a return of the trouble; the genital organs are in perfect condition.

Twelve such histories are cited, affording an ample test for this treatment. The results were uniformly favorable in all cases which had been traced.

Fig. 62.—Perineal Douche.

I have not been so uniformly successful, often finding it necessary to resort to the perineal douche. By combining these measures I have restored several unpromising cases of this type.

The Perineal Douche

(Fig. 62) is constructed by connecting the hot and cold water supply with an upright tube. The patient, seated upon a box or stool supplied with an opening through which the perineum is exposed, receives the ascending stream for from two to ten minutes directly upon this part.

Therapeutic Indications of the Perineal Douche.—In hemorrhoids, in which water at a temperature of 60°–75° is projected against protruding tumors, for antiphlogistic or astringent purposes, this douche is useful if repeated several times daily and applied with moderate pressure.

In impotence and prostatic hypertrophy the perineal douche is exceedingly useful. Several cases referred to me by genito-urinary specialists and treated by this method have afforded such satisfactory results that I would commend it as a valuable auxiliary in treating these unhappy individuals.

The Rectal Cooler.

The *cooling bladder* of Winternitz consists of a light rubber bag, secured over a perforated double-current tube, which admits of the introduction and outflow of hot or cold water. The entire apparatus is introduced into the rectum, the patient being in the recumbent posture, and the water is made to flow in and out of the rubber bladder, which is thus distended. It has been applied by Winternitz to painful hemorrhoids chiefly.

Goldenberg's Cooling Sound.

Dr. H. Goldenberg* has devised an instrument for the treatment of prostatitis.

"The original Arzberger's hemorrhoidal apparatus has proved to be a very valuable instrument in the treatment of prostatitis; owing to the early use of this instrument, not one single case went on to suppuration. Its being straight is objectionable sometimes.

"The patient, either in the recumbent position or while sitting on the edge of a chair, can introduce this instrument with ease, since it is curved and has a long handle. When *in situ*, it is not uncomfortable to the patient, even in acute cases. In the latter the protracted use of iced water is indicated; in chronic cases the writer prefers water as hot as the patient can stand."

Dr. Robert C. Kemp† has devised a rectal cooler which is quite ingeniously constructed and seems to be superior to the German instruments, which consist of a bladder and lack strength and stability.

By the use of this bag, heat or cold can be applied without wetting the patient, and the apparatus can be easily carbolized. It can also be used as a simple water-bag, by filling it and corking the openings.

Steam as a Therapeutic Agent.

The vapor of boiling water has long been used as a remedial agent, for the purpose of softening the exudation in croup, soothing the congested mucous membrane in laryngitis and pseudo-croup, and in laryngeal diphtheria. The vapor is produced by the so-called croup kettles which may be placed alongside the patient's bed. The latter is covered by several sheets secured like a canopy on a frame fastened to the bed. Several kettles are usually required; a good supply of

* Journal of Cutaneous and Genito-Urinary Diseases, May, 1896.

† American Medico-Surgical Bulletin, September 26th, 1896.

alcohol should be on hand to maintain the heat, or, what is better, one or more Bunsen burners or gas jets may furnish the required heat. The steam may be conducted under the canopy by rubber or tin tubes, the latter being superior. This method of treatment, which has been in use since the time of Trousseau, is still efficient as an adjunct in serious cases, or as a means of preventing the progress of laryngeal inflammation to the membranous stage. Every experienced physician has observed the great relief obtained from this simple practice.

Another useful application of steam is the part it plays in the Scotch douche, which is referred to in various parts of this book. For this purpose steam should be furnished by a boiler under low pressure and under perfect control.

Steam as a Styptic.

This novel application of steam was devised by Professor Snegirjow and published in the fourth volume of Professor Sacharjin's clinical lectures on therapeutics. The originator first applied steam as a styptic in uterine diseases, in the following manner:*

After dilating the cervix (without anæsthesia) and curetting the uterus, he introduced into the uterine canal a catheter having numerous openings in its distal end. The other end of the catheter was connected with the nozzle of a steam kettle. The steam was at a temperature of 100° C. After one or one and a half minutes' use of the steam its styptic and cauterizing action was noticeable; a brown bouillon-like fluid flowed from the catheter.

The operation was painless. Its effect upon the uterus was ascertained by subjecting a uterus which was about to be removed to the above treatment and examining it after ablation. The mucous membrane looked as though roasted and was covered with a thin white film; all odor disappeared entirely after this operation and the uterus was no longer sensitive.

Added to this cauterizing, anæsthetic, and deodorizing action of the steam its disinfecting and antiseptic action makes it a valuable agent.

It is especially valuable in bleeding from parenchymatous organs, and the author prophesies for it a great future in this connection.

Professor Snegirjow has removed pieces of the liver, lungs, and kidneys of animals under the use of steam, without hemorrhage.

Despite the apparently corrosive action of the steam, union takes place by first intention. This was demonstrated not only in animals but also in the human subject during a cœliotomy.

*J. Jaworski, Monatsschrift für praktische Wasserheilkunde, January, 1895.

It has also been used for the purpose of stopping hemorrhage in resection of the knee without an Esmarch bandage or ligatures; amputation of a carcinomatous breast; extirpation of growths in the skin (carcinoma, lipoma, angioma); amputation of the cervix; and in myomotomy.

The effect of steam upon a clot of blood, taken from a uræmic patient, was ascertained by Jaworski. After its application for a few minutes a thin film formed upon the clot, increasing in thickness until after the lapse of several minutes it was several millimetres in thickness. Several operations were performed, steam issuing from a Siegel apparatus and from a distilling apparatus being made to flow through a double-current catheter having several openings.

M——, 25 years of age, weak and miserable, has had an abortion with metrorrhagia; flowing for five weeks; uterus enlarged, anteflexed, and movable; external cervical opening patulous; inner not so large. Much blood in uterus. Diagnosis: Subinvolutio uteri, endometritis (decidualis), post-abortum metrorrhagia. The uterus was curetted and steam was applied after Snegirjow's method. The catheter caused slight pain on introduction, but this lasted only a few seconds. The steam was continued fifty seconds. In a few seconds a dark brown bouillon-like fluid began to exude from the catheter; at the same time an indescribably peculiar odor was noticed.

Several other cases are cited with a like favorable result in stopping discharge, bleeding, odor, and pain.

It is important to have superheated dry steam. This must have a temperature of 150°–300° C. in order to get the best results.

Following the recommendation of Snegirjow, Ludwig Pincus, of Danzig, has tested the efficiency of steam at a temperature of 100° C.* He "used an ordinary inhalation apparatus, to which he attached a safety valve. The steam pipe must be a little larger than on the ordinary apparatus. On the end of this a tube about a foot and a half long is fastened. A catheter with many openings in the end is fastened to this and is introduced into the uterus. Some sort of handle for the hot catheter is necessary. The water in the apparatus is brought to a boil and the flame is withdrawn. The catheter is then introduced and the lamp again lighted."

This author has used this instrument in:

1. A case of carcinoma uteri with profuse bleeding, fetid discharge, and severe pains in the pelvis.

2. In three cases of cervical endometritis with profuse discharge.

In the case of carcinoma the bleeding and discharge stopped entirely after several applications of the steam. After one or two minutes there was a discharge of clots and particles from the cervix. In the cases of endometritis the author found that the cervix was enlarged and

* Centralblatt für Gynäkologie, 1895, No. 11.

the discharge and bleeding were invariably improved. The operation is entirely painless. In only one case did uterine colic ensue.

As the method recommends itself on theoretical and bacteriological grounds, I would suggest that it be tried in cases of puerperal endometritis.

Dr. Otto Kiliani discusses the use of steam for the severe hemorrhages which sometimes occur in the operation of cholecystectomy on separation of the gall bladder from the liver, the latter sometimes being torn.* Especially in obese persons such bleeding may be fatal. The danger from hemorrhage is always enhanced in cholæmic persons. Referring to the Russian publication, Dr. Kiliani states, that having occasion to do many gall-bladder operations, he experimented with Dr. Schwyzer upon rabbits. Exposing a kidney, he cut it in half and stopped the bleeding instantly by steam. Then he extirpated the kidney and stopped the flow of blood from the renal artery and vein. The abdominal wound was superficially stitched, and the animal recovered completely. The cooking-process by steam has no deterrent effect upon primary union. The effect of steam upon the tissues is slow, coagulation is superficial. For stopping the flow of blood from the severed femoral artery of a dog, steam was applied three-quarters of a minute.

Dr. Kiliani demonstrated a simple apparatus which he is now perfecting. He has applied steam as a styptic in one gall-bladder operation and in two operations for hepatic abscess, and found it very convenient. In one case of abscess he found it necessary to make an incision through two inches of liver tissue, which by means of steam was rendered completely bloodless. Besides the possibility of scalding the patients or the operator by clumsy management, the chief disadvantage of using steam as a styptic lies in the fact that all the tissues touched by it assume the color of boiled flesh, and thus the different structures cannot be distinguished.

I have had no opportunity to test the mode of applying steam, and refer to it for the purpose of demonstrating the flexibility of water as a remedial agent and the fact that it may be applied in any form from ice to steam.

*New Yorker medicinische Monatschrift, February, 1897.

CHAPTER XII.

THE INTERNAL USE OF WATER.

The importance of water for the maintenance of the human organism is a trite physiological fact. It not only furnishes a solvent for the various elements required in the life and death of the tissues, but it serves to maintain that degree of tension in the tissues which is requisite for the proper circulation of the lymph stream.

Just as the external application of water upon the body influences the latter by reason of its temperature and pressure, so does the internal use of water furnish similar physiological action upon the circulation, respiration, digestion, temperature, tissue change, and secretion, but in a much less degree.

Glax* has furnished a *résumé* of the most recent investigations on this subject.

The pulse is affected according to the temperature of the water taken, cold water reducing the frequency by from six to thirty beats. Glax has seen a reduction from 80 to 49 beats from the drinking of 1,250 c.c. (45 oz.) at 6° C. (43° F.) in five doses of 250 c.c. (9 oz.) within thirty minutes.

Warm water increases the pulse by from ten to sixteen beats. The character of the pulse is also affected by the drinking of large quantities of water. Glax and Klemensiewicz furnish sphygmographic pictures of this change, taken from the brachial artery, together with the respiration curves:

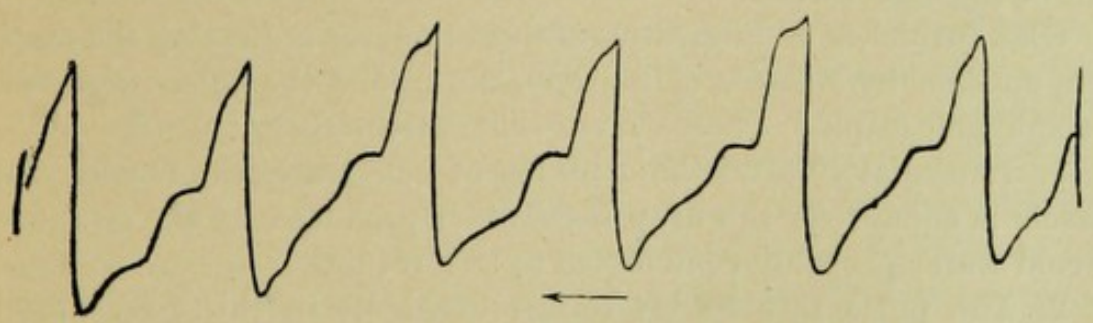


Fig. 63.—Before drinking 2,500 c.c. water at 6° C. (42.8° F.).

* "Lehrbuch der Balneotherapie," 1897.

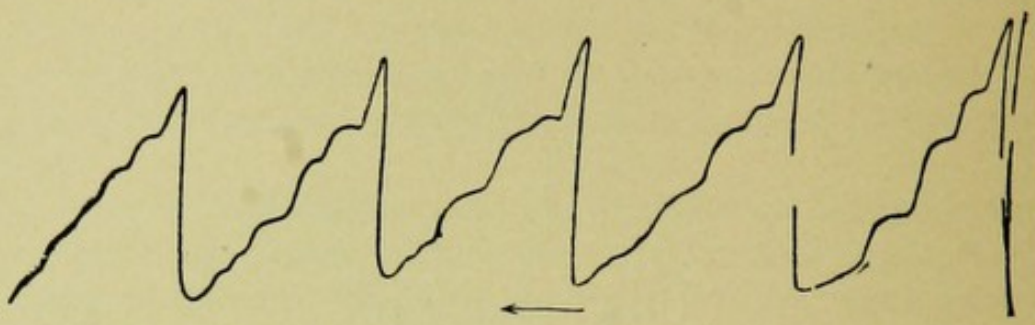


FIG. 64.—After drinking 2,500 c.c. water at 6° C.

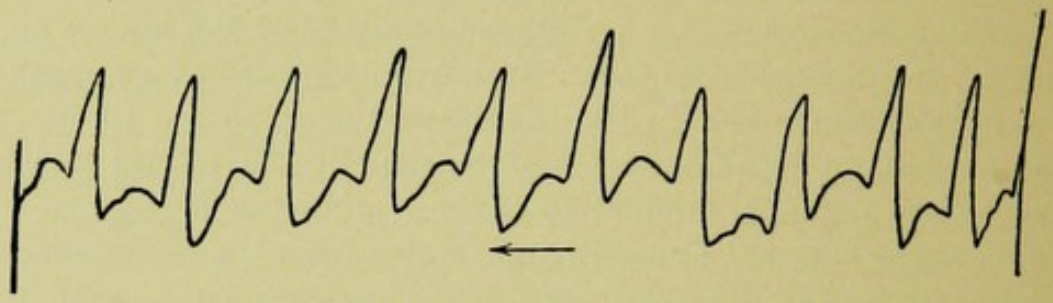


FIG. 65.—Before drinking 500 c.c. water at 56.2° C.

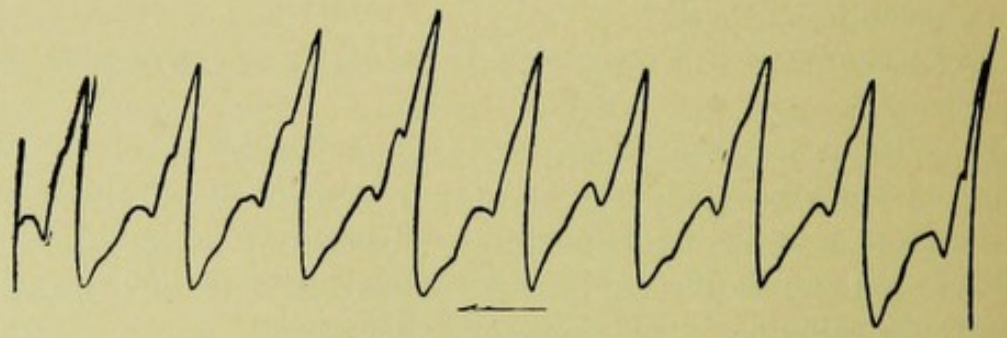


FIG. 66.—After drinking 500 c.c. water at 56.2° C. (151.6° F.).

These tracings clearly show that the imbibition of cold water not only lessens the frequency of the pulse, but improves its quality and the arterial tone, while the drinking of warm water produces a relaxation of the vessel walls.

Glax furnishes an interesting series of curves indicating the respiration, outlined by Marey's cylindre élastique, and the pulse indicated by the sphygmograph. These curves show distinctly:

1. Immediately after the drinking of cold water the tension in the vessels is enhanced; the deep inspiration produced by the swallowing of cold water probably contributes to this result.

2. The pulse rate begins to fall decidedly in thirty seconds, but a positive increase of tension in the arterial wall is not present, though occasionally the dicrotism is more pronounced.

3. A few minutes after the drinking of water at 6° C. (43° F.) the heightening of arterial tension is quite plain.

4. The repetition of the dose, in, say, five or eight minutes, continues to reduce the pulse and increase arterial tension.

5. The respiratory movements are increased after a large quantity (1,000–1,250 c.c., 35 to 43 oz.) of water is taken.

The effect of *warm-water drinking* on the pulse was studied by Glax and Klemensiewicz in a diabetic patient, thirty-two years old, who showed that an increase of pulse rate and diminution of arterial tone and an increase of respiration ensued after the drinking of warm water; also that an enduring relaxation of the arterial walls was produced by the methodically prolonged drinking of warm water. Friedrich and Stricker have made exact experiments with the drinking of seven ounces of water at different temperatures, ascertaining the pulse and pressure with the metallic sphygmometer of Basch on the radial artery. They found that the effects of water taken internally appear very quickly. Cold water diminishes the pulse, and generally raises the blood pressure, unless it be very cold, when it diminishes it in some cases; while hot water, on the contrary, increases the rapidity of the pulse and raises the blood pressure, and lukewarm water (77°–86°) diminishes it. The lowering of blood pressure is in proportion to the lowering of the temperature of the water drank, the contrary effect being produced by higher temperatures. Water at a medium temperature (60° F.) has very little effect.

The rapidity of the effect is enhanced by extreme temperatures, but the effect ceases entirely within twenty minutes.

Glax says correctly that the changes in the pulse ensue too quickly after the drinking of water of different temperatures to be the result of an increase of water in the blood; they are therefore very probably the result of a reflex action upon the vasomotor centres. The latter effect was actually demonstrated by the experiments of Spallita and Tomasini, who found after the imbibition of cold water a narrowing of the cutaneous vessels.

It may therefore be stated with some degree of positiveness that *the internal use of cold and of warm water has a definite influence upon the vasomotors*, not unlike that produced by their external application.

The effect of the drinking of large quantities of water upon the blood and upon blood pressure has also been studied also by Friedrich and Stricker. The larger the quantity of water (above 200 c.c.) drank, the greater is the effect upon the blood pressure and the more enduring is the effect, which, however, does not continue for more than three and one-half minutes. The imbibed water begins to appear in the tissues in one hour, and the entire quantity is eliminated within three and one-half

hours; large quantities (1,000 to 2,000 c.c.) being relatively more rapidly thrown off than smaller quantities (500 c.c.). The most recent investigations of Oertel and others demonstrate positively that the drinking of an abundant quantity of water produces an evanescent thinning of the blood. As the healthy organism is so constituted that it rapidly eliminates water taken internally, it follows that an hydræmic plethora is impossible, even when great excess is committed. On the contrary, the abundant use of cold water really acts as a diuretic, removing even water not imbibed. Warm water also increases the urine for a short time, according to Glax, but if its use is continued the urine is diminished and perspiration increased.

The diuretic effect of water-drinking does not depend upon the quantity imbibed, as is erroneously supposed, but rather upon an increase of blood pressure produced by the irritant action of cold and the consequent increased rapidity of the blood streams in the kidneys. For this reason it is absent when water is drank lukewarm, and when the heart is not sound. Hot water, having the same irritant action, also stimulates cardiac action and produces an increase of blood pressure, but the latter is evanescent. This may seem on first glance a reversal of a long-established belief, but a consensus of modern physiologists has established the fact that the elimination of fluid by the kidneys depends upon the pressure with which the blood circulates and the consequent enhanced force of its stream in those organs, and not so much upon the quantity of fluids imbibed.

Not only are the fluid portions of the urine increased by the drinking of large quantities of water, but the elimination of solid constituents, especially of urea, also results from it. That this result is not, however, due to an increased breaking up of albumin, but simply to an enhancement of the solution and consequent better elimination of nitrogen from the tissues, is established by the investigations of Oppenheim and confirmed recently by von Noorden.*

Other secretions are also increased by the drinking of water abundantly, by reason chiefly of a reflex effect upon the secretory organs. Heidenhain and other physiologists have noticed an increase of saliva and bile, by reason of reflex excitation of the nerves controlling the vessels of the glands.

Peiper claims to have ascertained positively that the drinking of even larger quantities of water has but slight influence upon the perspiration, especially if the water be cold. But lukewarm water increases cutaneous secretion decidedly. This view is shared by Glax.

The immediate increase of perspiration so commonly experienced in warm weather after the partaking of a glass of ice water would at

* "Lehrbuch der Pathologie des Stoffwechsels," 1893.

first glance gainsay these statements; but the fact should be borne in mind that these experiments of Peiper and Glax are exact, and the effects obtained by them were not momentary but enduring.

Therapeutic Indications.

From the above-mentioned physiological data with regard to the action of cold, warm, and hot water taken into the stomach, their application in diseased conditions is self-evident.

In acute infectious diseases the administration of six or eight ounces of cold water every two hours increases the urinary secretion enormously. I have seen the quantity rise from thirty to one hundred and twenty ounces in six days. The elimination of toxins, which is thus promoted, adds a powerful weapon in the battle with these treacherous maladies and seconds the cold bath very materially in this direction.

In diseases of the stomach the drinking of hot water has long been recommended as an adjuvant to other treatment. A glass of cold water taken on an empty stomach is regarded by some as a good stimulus to peristalsis.

Gastric Catarrh.—The chief therapeutic application of water-drinking, however, has been in catarrh and other stomach disorders in which there is an accumulation of mucus or fermenting material; and for this purpose hot water alone has been found useful. Besides its diluent, cleansing, and antiseptic effects upon the mucous membrane and contents of the stomach, the reflex effect of water at high temperature, slowly sipped, upon the muscular coats, is to produce enhanced motor capacity, which furthers the passage of the food into the duodenum. In order to accomplish this therapeutic aim, it is necessary to observe certain rules in the administration of hot water, which not only have the sanction of experience, but which are also justified by proper regard to the *rationale* of its action. The water must be so hot that it cannot be gulped down rapidly; it must be sipped by tablespoonfuls in order to obtain the reflex stimulating effect upon the blood-vessels and nerves, and consequently upon the muscular fibres of the stomach. The quantity thus taken must be not less than half a pint and not more than one and one-half pints, in order to obtain a thorough cleansing and yet not overdistend the organ. The water must be taken not less than half an hour nor more than an hour before one or more meals, in order to insure its removal from and sufficient rest for the stomach before food enters it. These conditions being carefully fulfiled, there is no remedial agent which affords so much comfort and expedites recovery more effectively in *subacute and chronic gastric catarrh, dilatation of the stomach,* and in some forms of *gastric neuroses,* than the sipping of

hot water before meals. The latter is much abused by the lay people in all these affections, but especially in gastric neuroses. Such patients rarely come under the physician's notice without having partaken of hot water abundantly in all sorts of fashion, mostly, however, just before eating—a practice which is always hurtful, because it distends the stomach, dilutes the food entering it, and thus embarrasses the digestive process. Jaworski found in the stomach after the lapse of a quarter of an hour half of the quantity of water drank, but none remained after the lapse of half an hour, the passage of water from the stomach differing according to its temperature, that of *warm water being slower than that of cold water*. Physiologists are almost unanimous in the belief that only the very smallest quantity of water is absorbed from the stomach. Hence the necessity of allowing some time to lapse between the drinking of hot water for therapeutic purposes and the subsequent meal.

This simple procedure, therefore, illustrates the importance of precision in the methods of hydrotherapy; also the idea that these are invariably based upon rational principles—important facts which the author has endeavored to impress upon the reader upon every possible occasion.

In certain infantile diseases the internal use of hot water is often effective. The clearing of the stomach by forced drinking of warm water through the nursing-bottle has often proved advantageous in my practice. When in the pulmonary affections of young infants the bronchial tubes become blocked by secretions, or the stomach is filled by swallowed mucus, *warm* sweetened water is readily taken through the bottle or from a spoon or cup, and acts as an emetic with great relief.

CHAPTER XIII.

PRACTICAL APPLICATION OF HYDROTHERAPY IN ACUTE AND CHRONIC DISEASES.

Under the caption "Therapeutic Indications," the foregoing pages contain many references to the application of hydrotherapy in disease. These references are necessarily brief, and apply only to the diseases in which certain procedures are indicated.

That hydrotherapy is a complex method of treating disease, which admits of many different procedures applicable to the varying conditions arising in each, will be evidenced in the following clinical portion of this work. Without any desire to depreciate their use or value, it may be asserted that medicinal agents, even the most efficient and powerful, are not capable of much flexibility. Antipyrin, for example, which reduces the temperature in the early stage of fevers, cannot be used safely as the disease advances, when the integrity of the heart becomes more and more impaired; there is no method of adapting it to varying conditions, except in the size of the dose, and, owing to certain depreciating effects, the dose is necessarily always made as small as possible, and the extent of its effect is thus limited.

Our most trusted medicinal agents—digitalis, aconite, chloral, salicylic acid, opium—have their fixed doses and methods of application. Even iodide of potassium and quinine and mercury, our only specific medicinal agents, are susceptible of variation in doses; but their limitation is fixed, and we cannot produce one practical result with one method of administration or with one dose, and another result with another, according to patients' conditions and the demands of each disease.

This reference to the limitations of medicinal agents is not intended to deprecate their use. On the contrary, the author yields to no one in appreciation of their value, derived from thirty-five years' application at the bedside.

In hydrotherapy the physician possesses the most *flexible* agent of his entire therapeutic armamentarium, an agent which he may adapt, by reason of the great variety of procedures and the large latitude in temperature, duration, and pressure, to every stage of every disease in

which it can be applied at all. Indeed, the necessity for its *correct use* in any disease exemplifies this proposition.

In the following pages, it is my purpose to enter into a detailed account of the application of water in some of those diseases which the physician encounters most frequently.

Typhoid Fever.

In the chapter on typhoid fever it has been the chief aim of the author to show that it presents the most frequent, if not the only, therapeutic indication for the cold full bath, and to marshal such evidence in support of this proposition that the most sceptical reader may find it difficult to cavil. While, however, the Brand method has been proved to be the most successful treatment of the disease, there are some cases to which it is not adapted, and there are many others in which the diagnosis is obscure in the first stage, but which would be advantageously treated by some other form of hydrotherapy, with the result not only of affording comfort for the present but also of insuring safety for the future. As a practical lesson the author purposes to present the methods he has found most useful in mild and in severe cases of typhoid fever. A careful examination of the patient having established the approximate diagnosis of an essential fever, the comfort of the patient is at once provided for by some mild hydriatric procedure. If the temperature be persistently over 102°, ablution, beginning with water at 80° and reducing the temperature of the water five degrees at each repetition, is practised every hour until the water temperature reaches 60°, at which it is continued. Wet compresses are also applied hourly over the abdomen until the body temperature registers 100°, every half-hour if it registers above 103°. Ablutions (page 82) are ordered every two hours, in the same relation to the temperature. If the latter continues high, larger quantities of water are used in ablution, and the compress is applied every half-hour. If the diagnosis becomes more suspicious of typhoid, I order a tub bath given in the bathroom, beginning with water at 90°, continued for fifteen minutes and repeated every four hours, the bath temperature being lowered five degrees with each bath, until 70° are reached. If the body temperature is not reduced over one and one-half degrees by these baths, they are continued until the diagnosis of typhoid is positive.

The compresses are applied during the interval between the baths. The patient has now received a sufficient number of baths to display his reactive capacity. As soon as the diagnosis is made, a portable bathtub of tin is placed alongside the bed, from which it is separated

by a screen. This is filled with water at 65°–70°, as indicated, and now the strict Brand method is pursued.

Such is my regular procedure in every case of typhoid, when no obstacles are placed in my path by relatives or by the patient. Although the latter contingency has rarely occurred to me personally, it would seem from my correspondence that many doubts arise in the minds of careful practitioners. These may be met by consulting the chapter on objections, on page 175.

There are several procedures open to the practitioner which may enable him to meet prejudice or ignorance, provided he has mastered the principles guiding his technique.

RÉSUMÉ.—That the treatment of typhoid fever presents the most pronounced example of the therapeutic advantages of water in acute diseases is well illustrated by its *rationale* and clinical results. The following methods are at the disposal of the physician:

1. Ablutions and compresses until temperature reaches 103° F., or when strict cold baths are impracticable.

2. The strict cold bath or Brand treatment—a bath at 65° F. for fifteen minutes, whenever the temperature reaches 102.5° *in recto*. The statistical result (reduction of mortality to 2.7 per cent) corroborated, as has been shown, in various countries, declares this to be the treatment *par excellence* of typhoid fever. This bath was first presented to the consideration of English-speaking physicians in February, 1889.* Although the author's plea excited much unfavorable comment and frequent opposition at that time, the method is now taught and practised by Delafield and Peabody, of the College of Physicians and Surgeons of New York; by W. Gilman Thompson, of the University of the City of New York; by J. C. Wilson, of the Jefferson Medical College of Philadelphia; by James Tyson and Horatio Wood, in the University of Pennsylvania; by Osler, in the Johns Hopkins University; and in many other medical schools.

3. If for any reason the Brand bath cannot be systematically given, or if the attendant is not convinced of its necessity, recourse may be had to the Ziemssen half-hour graduated bath, in which the water at 90° F. is gradually reduced to 70°. Ziemssen especially recommends these baths as most useful in private practice, after an experience in several thousand cases during twenty years. He orders the temperature according to the patient's condition.

4. In a weakly, nervous patient, in the second week of a neglected typhoid, only five to ten minute baths of from 88° to 92°, followed by brief cold affusions or a wet pack (page 101), should be risked. The temperature of the water may then be reduced if the effect is satisfac-

* New York State Medical Society, 1889.

tory, and the number and duration of the baths may be increased. The sum of all the symptoms and the influence of the bath upon the entire case, and not the temperature effect alone, should be the guide.

The statistical record of the Ziemssen treatment in the Tübingen University Clinic, from 1877–87, in two thousand cases, gave a mortality of 9.6 per cent (page 140).

5. The hammock bath of Riess (page 200) offers a valuable substitute for timid practitioners or timid patients; its statistical results are more favorable (8.5 per cent mortality) than those of the graduated cold bath.

6. The wet pack has been used by some; but experience has shown its inadequacy as an antifebrile agent and even as an antithermic agent. Liebermeister has shown that four wet packs, of ten minutes each, are equivalent to a cold bath of ten minutes. I have ascertained that six wet packs would be equivalent to a Brand bath. The choice between these methods is therefore easily made.*

* THE EXPECTANT TREATMENT OF TYPHOID FEVER.—In a recent number of the *Medical Record*, Dr. Arnot Spence, of New York, has an interesting paper on the expectant treatment of typhoid fever, founded on the results in 323 cases treated in the St. Francis Hospital of New York City, under the care of Dr. J. H. Ripley. Of the 323 patients 47 died—a mortality of 14.23 per cent. Of the 47 deaths 12 occurred within forty-eight hours after admission. If these are omitted, the death rate is reduced to 11.25. A specially interesting part of the report is that relating to the cause of death. Leaving out the twelve moribund, we have eleven cases which were fatal either from hemorrhage or from intestinal perforation, the remainder being due to the direct exhausting effects of the poison. Dr. Spence appears to be well satisfied with the results of treatment. In the face of results obtained by the Brand treatment, it is strange to think that any physician should be satisfied with having a no greater mortality than 11 per cent. Brand and his followers would claim that twenty, at least, of the deaths in the cases reported might have been prevented by the cold-water treatment. It is claimed, and we believe with justice, that the cold-water treatment practically eliminates deaths from broncho-pneumonia and those due to cardiac failure from direct action of the poison. Fully one-half of the deaths in Dr. Spence's tables were caused by the above conditions. It is more than probable that, had a strict hydriatic treatment been carried out, the rate of mortality would have been nearly a half less. In private practice the difficulties in carrying out the cold-bath treatment are often very great, but in a hospital the only excuse for not following this method of treatment is a belief in the efficacy of other modes of dealing with the disease. From the results obtained by the hydriatic treatment in Europe, and also on this side of the Atlantic, we believe that there is overwhelming proof that the death rate is much lower (probably from four to six per cent) than by any other mode of treatment.

Further, convalescence is undoubtedly shortened. That long period of physical and mental debility, so common and so marked after severe cases of typhoid, is seldom or never met in cases treated with cold water.—*Montana Medical Journal.*

If, as those most experienced in the method are agreed, our therapeutic efforts are directed to maintenance of the systemic functions, *we have in the methodical application of cold water the most effective means, because it not only reduces the temperature, but it refreshes and vivifies the nerve centres which preside over the functions upon whose integrity depends the nutrition of the patient.* Any judicious application of cold water will prove beneficial, but experience demonstrates that the more nearly we approach the ideal Brand method, the more positively satisfactory will be the results. The author would call attention to the fact that he has endeavored to present the subject of typhoid fever treatment fairly, imbued with the solemnity of a task which may be the means of saving large numbers from the fatal grasp of this relentless scourge. The evidence before us is clear and incontrovertible. Upon our conscientious, unbiassed, and fearless judgment and action rests the weal or woe of those who commit their lives into our keeping. No physician is expected to yield his own judgment and the results of his own experience in deference to any method, be it approved by ever so eminent an authority. But every true physician is in duty bound to examine the *rationale* and the clinical results of such a method, ere he condemns it.

This somewhat lengthy discussion may facilitate the study of the most important therapeutic method of the present time.

Clinical Illustrations.—The flexibility of hydriatic methods and procedures, which may be utilized in varying conditions and aspects of typhoid fever, are illustrated by the following histories from the hospital and private records of the author. A careful perusal may serve the reader as a guide in similar emergencies.

Case I.—*Typhoid Fever with Acute Infectious Nephritis—Treated by Ablutions, Abdominal Compresses, and Free Internal Use of Water—Recovery.*—M. W——, aged thirty-five years, a patient of Dr. Simpson, residing at Hotel Majestic, had a chill on the 20th of September, 1897, followed by fever. Temperature ranged from 102° to 106°, and pulse from 120 to 140. Urine, examined by Dr. Simpson, contained albumin and granular casts; quantity excreted, twenty-five ounces in twenty-four hours. Patient exceedingly nervous, sleepless, sometimes delirious, throwing towels at the nurse, etc., and altogether in an unpromising condition. On the 24th the quantity of urine passed was twenty-seven ounces. The treatment up to this time had been homœopathic, combined with alcohol sponges; diet, milk. On September 25th this treatment was discontinued and the following ordered: Five drops of dilute hydrochloric acid (placebo) every two hours in water, followed by six ounces of cold water, alternating with six ounces of milk every two hours; an abdominal compress at 60° every hour. Tub bath at 85° when temperature reaches 103°.

September 25th, urine contained albumin and casts. Temperature, which had reached 103° on the previous day, fell to 101° after the above hydriatic treatment had been instituted. It fluctuated between 101° and 102.5° for five days,

then gradually subsided until it reached normal on October 13th, reaching every day above 99°.

The pulse never exceeded 100 after this treatment was instituted, and averaged 80 during the last two weeks. The urine showed the most marked change. After the first twenty-four hours of this simple water treatment 60 ounces was passed; then followed 87, 92, 98, 117, 113, 123, 90, 116, 82, 109, 82, 112, 81, 83, 90, 76, 86, 86, 90, 70, 80, 82, 79, 60 oz., by exact measurement of the nurse, Miss Trousdell. Albumin and casts disappeared in ten days. This case illustrates that a severe type of typhoid fever may be modified and carried to a successful issue by simple hydriatic measures without cold baths.

That ablutions are a very efficient procedure in typhoid fever is demonstrated by the report of Dr. Cabot,* who has gathered the results of one thousand cold baths given in the Massachusetts General Hospital, two hundred being Brand baths (65°, twenty minutes with friction) and eight hundred being sponge baths, of from ice cold to 65°, according to the patient's temperature, the patient lying on a rubber sheet and having the water squeezed over him from a sponge and being *well-rubbed* with the latter. The reduction of temperature from the Brand bath averaged 2.4 degrees; the reduction from sponge baths 0.4 degrees. Fewer tub baths were needed; most patients liked the sponge baths, but none liked the tub baths. The results were the same after each. As a rule the tub baths produced shivering, cyanosis, and feeble pulse.

This report offers an excellent showing for sponge ablutions with friction, but I am disposed to believe that there was some defect in the technique of the bath, to which persistent cyanosis and feeble pulse may always be traced. Indeed, when the latter occurred, Brand himself never continues the bath at 65°, nor for twenty minutes. In such cases either the bath should be shortened—Brand's rule is to remove patient from the water at any moment when cyanosis ensues—or it should be given at 70° or 75°. Here again the importance of following Brands' technique strictly is illustrated.

CASE II.—*Typhoid Fever Treated at Home Eleven Days without Baths—Brought to Hospital in Desperate Condition—Brand Baths and Affusions Change Aspect of Case—Recovery.*—Abstract 830, furnished by Dr. Rossman, house surgeon of J. Hood Wright Memorial Hospital. E. J. C——, aged twenty-seven years, admitted by ambulance, November 14th, 1896. Visiting physician, Dr. Baruch; house physician, Dr. Lewald.

History: Thirteen days under treatment for typhoid fever by Dr. Frank Daniels; temperature ranging from 103° to 105°, pulse from 120 to 150; delirious, actively at first, now muttering.

Present condition: Is stuporous; responds when sharply spoken to; tongue dry and brown; teeth covered with sordes; skin much congested; abdomen distended, tympanitic, shows several rose spots.

* Boston Medical and Surgical Journal, 1894, p. 290.

Ordered milk, ℥ vi., and lime water, ℥ ii., every three hours.

℞ Dilute hydrochloric acid ..... ♏ v.
Water ..... ℥ vi.
S. Every three hours alternating, with milk every two hours.

Tub baths at 80°, reduced five degrees each until 70° is reached, for fifteen minutes every three hours, when temperature reaches 103°.

November 15th.—Abdominal distention more marked. Has received three baths during the night, causing a fall of one degree. Subsultus and mental torpor still present. 9 P.M., turpentine, ♏x. every three hours. Temperature, 102.2°. Affusions, 60°, to head and shoulders, to relieve stupor.

November 16th.—Affusions at 3 and 6 A.M. Passed forty-five ounces of urine during past twenty-four hours, containing albumin, hyaline and granular casts. Mental condition improved.

November 17th.—Two affusions and three baths given yesterday. Subsultus continues; is more stuporous. Two ounces of strong hot coffee before and after baths and affusions. Affusions every two hours, alternating with baths every two hours; omit whiskey. Temperature remains below 103°. Enema (turpentine) removed distention.

November 18th.—Mental condition the same. Affusions continued.

November 19th.—Mental condition improved. No tympanites.

November 20th.—Tongue moist, appears almost rational, and asks questions.

November 21st.—Temperature, 101° Affusions (cardiac tonic) given every four hours. At 9 P.M., temperature rose to 104°; pulse, 120. Tub baths given at 70°; compresses at 60° after bath. Half an hour later, temperature, 103.8°; at 12 P.M., temperature, 105°.

November 22d.—Three baths given during the night. Abdomen distended. At 9 P.M., temperature, 100°. Affusions continued.

November 23d.—At 3 P.M., last affusion.

November 28th.—For the past four days the temperature has been between 100 and 102.8°. Half-pack, 65°, every hour.

November 29th.—At 6 P.M., temperature, 103.4°; full bath given at 70° for ten minutes.

November 30th.—Fæces contains clots.

December 1st.—Examination of blood, responsive to Widal.

December 2d.—New spots on abdomen.

December 4th.—Temperature, 103°; three baths at 70°.

December 5th.—Three baths, 70°, for ten minutes.

December 7th.—Two baths.

December 9th.—Four baths.

December 11th.—Temperature normal.

December 15th.—Abscess in lower sacral region incised by Dr. Baruch; six ounces of pus; drain introduced.

December 20th.—Eats light pudding. Sacral wound healed.

January 1st, 1897.—Dr. Knickerbocker attending.

January 2d.—Temperature rose suddenly to 103°; pulse, 132; respirations, 24. At midnight temperature fell to 100°.

February 1st.—Patient discharged cured.

Dr. Frank Daniels, who had treated this desperate case until the patient was transferred to the hospital, reported it to the Harvard Medical Society, with the following comments: "I have no doubt whatever that

this man was saved by the application of the Brand baths and cold affusions to the head and shoulders. This case shows, better than any other I could present, the advantage of this method of treatment. Begun as it was late in the course of the disease, *i.e.*, at the end of the second or the beginning of the third week, it still was efficacious."

CASE III.—*Desperate Case of Typhoid—Hypostatic Pneumonia—Ablutions—Wet Compresses and Internal Use of Cold Water—Recovery.*—Mrs. P——, aged forty-five years, seen by the author with Dr. E. J. Ware at midnight, February 13th, 1895. The patient's condition was so desperate that a midnight consultation was held. When I arrived at the house she was engaged in a sad leave-taking from the family. The patient had been seen by several other consultants during the protracted course of the disease, and hypostatic pneumonia had developed which failed to yield to the best-directed treatment. Hypodermic stimulation had been freely used several hours before I saw the patient. A compress, wrung out of water at 60°, covered with a flannel bandage and enveloping the chest, was advised, to be repeated half-hourly; also gentle ablutions of the trunk with water at 70°, followed by drying of each part for the purpose of producing reaction before another part was attacked; and the systematic administration every two hours of six ounces of water. This simple treatment revived the flagging heart, visibly deepened the inspirations, and refreshed the patient. On the following day her voice was stronger, and she expressed herself as much improved. The case progressed very slowly to a favorable termination.

CASE IV.—*Typhoid Fever—Third Week—Baths at 70°—Recovery.*—Mr. P——, aged thirty-five years, was seen with Dr. L. A. Rodenstein, who had treated him skilfully with cold baths at 80°, five to ten minutes in duration, several times daily. The patient was in a precarious condition—muttering delirium, picking at the bedclothes; pulse, 140; subsultus and stupor. Baths of 70°, fifteen minutes in duration, with friction, and affusions at 60° F. over the head and shoulders, were suggested. The patient being well advanced into the third week, four baths effected such a change in his condition that recovery became assured. The first bath with affusions restored consciousness.

CASE V.—*Case of Typhoid Demonstrating Diagnostic Significance of Bath, and the Value of Various Medicinal and Hydriatric Procedures. From the Records of the Manhattan General Hospital.*—W. C——, married, aged thirty years, domestic. Admitted May 8th, 1893. Attending physician, Dr. Baruch; house surgeon, Dr. Covert. History (abbreviated): A week ago she was taken sick with pains all over the body, headache, and general malaise, which have continued up to the present time. Lungs normal; heart sounds clear; pain on pressure in right iliac region. Tongue coated brown. Temperature, 102.2°. ℞. Calomel, gr. viii. Milk diet.

May 9th.—Three hours after her admission, temperature was 105.2°. Calomel caused three movements; she feels better; pain in abdomen still severe. Temperature, 103.2°.

May 10th.—Has had five movements this morning. ℞. Morphine sulphate, gr. ⅛, suppository. Temperature, 105.4°. *Tub bath, water at 95° reduced to 85°*, to be given every three hours for fifteen minutes when rectal temperature is 102°. Reduce temperature of water two degrees each bath, till 65° is reached. Naphthalin, gr. v., every four hours; dilute hydrochloric acid, ♏ x. and water, 6 oz.,

every four hours. Temperature at 7 :10 A.M., 105.4°. Bath given. Temperature before bath, 105.4° ; pulse, 116 ; respiration, 28. Temperature after bath, 105° ; pulse, 112 ; respiration, 28. Temperature one-half hour after bath, 105.2° ; pulse, 118 ; respiration, 28. Bath at 11 A.M. Temperature before bath, 105.6° ; pulse, 116 ; respiration, 29. Temperature after bath, 105° ; pulse, 116 ; respiration, 29. Temperature one-half hour after bath, 105° ; pulse, 116 ; respiration, 28. Although the patient has by her clinical history been ill nine or ten days, no spots have appeared and there is no splenic enlargement.

The diagnosis was obscure. *It was at once cleared up by the resistance of her temperature to the baths.* The writer has frequently noted this symptom in the early stage of typhoid, and also the fact that in other diseases simulating it, as miliary tuberculosis, central pneumonia, etc., the temperature yielded readily to the ordinary reduced bath. A diagnosis of typhoid fever was now unhesitatingly given.

May 11th.—A few rose-colored spots have appeared on the abdomen. Bath at 11 : 30 A.M., 90° reduced to 80°. Temperature before bath, 104.2° ; pulse, 114 ; respiration, 28. Temperature after bath, 104° ; pulse, 112 ; respiration, 28. Temperature one-half hour after bath, 103.4° ; pulse, 112 ; respiration, 26. Patient does not react well ; shivering continues ; nails cyanosed. Hence it was determined to try the Riess continuous (Hammock) bath for its antithermic effect, until the system was in better condition to resume the regular bath treatment.

Ordered continuous bath, 88°, when patient's temperature reaches 102.5°, till mouth temperature is 101°. Placed in bath at 4 P.M. Rectal temperature before bath, 104.4° ; pulse, 112 ; respiration, 28. One hour in bath, mouth temperature, 102.6° ; pulse, 112 ; respiration, 32. Two hours in bath, mouth temperature, 101.4° ; pulse, 112 ; respiration, 32. Three hours in bath, mouth temperature, 102° ; pulse, 112 ; respiration, 30. Four hours in bath, mouth temperature, 103° ; pulse, 112 ; respiration, 30. Five hours in bath, mouth temperature, 103° ; pulse, 112 ; respiration, 30. Had a chill and was taken out of bath. After bath, rectal temperature, 102.2° ; pulse, 112 ; respiration, 32. One-half hour after bath, rectal temperature, 102.2° ; pulse, 112 ; respiration, 32.

May 12th.—Placed in continuous bath at 88° at 6 :15 A.M. Rectal temperature before bath, 103° ; pulse, 112 ; respiration, 38. Patient became very much wearied while in these baths. Although they reduced her temperature, the typhoid countenance did not improve in them, nor was the heart action improved, demonstrating that this method is only an antithermic procedure, which, though far superior to chemical antithermics, cannot approach the Brand bath as a true antifebrile agent.

Continuous baths omitted. Patient being now in better condition, Brand bath for twenty minutes, temperature 65°, every three hours if temperature reaches 102.5. At 7 :10 P.M., before bath, temperature, 103° ; pulse, 108 ; respiration, 34. After bath, temperature, 103° , pulse, 108 ; respiration, 34. One-half hour after bath, temperature, 101.8° ; pulse, 106 ; respiration, 34.

May 13th.—New crop of spots on abdomen numerous. Bowels still loose and movements green in color.

Irrigate bowels with water (temperature, 100°), two pints, followed in one-half hour with starch water and tincture of opium, gtt. l.

May 14th.—Brand baths were continued every four hours until the 17th, after which time the body temperature did not reach the bathing temperature.

May 17th.—Patient feeling much better. Temperature at 8 A.M., 101°. Diarrhœa has nearly ceased, but movements are still green in color.

May 27th.—These baths, which have been given every three to five hours, produced decided reduction of temperature, as evidenced by the last bath; showing the greater antithermic efficiency of the Brand bath in the later days of the disease.

Before bath, temperature, 104.2°; pulse, 121; respiration, 30. After bath, temperature, 101.4°; pulse, 114; respiration, 32. One-half hour after bath, temperature, 99.4°; pulse, 118; respiration, 30. Patient passed three small blood clots with fæces, which are becoming formed. Baths ordered omitted, to give rest.

May 29th.—Had a movement without blood. Had a chill and presents typhoid countenance, dry tongue, and feeble pulse. Shallow hip bath at 90°, with water, three basins, at 60°, thrown over the body, to remove general nerve depreciation and invigorate the failing heart. Affusion at 6:30 P.M., temperature being 102.2°; pulse, 136; respiration, 38. Reduced temperature to 101.2; pulse, 114; respiration, 34.

May 30th.—Several affusions were given, the last one showing a reduction of temperature from 103°; pulse, 130; respiration, 36; to temperature, 102.8°; pulse, 116; respiration, 28. Patient fell asleep. This result illustrates the marked effect of affusions as a heart tonic.

May 31st.—Patient has grown stronger during the last two days. The affusions intended to bring the patient back to tolerance of the tub bath produced the anticipated result. She now was ordered a tub bath at 70° for fifteen minutes every three hours.

June 17th.—These baths have been administered about every four hours, whenever the temperature reached 102.5°. That they produced a most decided reduction of temperature is evident from a bath given at 4:20 P.M. Before the bath, temperature was 103.2; pulse, 122; respiration, 28. Half an hour after the bath, temperature was 99°; pulse, 112; respiration, 24.

That the antithermic effect of the Brand bath is greater in the later stages of typhoid fever than in the first was amply demonstrated in this case.

June 25th.—The temperature reaches normal each morning and the afternoon rise is becoming less each day. The patient feels much stronger every day.

August 20th.—The patient is up walking about the ward each day.

Remarks.—This case is interesting and instructive, because it is a severe type treated by baths, until they were contraindicated by hemorrhage; then by chemical antipyretics which, though they reduced temperature, caused a return of the typhoid state. Heart failure, now arising, was combated with cold affusions, which acted well and brought the patient into condition to bear tub bathing, which in the later days of the disease produced much greater temperature reduction than in the early days. This is a characteristic of typhoid fever, which should be utilized more frequently. While the most active hydriatric procedures do not influence the temperature very decidedly in the first days of the disease, mild measures become effective in the later stages so frequently that the author has often pointed the fact out to colleagues.

Conclusions.—From these histories it is evident that the application of water may be as varied as are the indications for its use, and that a

correct appreciation of its mode of action enables the physician so to modify it as to meet many difficulties and tide the patient over many dangers. They may serve as guides to the manner of meeting the indications that may arise. No other remedy possesses the flexibility of water, and none will afford the physician greater satisfaction in the management of fever patients.

CHAPTER XIV.

THE EXANTHEMATA.

In the preceding chapter reference has frequently been made to the application of water in the eruptive fevers. It is the purpose in this chapter to offer clinical illustrations of the author's practice in such cases.

Measles.

Although this disease usually runs an uneventful course, many cases are encountered by the general practitioner which cause him anxiety and which are the source of distress and danger to the patient. Especially difficult does the management of this affection become when, during the later part of its course, pulmonary complications ensue.

The removal of the etiological factor being at the present time impossible, the efforts of the physician are directed, as in all infectious diseases, to the enhancement of the resisting capacity of the patient—a practice which has found frequent expression in these pages.

Attention to the hygienic surroundings of the patient, to his diet, and to the alleviation of distressing symptoms usually suffices to carry the case to a successful issue. When, however, the temperature is high (above 103°), the patient is restless, sleep is impossible or fitful, and cough is distressing—all these being manifestations of an intense toxæmia acting upon the nervous system—a judicious hydrotherapy may prove a boon to physician and patient alike.

The prejudice against cold air in measles has happily disappeared, but the prejudice against cold water still exists, even among many medical men. Lay people may readily be convinced of the harmlessness of cold ablutions or brief baths by being reminded how the hand reddens and grows warm when throwing snowballs, and a practical illustration by laving the back of the patient, which is usually most congested, with a piece of gauze dipped in water at 75°, will quickly demonstrate how rapidly reaction takes place and how absurd is the idea of harm from "striking in" of the eruption.

In the milder forms of measles, when the temperature reaches 103° and the patient is restless, much comfort may be afforded by a full bath of ten minutes' duration at 95°, repeated every four hours if

necessary, the bath temperature being reduced five degrees each time, until a calming effect is produced or the bath temperature reaches 70°. With the latter temperature it is necessary to reduce the duration to five minutes. The effect upon the general condition of the patient is usually gratifying; he falls asleep, cough is diminished and jactitation removed. When the patient or friends are too greatly alarmed by the full bath, ablution with water at the same temperature, applied with a soft piece of gauze or a wash cloth, will be found useful. In this disease the ablution should be rapid and active friction must be avoided.

Cerebral symptoms may be successfully combated by a careful and definite water treatment. Whether accompanied by high temperature or not, delirium, stupor, muttering, and extreme jactitation must be energetically met. Medicinal agents, though efficient in reducing temperature, are unavailing for the removal of the cerebral symptoms, which are due to the circulation of toxic elements in the blood. Here the rapid application of cold water is a boon for which the physician will have cause to be grateful, if he appreciates that the indication is to arouse the central nervous system by reflex action from the cutaneous sensory nerve endings. In these cases I order the patient to be placed semirecumbent in a half-bath at 95° F., and to have three or four basinfuls of water at 75°, or less, thrown over his head and shoulders. If this affusion does not succeed, a stream of water at 50°–60° may be poured from a height of a few feet over the nucha and spine for one minute, and repeated in four or five minutes, the patient in the mean time being laid recumbent and rubbed with the bath water (95°). These applications are the chief resource for arousing the lethargic nerve centres and restoring life and activity to the dependent sluggish organs. How often have I seen a child, which has lain listless, moaning or tossing unceasingly upon its couch, aroused from these conditions refreshed and invigorated for further combat with the toxins that threatened to overwhelm it! These procedures may be repeated every two hours or oftener, if the child lapses back into stupor. In the interval much benefit will be derived from the trunk pack at 70°, if the body temperature is 103° or over. The watchful physician will inaugurate an active hydrotherapy as soon as he descries the slightest cerebral manifestations of toxæmia. It is the office of this treatment to prevent rather than to cure the latter.

The *broncho-pneumonia* or capillary bronchitis complicating measles is so frequently fatal that it is the attendant's duty to watch for the earliest symptoms of failing respiration. These serious complications may be easily forestalled by three-hourly baths at 90° reduced to 80°, for five minutes, followed by chest compresses (p. 114) at 80° every hour. Regard should always be accorded to the fact that *children suffering from*

measles do not bear the abstraction of heat well. Hence brief procedures are the best and safest method. When the disease is fully developed, and atelectasis exists or is threatened by reason of lobular infiltration which obstructs the interchange of gases and additionally intoxicates the brain, active measures are demanded. If the temperature is not high, below 100°, water at 60° sprinkled on the chest for a few seconds, followed by friction with the flat hand and repeated every five minutes, or the rapid slapping of various parts of the chest with cloths saturated with water at 50°, has been found useful by the writer. This failing, the child may be held over a basin and water at 60° poured from a pitcher over the spine and chest for a few seconds, followed by friction and chafing and repeated two or three times with intervals of five minutes. These measures deepen inspiratory efforts, enhance oxygenation of the blood, and remove cardiac embarrassment, all of which are evidenced by cyanosis and coldness of the extremities. The latter is almost invariably removed and warmth restored to the clammy limbs. By these simple measures the patient may be rescued from the most desperate condition. The two-hourly drinking of four or six ounces of cold water is a measure which should not be neglected.

That the writer does not stand alone in the above optimistic view may be demonstrated by the writings of eminent clinicians.

Professor Fürbringer* says: "In several cases of measles complicated by pneumonia with intense CO_2 narcosis, we have applied these baths for several days and nights (up to seventy baths a week), with the result of seeing these apparently hopeless cases recover. This treatment affords decidedly more satisfactory results than the formerly adopted medicinal treatment."

Professor Jürgensen† says: "I think that in severe forms of infection this method offers the only hope. To be useful, we must be merciless and institute severe treatment. The respiration is very much benefited by cold affusions. The Priessnitz compress is very highly efficacious."

Guinon, the Parisian pædiatrist, says:‡ "In the malignant hyperpyretic nervous types of measles the full bath is useful (71° to 74° for adults and 64° to 88° for children), for five to ten minutes, and repeated every three or four hours. For intense adynamia cold affusions are preferable." For convulsions he recommends lukewarm baths, with cold affusions, as the head and lung complications do not contraindicate baths when the temperature is high. Musselier and Dielafoy§

* "Real-Encyclopädie," No. 13.

† Nothnagel's "Specielle Pathologie und Therapie," iv., 1895.

‡ Revue des Maladies de l'Enfance, 1891.

§ Archiv für Kinderheilkunde, 1892.

have succeeded in removing the most pronounced toxæmic manifestation in the first stage of measles by cold baths. The latter do not act upon the high temperature alone, but chiefly upon the nervous system, which in grave cases is usually completely depressed, as evidenced by delirium and adynamia.

Dr. von Becker* reports an epidemic of measles in which eight hundred children were attacked. The mortality was slight and complications had a favorable issue, in von Becker's opinion, on account of the treatment adopted. Each child received an initiatory bath at 95° for ten minutes, after which it was wrapped in a woollen blanket for an hour. The perspiration was then dried and the child thoroughly rubbed. In two hours a cold wet compress was placed around the chest, which was changed every two hours; in high fever a cold wet turban was wrapped around the head. Three or four baths sufficed to bring the rash to a conclusion; bronchitis disappeared rapidly without expectorants; all the usual complications were either absent or without unfavorable effect. The influence of this water treatment upon incipient cases was still more favorable. As soon as a case of measles occurred all the children in the family were examined, and if the spotted redness of the gums was found in any they were subjected to the above treatment.

In America, Dr. Hiram Corson, an aged country practitioner, whose practical writings exercised great influence on my own mind twenty-five years ago, says:† "In sixty years, with thousands of children under my care with measles, I have never lost one with that disease. I scarcely ever did anything in measles except to give a laxative and then keep the patient cool. I often sponged the whole body with cold water, and gave it copiously as a cooling remedy."

The above-cited clinical data cannot fail to convince any reasonable reader of the value of hydrotherapy in measles.

Conclusions.—As in other diseases, the author has cited in support of his own advocacy of hydrotherapy in measles the views of well-known practitioners and teachers, whose testimony is unbiassed, clear, and unimpeachable.

Scarlatina.

This disease is so often accompanied by serious manifestations in all its stages that the experienced practitioner is always wary in its presence. The toxic agent which has invaded the organism cannot be neutralized, but its onslaught may be met with measures which are harmless to the patient but extremely effective in carrying the case to a successful issue. As in other infectious diseases, the judicious use of water enables the physician so to enhance the patient's resisting power

* Der Kinder-Arzt, November 3d, 1897.

† University Medical Magazine, 1891.

that serious complications may be averted or successfully combated. This is accomplished by maintaining cardiac action at its highest standard, which is highly important in a disease in which the kidneys are menaced. This cardiac enhancement may be most effectively induced by cool or cold procedures, the reduction of temperature, though valuable, being in my opinion secondary to it.

In the prodromal stage of scarlatina, ere a diagnosis can be clearly established, and in those cases in which the eruption is imperfect, with or without high temperature, the chief brunt of the disease is borne by the heart, as evidenced by feeble, rapid, and compressible pulse, mottled or cyanotic skin, and apathy. Here the cold affusions afford a most valuable resource. A full bath of 100°, if the body temperature is not above this point, or of 90° if above it, will in five or ten minutes allay the nervous manifestations, convulsions, twitchings, etc. When these are accompanied by feeble heart action, the child should be held semirecumbent by one attendant, while another pours two or four basinfuls of water at 60° or less over the head and shoulders. After he is dried and well rubbed, the patient is placed between blankets to aid reaction. The affusion may be repeated hourly if necessary, the water being reduced in temperature five degrees each time, and the application being made briefer. The change is often marvellous. The cutaneous venous congestion due to imperfect cardiac propulsion gives way to a bright-hued congestion, which relieves the laboring heart; the patient falls into a refreshing slumber. Even if the temperature rises, sleep should not be interrupted unless the pulse indicates heart failure.

When the disease is fairly established, the eruption well defined, and the intellect clear, no treatment beyond quiet, ventilation, milk diet, and the systematic internal use of cold water, alternating hourly with the milk, is required. The disease is self-limited, the toxins will gradually be eliminated, and a successful termination is assured in ordinary cases.

When, however, the temperature persists above 103°, the pulse above 130, when the patient is restless and sleeps badly, the physician will be forearmed by being forewarned. Medication is unsatisfactory, while the most simple hydriatic measures afford comfort and neutralize danger. Ablutions with the naked hand or with a piece of soft gauze, avoiding active friction, with water at 90°, reduced each time one degree until 75° is reached, now come into play. They may be repeated every hour or two hours, according to the severity of the manifestations. It is the author's practice to apply a trunk pack at 70° every two hours, for the purpose of maintaining the effect of the ablutions. To invigorate the cardiac action, to increase the urine both in quantity

and in toxic contents, and to reduce temperature, these procedures are most effective, and in many trying cases have served me well. Occasionally I have found it necessary when the temperature was continuously high, above 104°, to resort to the gradually cooled full bath—95° reduced to 80°, during five or ten minutes, with gentle friction—as an aid to the above measures. Although patients suffering from scarlatina bear abstraction of heat better than measles cases, I do not regard prolonged cold procedures (over five minutes and under 75°) as safe in this disease. The affusions referred to above are far more valuable for meeting all indications, and they should be preferred, even if frequent repetition every hour or two hours is demanded.

Whether hydriatric procedures prevent nephritis or not I am not prepared to say, but I would insist that they place the patient in better form to pass through this serious complication. Every cautious practitioner examines carefully for evidence of the latter. If nephritis ensues during the acute stage of scarlatina, the above-detailed treatment should not be omitted for fear of any prejudice against cold applications. The latter are so brief that no possible harm can come to the internal organs; the improvement of cardiac action resulting from them is a powerful weapon against nephritis. When the latter develops during the desquamative stage, we have in hot baths, followed by dry packs, the most effective diaphoretic measure for relieving the inflamed kidney of some of its work. A full bath of 95° should be prepared and the patient placed in it; hot water, which has previously been gotten ready in pitchers or buckets, may now be added until the temperature of the water becomes uncomfortable to the patient. Cool drinks and bathing the face and head in cold water will prevent faintness, which must be carefully watched for. The bath may continue half an hour, if no unpleasant manifestations arise. While the patient is in the bath, his bed is prepared by spreading two woollen blankets upon it, which have been warmed with hot-water bags and bottles. On removal from the tub, the patient is snugly wrapped in these blankets and allowed to remain for diaphoretic effect an hour or two, cold water, plain or mixed, with some agreeable syrup, being abundantly given him to promote diuresis.

The hot wet-blanket pack is also a valuable diaphoretic procedure. It is prepared like a wet pack, except that a blanket is substituted for the linen sheet, and the hottest water is used instead of cold water. The blanket is wrung out by two persons twisting it in opposite directions, and is spread steaming upon the bed, where it rapidly cools to a comfortable temperature.

This treatment may be repeated once a day or oftener when uræmic symptoms threaten. If this treatment is not effective, it may be

alternated with wet packs at 65°. That this seemingly heroic measure is useful is attested by many observers.

Kussmaul* has "often seen in his consultation practice serious dyspnœa, with serious and even lethal results from hot baths, while the cold pack acted far better. The subjective condition of the patient was greatly improved. An energetic derivation to the skin was instituted, and if the patient was well covered with blankets after removal from the pack an abundant diaphoresis ensued. The blood pressure was always diminished by the wet pack, and returned to its original high point only after considerable lapse of time."

The condition of the patient, the immediate result of the treatment, must guide the medical attendant in the selection of hot or cold procedures. The fact should be borne in mind, however, that the wet pack really produces a stimulating, hyperæmatizing effect upon the cutaneous surface, although its initial action is that of a cold procedure. The *rationale* of whatever procedure is used should be clearly before the practitioner's mind; his action should not be empirical, but judiciously arranged in accordance with the therapeutic indications which are present. Only in this wise may the apparent paradoxes of cold and hot applications be cleared up and made to inure to the benefit of suffering humanity.

That the treatment adopted by the author and above outlined is the most useful in scarlatina, finds ample corroboration in the publications of justly eminent and trustworthy observers. Among the latter the following may be cited as illustrating the methods most practised by clinical teachers:

Guinon gives† precise directions for the use of water in measles. "There are three great indications to moderate the fever—quiet nervous disturbances and prevent and combat the secondary infections. Antipyretics should be avoided. Hydrotherapy certainly provides more efficient means and is easier of control. Cold baths are the selective method of Guinon in persistent pyrexia and adynamia of scarlatina, when there is no cyanosis or feeble pulse. Pulmonary complications are favorably influenced by them."

Guinon's views with regard to *variola* may appropriately be quoted here, since this disease will not be separately treated in this work. He finds cold baths eminently useful to overcome the nervous accidents and moderate suppuration. "Tepid baths decrease pain and warm baths are cleansing. In the invasion stage, with dyspnœa, somnolence, and temperature of 104°, cold baths (64° to 68° F.) for adults, 70° to 74° F. for children, should be used systematically, and in sudden emer-

* Berliner klinische Wochenschrift, July 9th, 1898.

† Revue Mensuelle des Maladies de l'Enfance, 1892.

gencies cold affusions. *These cold baths do not check but favor eruptions and diuresis.*"

This dictum of the eminent Parisian pædiatrist should be borne in mind when any doubt arises with regard to cold applications in any of the eruptive fevers.

Baginsky* expresses himself as follows: "Our therapy has to fulfil two indications—to moderate fever and prevent complications. *Both indications are fulfilled by baths.* In the most grave complication of scarlatina, nephritis, the suppression of cutaneous function by the diffuse dermatitis is etiologically concerned, and therefore attention to the skin stands at the head of our therapy. It is sufficient in mild cases to keep the skin clean; in more severe cases it is advisable to bathe frequently."

Schill, of Wiesbaden, has contributed an excellent statistical and practical article on the bath treatment of scarlatina,† in which he relates one hundred and ten cases, treated by himself and Schellenberg with daily warm baths, 95°, for ten minutes, twice a day in the first week and once daily in the second week. Nephritis or albumin did not occur in any case, and the progress of the disease was rendered mild by this simple treatment.

Comby, the eminent pædiatrist of the Hôpital Trousseau,‡ "regards cold water in the exanthemata as refreshing, derivative, heart invigorative, diuretic, tonic, and sedative."

Guerin§ is an enthusiastic advocate of frequent but brief cold baths (78° F.) in the grave forms of scarlatina and measles, which demand imperatively their immediate use. Under their influence the function of the kidneys is rapidly restored and a very good impression is made upon existing bronchitis or pneumonia. Guerin's views are shared by Regnault.

Professor Jürgensen‖ considers "cool baths the best treatment of scarlatina from its invasion to its cessation. The toxic manifestations and elevated temperature can be successfully combated only by the use of water. Baths of short duration (60° to 70° F.) have a marked beneficent effect. Hot baths in the later stages prevent uræmic intoxication and improve diuresis."

In the presentation of this subject the author has endeavored to offer a fair statement of his own practice and observation, fortified by the views of physicians whose abundant hospital material and high reputation entitle them to the highest consideration.

* "Lehrbuch der Kinderkrankheiten," Berlin, 1896.
† Therapeutische Monatshefte, No. 43, 1896.
‡ La Médecine Moderne, No. 1, 1897.
§ Gazette des Hôpitaux, February, 1891. ‖ *Op. cit.*

CHAPTER XV.

PNEUMONIA.

The history of the treatment of pneumonia illustrates that its success or failure is in proportion to a correct understanding and mastery of the nature of the disease. An impartial review impels the author to believe that we stand to-day on the threshold of a view of croupous pneumonia which will contribute more to the saving of lives than all the doctrines and remedies suggested since the days of Hippocrates. The student is no longer taught that the pneumonia patient dies from apnœa. *Heart failure is the spectre that now stands at the bedside of the patient in this, and for that matter in most other acute diseases,* and the chief therapeutic aim should be to prevent it.

The view that *pneumonia is an infectious disease, whose chief recognizable lesion is in the lungs, but whose lethal tendency is in the overwhelming of systemic force and vigor,* is obtaining more and more recognition.

I would even go farther than this. Careful clinical observation and a judicious sifting of the testimony of reliable practitioners have brought me to the belief that croupous pneumonia is no more a lung disease than is typhoid fever a bowel disease. Whenever this doctrine shall receive universal acceptance, we shall cease to *treat the disease,* and we shall be prepared for a more effective management of the patient suffering from it.

The great American clinician, Austin Flint, called it "pneumonic fever" in 1877, and pointed out its analogy to typhoid fever. Two hundred years ago Huxham had also insisted upon the infectious character of pneumonia.

The analogy of croupous pneumonia to typhoid fever may be discovered in its etiology, symptoms, and course. The Sternberg-Fraenkel diplococcus is an important factor in the production of croupous pneumonia, being present in about seventy-five per cent of cases. The presence of some constitutional depression is a potent etiological factor. Age is a predisposing and exempting factor, inasmuch as young children are rarely attacked; while it is most prevalent among adults, and liability to it diminishes with advancing years.

Typhoid fever presents analogous conditions. In pneumonia we

have practically the same manifestations which characterize typhoid fever, differing only in regard to the habitat of the micro-organism, diarrhœa taking the place of cough. The fever runs a different course because of the difference in the life period of the organisms involved in each disease.

The most striking and important similarity is that the chief point of attack in both diseases is upon the nervous system; the toxæmia resulting from the life and death of the micro-organism spends its chief force upon the nerve centres. This explains the well-recognized clinical fact that the general symptoms are rarely a correct index to the local lesion. Dyspnœa and fever especially may be extreme, and the case may terminate fatally, with slight involvement of the lung, just as we may observe the most serious general condition in typhoid fever, without evidences of local lesion in the intestines.

Crisis in croupous pneumonia is signalized by complete cessation of all the general symptoms, because the life period of the micro-organisms is terminated. And yet the lung remains more or less solidified by exudates, as is evident from the physical signs continuing. So do the general symptoms of typhoid fever cease with the cessation of the life period of the Eberth bacillus, although the intestinal lesions are still so far from being removed that great care needs to be exercised with regard to diet, rest, and other preventive measures.

The *prognosis* of croupous pneumonia and that of typhoid fever have a close resemblance in many respects. The effect of previous mode of life, habits, and environment, before and during the illness, upon the issue of the case, is very much alike in both diseases, as is the influence of childhood upon the prognosis.

This brief presentation of the close analogy in the etiology, symptoms, and prognosis of these diseases points to the expediency *of following in pneumonia, as far as the differences indicated above may admit, the line of management which has afforded the best results in typhoid.*

We have learned from sad experience that the chief indication in typhoid fever must be to enhance the patient's resisting capacity to the lethal agencies evolved by the infection process.

It is the aim of these pages to emphasize a similar course of action in pneumonia. The management of the pneumonia patient which is here presented is the result of an evolution from the methods which I have been taught and have practised for many years. Until a few years ago I felt as helpless in a case of pneumonia as I did at that time in typhoid fever. Recovery in both diseases seemed to be the result of conditions over which my control was feeble or lacking. The patient's constitution, the type of the disease, and his environment

played the chief *rôle*. Treatment was symptomatic in both diseases; expectant it was termed—and not inaptly, for something was always expected to happen which the physician seemed powerless to prevent. When the true principles and value of the Brand method in typhoid fever became known and appreciated, a positive treatment was at command, by which, *if employed early*, serious and fatal complications, against which we were formerly impotent, could be prevented. For the comfort and the sense of security derived from this method, since I mastered its technique, I shall ever be grateful to its author.

It has been my ardent desire to reach a similarly comforting attitude in pneumonia. Weary of the expectant plan, and observing its enormous fatality, especially in those depreciated by faulty modes of life and habits, I looked to hydrotherapy for succor. While the latter has not reached an entirely satisfactory degree, observation and reflection have evolved a method of management whose clinical value deserves to be further tested.

The prevailing type of the disease should be carefully considered. The vaunted success of certain methods of treatment may be attributed to a change of type in the disease and the previous conditions of the patient. Any new treatment should therefore be approached with caution and judgment.

The type of pneumonia common in New York City appears to be grave. *In hospital and private practice this disease is more fatal than any other acute disease of adults.* In the New York City Board of Health statistics it ranks next to phthisis in fatality. The chief reason of the great fatality may be sought for and found in the helplessness of physicians in the presence of this fearful disease.

Complete rest of body and mind and good nursing are essentials in furthering recovery. This cannot be too earnestly urged upon the patient and his family. The ventilation of the sick-room, too, which is much opposed by the laity, should be anxiously watched by the medical attendant, who is too prone to yield to existing prejudices, and thus to become an unwilling accomplice in depriving the patient of this greatest pabulum in infectious diseases—fresh, pure air. The patient and family should be positively assured that there is no danger of taking cold if the body temperature is elevated to any considerable extent. In summer and winter the air of the sick-room should be constantly renewed, even at the cost of reducing its temperature to an extent which in winter may be uncomfortable to the nurses. During the late war cases of pneumonia treated in tents in rigorous weather did far better than those treated in improvised hospital buildings.

As in typhoid fever, the diet should be restricted to milk and farinaceous broths, administered with precision while the patient is

awake, every two hours, in quantities ranging from four to eight ounces. I do not share the horror of asthenia in this disease, which is only too prevalent and leads to undue feeding and stimulation. The disease is of short duration; it not infrequently suddenly attacks well-nourished persons in the midst of comparatively good health. It seems an unphysiological proceeding to stuff these patients with concentrated foods in large quantities, which they cannot assimilate, and thus to impose an additional tax upon the system. Stimulants also have rarely been as necessary to the same extent as formerly, since the course of management here outlined was adopted. In the case of alcoholic subjects whose consumption of liquor has been a daily habit and requirement, one-half to two ounces of good whiskey every two or three hours may be useful, especially while resolution is going on, but not as a spur to a failing heart, as is commonly the purpose. Not quite sure on this point, I still feel myself under the dominion of this idea. It would seem that, inasmuch as a large part of alcohol is eliminated through the lungs, the latter are needlessly overburdened while they are straining their functionary capacity to the utmost.

Of medicinal agents but very few are required. Besides an opening dose of ten or fifteen grains of calomel, strychnine and an occasional dose of morphine for pain are the only medicines that seem to be of any real value. When the first sound of the heart becomes muffled or feeble, which rarely happens if hydrotherapy is applied early, hypodermics of strychnine, one-thirtieth to one-tenth of a grain every three or four hours, offer a valuable aid to tide the patient over a trying period. Given even to the production of trismus, if necessary, strychnine is far superior to digitalis or brandy. I do not fear an occasional dose of phenacetin when the patient is restless with high temperature, but its use should not become a routine practice for temperature reduction; it is rarely required. Quinine, aconite, veratrum, digitalis, and other drugs I have discarded, after a prolonged trial.

The most valuable remedy in pneumonia is hydrotherapy judiciously adapted to the indications of the case. Its application will be considered under two heads, viz.: 1. Pneumonia of children. 2. Pneumonia of adults.

1. Pneumonia of Children.

Although the principles underlying a correct application of water in pneumonia are, as in other diseases, the same in children and in adult life, the former present certain peculiarities which it may be interesting and profitable to discuss. The sensitive nervous organization of the child endows it with greater susceptibility to the development of nervous symptoms. Convulsions not infrequently occur in pneumonia; delirium

and jactitation, listlessness, and somnolence often characterize it in children.

The toxic agents circulating in the blood in pneumonia do not endow the heat centres with the same resisting capacity to heat reduction by hydriatic cooling measures as in typhoid fever. This empirical fact upon which I have based the *diagnostic bath* (page 179) is emphasized in the child by reason of the larger surface area in the child in proportion to its weight, which favors a more rapid cooling of the body of the child than of that of an adult. Moreover, the heart of the average child does not possess the resisting power of the adult heart, and therefore the sudden contraction of the proportionately larger area of cutaneous vessels by intense cold may induce collapse more readily in the child than in the adult. This fact must be constantly borne in mind in the prescription of hydriatric procedures, by the correct adaptation of which danger may not only be obviated, but may be fully and successfully met, with the result of promoting rapid recovery and saving life.

In pneumonia as in other infectious diseases the chief danger is not to be sought, as I have often pointed out, in the high temperature. The heart is more threatened in this disease than in any other, because, in addition to its depreciation by the toxæmia, the obstructed pulmonary circulation increases the amount of work it is called upon to do, and thus contributes an additional element of danger.

In the early stages of pneumonia in children the full bath is extremely useful. Children are so easily handled and many are so accustomed to bathing, that this procedure, carefully adapted, produces a minimum of disturbance with a maximum of effect. It is always wise to begin bathing when the body temperature reaches 103°, although a lower temperature also demands the bath when nervous symptoms are pronounced. Beginning with a bath of 95° for ten minutes, this should be repeated every four hours, and its temperature reduced two degrees each time. I do not resort to full baths below 80° in the pneumonia of children, for reasons stated above. Friction must never be omitted; chilling, which is apt to occur in children, may alarm the parents and lead to a subsequent rise of temperature. Such baths usually reduce the temperature two or three degrees; they stimulate the heart, deepen the inspiration, promote expectoration, and refresh the child, as no medicinal agent is capable of doing. Their effect may be prolonged by chest compresses (page 114), repeated every hour or two as required. When dyspnœa, heart failure, cyanosis, delirium, or other alarming manifestations occur a briefer but more energetic procedure is indicated. The little one is held for five minutes in a bath of 100° up to its navel, and two or four basins of

water at 75–65° are poured over its shoulders rapidly. This should be followed by rapid friction and drying. This procedure may be repeated every two or four hours, as indicated. The result is simply delightful. Crying and coughing which naturally ensue, aid in expectoration of stagnant secretions; the respiration is rendered free and unobstructed; the skin grows red and congested, relieving the heart most admirably when combined with the reflex stimulation of the organ produced by the brief but sudden impact of cold. The pulse becomes less frequent, more quiet, and regular. The pulmonary circulation being improved, a local effect upon the inflamed and congested parenchyma is produced.

This method of treatment, combined with the usual hygienic and dietetic management, has afforded the author satisfactory results not only in family practice but also in the large clinical material of the New York Juvenile Asylum, which was at his disposal for thirteen years.

The value of hydrotherapy in the pneumonia of children has been confirmed by the highest authorities. Jacobi* "uses cold baths or packs when the temperature is high, but most cases will do quite well with sponging or friction with wet and cold towels. The latter plan acts both as a refrigerant and stimulant."

It is not "the cooling of the surface," however, which is the key to the *rationale* of the cold bath, but the stimulus following the shock, due to impingement of cold upon the cutaneous nerves, which is conveyed to the central nervous system and thence reflected to every organ over which it presides. The cooling (refrigerant) effect is the most palpable to the eye; it is demonstrated by the thermometer; but if this were the chief aim of pneumonia therapy it would be far more perfectly reached by the coal-tar antipyretics.

Jacobi correctly says: "It is not the temperature that is injurious, but the absence or insufficiency of resistance the tissues offer to its effect."

The danger lies in the toxæmia which is overwhelming the nervous system, and thus impairing the functions of the organs depending upon them; digestion, respiration, cardiac action, the secretions, all are crushed under the octopus, *infection*. The system is laboring under the load; the conservative powers residing within it are strained to their utmost to maintain life. The cold bath comes nobly to the rescue, when judiciously used; the nervous system is refreshed, the dormant functions are aroused to renewed activity, the eye brightens, the respiration is deepened, the pulse is slowed and rendered less dicrotic. But this effect is not produced by the antipyretic bath, which allows the patient to lie quietly in the cold water, and from which he is taken when he shivers. Active but gentle friction of the surface

* Archives of Pediatrics, 1895.

prevents chilling and multiplies the shock to the peripheral nerves, while it counteracts paresis of the vascular walls and formation of cutis anserina. Such a bath is *antifebrile*, meeting *all* indications arising from insufficiency or absence of resistance.

A. Baginsky * teaches that "the chief aim is to moderate fever and maintain the strength. *Both indications are well fulfilled by cold compresses* around the thorax, repeated every half-hour or hour. When properly employed under appropriate conditions, especially with regard to cardiac power, they may be life-saving, and they are to be decidedly preferred to antipyretics, which are to be avoided in the pneumonia of children, because of their deleterious effects upon the heart."

Professor Penzoldt † gives an analysis of twenty-two hundred cases treated from 1867 to 1889 in the Poliklinik of Erlangen. "The reduction of temperature is not to be regarded the sole factor. If the indication is to improve the respiration, circulation, and cerebral activity, and to further expectoration, preference should always be given to a cautious bath treatment."

Professor Hutinel, in a clinical lecture at the Hôpital des Enfants Malades, ‡ closely presents the view I have so often urged: "It is especially against the different manifestations of the general infection that we must act; and it is precisely in those cases in which the general phenomena are quite marked that cold baths (64° to 75° F.) are particularly useful. The cold bath not only diminishes the temperature of the body; it at the same time exercises other beneficial influences. It enhances the various secretions, increases the arterial pressure, and sustains the heart; while, on the other hand, most of the antithermic remedies produce untoward effects in similar conditions.

"The cold bath acts energetically upon the nervous system. It gives, as Professor Peter has remarked, speaking of typhoid fever, a lashing to the economy. It diminishes the depression so marked in certain cases of broncho-pneumonia. Patients who have been bathed return to life, to use the happy expression of Juhel-Renoy. *In my experience the cold bath has never produced evil effects upon the lung*, and, like many others, I am convinced that the measure has been wrongly accused of being the cause of pulmonary complication."

Hutinel details a desperate case as a striking illustration of the water treatment of pneumonia, and he affords us a glimpse of his practical ability as follows: "Families will often oppose the application of a cold bath in these cases. Under such circumstances we must employ a certain amount of artifice. Under the cover of revulsion you

* "Lehrbuch der Kinderkrankheiten," 1896.

† Münchener Medicinische Wochenschrift, 1890, No. 36.

‡ Le Bulletin Médical, Paris, 1893.

may add to the water a little mustard; for, as a general rule, parents believe in the efficacy of this simple remedy, and it behooves us to wrestle not so much against their reluctance as against their overzealousness. At the Hospice des Enfants Assistés I have obtained most excellent results, but I have also observed many failures. Employed when specially indicated, cold baths produce excellent results; but employed indiscriminately, they are often the source of disappointment."

M. Albert* reports forty cases of broncho-pneumonia of children from four months to four years old, which he treated with half-hourly or hourly chest compresses dipped in water of 59°–68°; the mortality was seventeen per cent.

Le Gendre† states "in the course of all acute diseases of the respiratory passages and in certain acute stages of chronic disease of the same region, active hyperæmia is an important factor in determining the aggravation of the local and general conditions. In cases where such hyperæmia occurs I have found preferable to all other revulsive measures the permanent wrapping of the thorax in compresses soaked in cold water, wrung out so as to be merely damp, and covered with a thin oilcloth. These compresses should be renewed every quarter of an hour, then every half-hour or hour, according to the condition of the patient. This method is of especial value in infantile therapeutics; it may be used for the youngest child, continued as long as necessary, and resumed whenever there is a return of the congestion."

In the discussion of Le Gendre's paper Rendu stated that he had made use of the wet pack since 1884, and had found that it caused great improvement in grave broncho-pneumonia. He does not use the same method as Le Gendre, but leaves his patient in the pack for two or three hours. Richardière has treated sixty cases of broncho-pneumonia after measles at the Trousseau Hospital, and has had excellent results with the wet pack. An important fact is that the temperature does not immediately fall, but that the nervous phenomena are quieted and abundant sweating occurs.

2. Pneumonia of Adults.

Pneumonia occurring in adults has long been treated by Jürgensen and others with cold baths of 60°–70°, of ten to fifteen minutes' duration, and large quantities of stimulants to counteract heart failure.

Dr. A. Vogl, chief of military hospitals in Munich, has in a written communication informed me that he has found the baths, as applied in typhoid fever, of great value in pneumonia. Being a very careful and

*Gazette Hebdomadaire, 88, 1896.

†La Médecine Moderne, March 17th, 1894.

conscientious clinician, however, he was unwilling, upon the strength of only a few hundred cases, to furnish practical deductions.

The gentlemen who report therapeutic successes from, or sweepingly condemn cold baths upon results derived from a few cases, may here draw a valuable lesson of caution. This has been the author's reason for withholding in this work his own experience as an argument, wherever larger statistical material could be brought to bear upon the subject from other sources.

In a discussion on pneumonia * Dr. Charles B. Folsom stated that he had tested the cold-bath treatment in thirty-six severe cases in the Boston City Hospital. He was more than satisfied with the results. In marked contrast with the bath treatment of typhoid fever was the fact that all these patients said that the baths were grateful to them. These baths controlled the fever, diminished the cough, lessened delirium, and induced sleep.

Dr. Northrup, physician to the Presbyterian Hospital, said "that a bath of 90° F. would often calm a very excitable patient with an alcoholic pneumonia, and would at the same time improve his general condition. He had proved by experience the benefits of hydrotherapy in pneumonia, and believed that in this disease the effect of such treatment could be briefly summed up by saying that it quieted the mental excitement, improved the quality of the pulse, increased the depth of the respirations, and promoted sleep."

Professor Strümpell † *advocates tepid baths* (90°–92.5°) as the most effective means of improving the respiration, of aiding expectoration, and of stimulating and refreshing the whole system. "The main point is that the patient should make no physical exertion in the bath; that he should be lifted into it, held and supported while in it, and lifted into bed again after it. The favorable action of the baths is especially seen in the great relief and refreshment that the patient feels. The respiration is quieter and slower, but deeper; the patient often falls into a quiet sleep after the bath."

My observation agrees with that of Strümpell, that the disturbance and agitation incident to a cold tub bath increase the lung disturbance. If the patient is very dull, cyanotic, and presents great nerve prostration, resembling the typhoid state, I do not hesitate to choose between the two evils, an increase of the local disturbance and a decrease of nerve prostration, by placing the patient into a bath of 80° F., or less, or seating him in water at 100° and pouring several basins of water at 65°–75° F. over his head and shoulders. This has been referred to (page 276) as a valuable heart tonic. It serves,

* Medical News, January 2d, 1897.

† "Text-Book of Medicine," p. 205.

by deepening the inspirations, to dislodge accumulations in the bronchi, which have crippled the healthy as well as the affected lung.

The Chest Compress.—In my own observation *the chest compress* has proved the most useful hydriatric procedure in pneumonia.

The technique of this procedure has been explained on page 114, with a detail that may seem needless, but these details insure precision, and upon their exact execution may depend success or failure. The physician should himself supervise the first application, just as he should supervise the first Brand bath in typhoid fever. A skilled nurse can apply these compresses with a minimum of disturbance.

There is need, too, of individualization. In the average case a temperature of 60° F. will be appropriate. Should the patient evince stupor or muttering delirium, a lower temperature should be adopted, and the chest should receive one or more dashes of colder water before renewal of each compress. The same procedure is useful in broncho-pneumonia, when the bronchi are blocked by secretions or cyanosis exists. In a case which I had the privilege of seeing with Dr. E. J. Ware, this application proved its worth. By skilful management the patient had been sustained up to this time. The right lung in its entire posterior aspect was solidified. The temperature was usually below 102° F., and the pulse exceedingly rapid. There was no dyspnœa. In this case the modified procedure referred to was extremely valuable. Inspiration soon deepened, the heart slowed, and in a few days the patient rallied from a most desperate condition.

A higher temperature than 60° F. may be used if there be much jactitation, insomnia, or excitability. In the latter event great benefit will accrue from allowing the compress to remain two hours and moistening it more thoroughly, which converts the compress into a soothing fomentation that is not relaxing like a poultice.

In a colleague, whom I had the privilege of seeing with Dr. Palmer Cole, there was complete involvement of the entire right and subsequently of the left lung, with temperature ranging from 103°–105° F., the heart action being fair. The patient being a morphine *habitué*, there was a decided neurotic element in the case, involving insomnia and great jactitation. The compresses were applied hourly, despite the high temperature, but they were allowed to be quite moist, in order to obtain a calming effect. Dr. Cole says:* "The patient has no recollection of what had occurred during a period of four weeks. He subsequently thanked me more for having cured him of his opium habit than for saving his life. I have not the slightest doubt that the patient owed his life to the persistent external use of cold water, and that under any other treatment he would have died."

* Medical News, February 19th, 1898.

Rationale of the Cold Compress in Pneumonia.—No remedial measure deserves adoption by the profession unless the *rationale* can be satisfactorily explained.

The therapeutic indications are—(1) to stimulate and invigorate the nerve centres with a view to enhancing the patient's vital powers; (2) to prevent and control heart failure; (3) to reduce temperature; (4) to eliminate toxins.

The *nerve centres* are well stimulated and rehabilitated by the repeated gentle shocks and subsequent reactive stimulation of the sensory fibres in the skin, both of which are conveyed to the central nervous system and thence reflected to the organs, upon whose functionating capacity depends the patient's ability to resist the toxic agencies circulating in the blood. We aim here to accomplish precisely the same object as with the Brand bath in typhoid fever. The milder form of shock is better adapted to pneumonia, because it is less disturbing, and because the toxæmia induced by the diplococcus is less intense in the average case, and certainly has only one-third that of the life period of the Eberth bacillus.

After a few compresses the patient grows more calm, the inspirations, which are deepened by each application, continue deeper, dyspnœa is markedly relieved, sleep ensues, appetite improves, and the skin and kidneys begin to act more freely. These clinical evidences demonstrate the correctness of the *rationale* enunciated above.

The maintenance of the heart action is accomplished by the wet compresses in the following manner: When the cold compress is applied, there is a rapid contraction of the cutaneous vessels, which raises the tension at once, but eventuates in a tonic dilatation of these vessels, which is evidenced by a ruddy hue of the skin. This dilatation differs very decidedly from that relaxed condition of the cutaneous vessels produced by warm poultices. The latter relax the vasoconstrictors, producing a paretic condition of the vessels, or a stasis, while cold applications stimulate the vasodilators, giving rise to an active dilatation, with maintenance of the tone of the vessels, an active hyperæmia, by reason of which the blood is propelled more vigorously through them. The heart is thus relieved; not by a *vis a tergo*, as is the case after digitalis, but by a *vis a fronte*, formed by broadening of the blood stream in the cutaneous capillaries, whose enhanced tonicity aids at the same time in propelling the blood onward. Arterial tension is increased, as is evidenced by the better filling of the radial arteries. The right heart is indirectly aided by this enhancement of the general tone in the vascular apparatus, and may thus expend more force upon the pulmonary circulation, whose vessels contract more firmly by reason of the dilatation of the superficial vessels (see page 149).

Romberg has by injecting Fraenkel's diplococci into rabbits recently confirmed what I have for many years insisted upon, that the heart is embarrassed by reason of the incompetent peripheral circulation in infectious diseases. The dyspnœa and overloading of the right ventricle are not due chiefly to lung infiltration, because when crisis ensues the exudation is not at once removed, and yet the respiration and circulation are relieved at once. This can be accounted for only by the sudden relief of the nervous system from toxic elements generated by the diplococcus, whose activity ceases at once when it has reached the end of its natural life period. It is probable that crisis ensues when the antitoxins evolved in the natural course of the disease have attained an overbalance of power. The battle between the diplococcus, with its allies, and the patient's vital powers, is at an end. The most important effect of cold applications in pneumonia is, therefore, the aid and sustenance they furnish to the nervous system, which bears the brunt of the fight. The improvement of cardiac action is one of the results.

Reduction of temperature is an important therapeutic element in these cases. Persistent high temperature may enfeeble the heart, and certainly depreciates the nerve centres. Some good clinicians claim that high temperature is the chief danger to patients suffering from pneumonia. Since my argument against this view * I have repeatedly expressed opposition to this firmly established error, an error which has given unhappy prominence to the coal-tar antipyretics in the therapy of fevers. If any further testimony is needed to lay this ghost, which has so long affrighted timid practitioners, to rest, the statements of Hutinel, Baginsky, and Strümpell, cited above, demonstrate that we should cease to regard elevation of temperature as the cardinal symptom for therapeutic attack in pneumonia. While, however, these clinicians fully corroborate my own views expressed eight years ago, I may say that high temperature, though not actually and directly a lethal factor by inducing fatty degeneration of the cardiac muscular fibre, does seriously cripple the work of the heart by imposing upon it more rapid action, and it does seriously interfere with the patient's comfort. *High temperature, therefore, demands careful attention by measures* that are not harmful like the routine use of coal-tar antipyretics. I do not hesitate to use the latter occasionally when high temperature is associated with sleeplessness or great jactitation. They give great comfort to the patient, and are less annoying and disturbing than the wet compresses.

The susceptibility of pneumonia patients to cold baths, and the great facility with which their temperature may be reduced, render great care in the application of these measures imperative. For this reason *I have*

*Transactions of the New York State Medical Society, 1889.

abandoned cold baths, and have dwelt so minutely upon another hydriatric method. That so mild a procedure as the wet compress should be capable of reducing high temperature in pneumonia, I have numerous charts to demonstrate. The decline is not so rapid as after cold baths, but it is pronounced and steady. It does not ensue after one or more compresses, nor does it follow the course of temperature reduction observed after cold baths in typhoid fever. The temperature decreases day by day one or more degrees. This is not the result of direct refrigeration; such an effect is neither aimed at nor obtainable. When a compress at 60° F. covered with flannel is applied around the chest of a pneumonia patient who presents a temperature of 102° to 106° F., there is an immediate cooling of the surface covered by it, which is followed by a gradual reaction with a more or less rapid rise of the surface temperature, until the latter is nearly the same as it was previous to the application. The surface is now bathed in a vapor produced by the heating of the compress. If the latter be allowed to remain sufficiently long, the flannel covering receives the vaporized water, and slowly passes it outward until the compress becomes dry. But if the compress is changed, as indicated above, the vapor is more slowly removed, and the skin and compress are found to be cooler than is the flannel covering. Thus the gradual cooling process is continued until a fresh cold compress is applied, when the skin, more sensitive by reason of having been bathed in this warm vapor, feels the shock more distinctly and reacts more fully. The error is not infrequently committed of covering a wet compress with oiled silk. While this would protect the bed and clothing of the patient, it would defeat the object of the compress by converting it into a poultice. If the body temperature is 103° F. or over, the compress applied as above becomes warm in half an hour, although evaporation of the moisture through the flannel renders the skin under it cooler than other parts of the body. When it is renewed, the repetition of the gentle shock and tonic dilatation occurs. Thus a slow cooling process, not relaxing or in any way depreciating, is maintained, which gradually lowers the general temperature, calms the patient, and contributes much to his recovery.

How far this cutaneous hyperæmia acts as a revulsive, it is impossible to ascertain, but it is a well-known fact that such superficial hyperæmia is always accompanied by contraction of the blood-vessels in the deeper underlying parts. Thus may a favorable effect be produced also upon the inflamed lung tissue, and its circulation be improved.

3. The *elimination of toxins* is promoted by the wet compress, as by all cold hydriatric procedures.

This antitoxic eliminating effect is increased by copious libations of

water. It is my custom to administer in pneumonia, as in typhoid fever, six ounces of cold water every two hours, alternating with the same quantity of cold milk, night and day, when the patient is awake. The enormous increase of urine is scarcely credible. I have charts showing from sixty to one hundred and twenty-two ounces in twenty-four hours.

A Peculiar Effect.—There is a striking peculiarity impressed upon the regular course of croupous pneumonia by the method here outlined, to which I desire to call attention. Although the fever, dyspnœa, and other distressing manifestations yield, to a remarkable extent, in a large proportion of cases, in a few days, the physical signs do not change in a proportionate degree. Indeed, I have observed a distinct crisis in only about forty per cent of the cases so treated; in the remainder, the disease ended by lysis of a very slow type. Improvement of the general symptoms goes on, the patient seems well, and is anxious to rise, but a dull percussion note, muffled breath sounds, and bronchial whisper bear testimony to lingering exudates for many days, despite normal temperature. When the latter exists in the afternoon I allow the patient to rise.

H. E——, sickened on December 8th, 1895. His temperature ranged from 102° to 104° F. for four days, without any pronounced physical signs in the lungs, which were examined every day. On December 12th, consolidation of the posterior lower half of the right lung was made out. The mouth temperature was 104° F. at 3 P.M.; cough had been distressing several days; there were now rusty sputum and increased dyspnœa. The family being greatly alarmed, Dr. A. A. Smith was called in consultation, but did not see the patient until the next morning. Calomel having been administered, the wet compresses were applied, with the effect of bringing the temperature down two degrees in five hours, and producing good sleep. After twelve compresses the temperature was 101° F. at 8 A.M. When Dr. Smith saw him at ten o'clock he found him so comfortable that he expressed surprise at being called, and concurred in the treatment. Physical signs of consolidation were distinct. There had been no other treatment except five drops of dilute hydrochloric acid every two hours, followed by six ounces of water as a placebo. Temperature reached the normal point once every day for two days, and remained normal for ten days, when the patient was dismissed. Physical signs continued during Dr. Smith's attendance, and dulness of the percussion note had not entirely cleared up when I last saw the patient, although he was free from temperature, had a good appetite, and was able to sit up.

Clinical results confirm the *rationale* of this treatment, and attest its value. A quarter of a century ago the greatest living German clinician, Professor Niemeyer said: "I have made extensive employment of cold in the treatment of pneumonia, and, relying upon a large number of very favorable results, can recommend the procedure. In all cases I cover the chest of the patient, and the affected side in particular, with cloths which have been dipped in cold water and well

wrung out. . . . In the hospital at Prague, every pneumonia is treated with cold compresses, and, according to the statement of Smoler, it is exceptional for a patient not to feel material relief from the treatment."

Why has a treatment which had received high commendation by so eminent a teacher not become an established practice in a disease which so often baffles the physician under other management?

For the student of the history of hydrotherapy this question is not difficult to answer. Although water is an orthodox remedy, to which Hippocrates devoted almost an entire book, and although it has been highly commended by eminent physicians at various times, it has not become the common property of the profession, because *most of those who taught its use and value most earnestly, failed to give definite directions for its application.* Niemeyer illustrates this point. He simply advises "cloths wrung out of cold water to be applied to the chest" of the pneumonic patient. The temperature of the water, the duration, technique, frequency of repetition, were left to the discretion and good or bad judgment of his hearers and readers, and yet these are far more important in hydrotherapy than are the preparation, time of administration, frequency, etc., in prescribing medicinal agents.

Just as Niemeyer failed to create a permanent following for the practice which he so highly lauded, so has another justly famous American teacher failed to impress upon the profession a practice which he had taught in 1870, as follows: "If there be anything I should rely on in pneumonia, if the temperature is very high, it is cold water." If this excellent teacher had been as explicit in giving temperature, duration, etc., of the "cold-water treatment," as he was in giving the doses of the medicines he advises, the valuable lessons he endeavored to inculcate would not now (twenty-eight years later) require to be taught anew; they would have served as a beacon light to the vain searcher after reliable therapeutic methods in this fatal disease.

Statistical evidence to prove the value of the measures here advocated, or of any other method of managing pneumonia patients, is indeed very difficult to produce. The type of the disease differs very much; in private practice the number of cases is too meagre, and observations are too inaccurate and unreliable. The author has not lost a case of uncomplicated croupous pneumonia in private practice since the adoption of the management of patients here outlined. In hospital work the chief element of success with this method, viz., its application in the early stages of pneumonia, is unfortunately absent. Its favorable influence upon the progress of the disease is attested, however, by the statistics of one hundred and fifty-six cases in the J. Hood Wright Memorial (formerly Manhattan General) Hospital, in which the total mortality from pneumonia has been reduced

one-half since the method here advocated has been adopted by the entire staff; while in the cases admitted before the fifth day the mortality has been twelve per cent against thirty-seven per cent under the formerly prevailing expectant plan, many patients being badly nourished or addicted to alcohol. These cases were under the observation and treatment of my colleagues, Drs. Daniels and Knickerbocker, and myself.

Catarrhal Pneumonia.—The method described above is, with slight modifications, equally favorable in catarrhal pneumonia. When the latter occurs in infants or children, cold affusions are more frequently required than baths; in adults ablutions of the chest are useful adjuvants to the supporting measures usually applied in these cases.

Ample confirmation of the value of the chest pack in pneumonia may be cited from the literature of the subject. Jackson* relates his experience with it:

"In order to obtain the effects to be desired in this treatment, the cold must be freely applied and with a firm hand, until the effect of a reduction of temperature and arrest of symptoms occurs.

"The treatment is grateful to the patient. It can be managed without incommoding the sufferer, by the exercise of a little ingenuity. It is prompt in its effects for good, and it is easily applied.

"Under the usual routine treatment of poultices, expectorants, and whiskey, I can quite understand Dr. Osler's view as to the non-efficiency of treatment. But with the experience of the free use of cold, in the manner herein outlined, and in view of the etiological considerations advanced, I feel that a new and happier era is dawning in the treatment of pneumonia."

In order to offer the reader a fair and unbiassed review of other hydriatric methods recommended by reliable clinical observers in pneumonia, the following abbreviated statement of Dr. Fenwick, of the London Hospital, is cited. In the London *Lancet* Fenwick furnishes an analysis of 1,000 cases of pneumonia treated by different methods during the last ten years. In 56 cases treated by cold sponging, the mortality was 13 per cent. The "ice cradle" was used in 43 cases; mortality only 7 per cent. By all the various cold applications 108 cases were treated, with 10 per cent of failure. By all other grouped phases of treatment the losses were double those by the cold method. Stimulants were given in these latter cases whenever indicated. *Cold appears to be the best of the antipyretics* for the class of patients with which Dr. Fenwick has to deal, chiefly for the reason that it has less of depressant action upon the heart than antipyrin, quinine, etc.

The aim of the author being a perfectly fair representation of the

* Therapeutic Gazette, 1892.

subject, this contribution from a well-known clinician will prove valuable in moulding opinion.

Ice Packs.—This treatment has been warmly advocated by Dr. T. J. Mays, of Philadelphia, who brings strong statistical testimony to its support.* The cases cited by Dr. Mays are the result of a collective report from general practitioners in different parts of the United States. Eighty-one of these cases are reported with sufficient detail to enable him to tabulate them. All the cases in this table bear a record of the sex and age of the patient, the highest temperature and greatest frequency of respiration reached during the attack, the number of days intervening between the chill or the beginning of the disease and the day of crisis, or the subsidence of fever; the presence or absence of delirium, the unilateral or bilateral location of the disease, the result in each case, together with remarks, and the names and addresses of the reporters; they are chiefly from private practice.

The ages ranged from three weeks to seventy-five years; the temperature from 100° to 107°. There were 108 cases of single and 38 cases of double pneumonia; crisis ranged from the first day to the twelfth day of treatment.

The mortality was 3.58 per cent.

Dr. Mays says: "When we come to compare the results of the ice-cold treatment of pneumonia with those which have been obtained from other forms of treatment, it is safe to say that the former are infinitely more satisfactory than the latter. Statistics indicate that cold *has* a marked and decided influence on the pneumonic process, not only in bringing it to a favorable termination, but materially to shorten its course. This abortive power of the ice has been noticed and spoken of by many of the observers in my collection, and I believe that it demonstrates the great value of the remedy more than anything else.

"Cold reduces the pyrexia, strengthens the pulse, tones up the heart, diminishes the pain in the chest, alleviates difficulty of breathing, and gives greater general comfort to the patient. It is capable, however, of doing a great deal more. In virtue of its power to stimulate nerve function and to contract small blood-vessels, it promotes the pulmonary circulation, relieves stasis, hastens resolution, and disperses the products of exudation."

While the statistical evidence of the ice-pack treatment establishes its clinical value, I cannot accept all the elements of the *rationale* offered by Dr. Mays to explain its favorable action, especially the direct cooling effect upon the lung. It would seem that its success is due chiefly to its fulfiling all the indications in pneumonia almost as well as the chest compresses. The ice applied in bags, which are wrapped

* Med. Trans., Philadelphia County Med. Soc., 1895.

in towels and placed over the affected area, cannot reduce the inflammatory process in the lung by the direct effect of cold. That the latter is an erroneous idea has been proven by the experiments of Silex and Gilman Thompson (page 120). The *rationale* of the favorable influence of the ice-compress treatment, however, is not difficult to explain upon recognized principles of hydrotherapy.

The towels which envelop the bags of ice soon become thoroughly wet by melting and condensation, and thus the ice pack of Dr. Mays is practically a continuous wet compress. This fact prevents the complete reaction which is so useful in repeated cold application by arousing the nerve centres. Being applied upon parts of the chest only, undesirable results are prevented. The objections to ice compresses would seem to be that their uneven surfaces render them uncomfortable when applied to the posterior portions of the lungs, the patient lying on the back; and that their weight when applied anteriorly must render them inconvenient. In consideration of these facts I have not felt justified in applying this method of ice packs so long as good results were obtained from the wet compresses.

CHAPTER XVI

ENTERO-COLITIS.

ENTERO-COLITIS plays havoc among children whose diet and hygiene have been defective. As long as summer diarrhœa was regarded as a purely inflammatory disease, the treatment continued unsatisfactory; the mild cases recovered and the more severe succumbed.* The prognosis has become more favorable since the faulty character of this theory became apparent, and since the substitution of hydriatric measures for the formerly prevalent active medicinal treatment, together with more careful attention to the removal of irritating matters and a due regard to food and other hygienic essentials. It is now the almost universal belief that this disease is chiefly, though not solely, due to the ingestion and multiplication of micro-organisms which create in the gastro-intestinal tract conditions somewhat similar to those found in wounds to which septic material has had access. As in the latter we observe heat, redness, and swelling, signifying inflammation, with all its concomitants and sequelæ, modified by the position and functions of the parts involved; so have we in the former inflammations whose disturbing influence is exerted upon the organs involved, and which give rise to the manifestations of so-called entero-colitis.

The indications of treatment are:

1st. To diminish or remove the source of bacterial supply.

2d. To neutralize the disturbance produced by the bacteria.

3d. To remove them from the intestinal tract.

4th. To meet the nervous prostration, inanition, exhaustion, and other manifestations due to the diarrhœa.

1st. To accomplish the first object will be required only in an artificially fed infant. A wet-nurse should, if possible, be procured. This being impossible, it is necessary to look into the mode of preparing the food supply, *i.e.*, pasteurizing or sterilizing all the milk, and scrupulous attention to its preparation for the bottle, are of the utmost importance. All these are familiar to the intelligent physician.

2d. To neutralize the disturbance produced by the ingested and

* "A Clinical Study of the Etiology and Treatment of Summer Diarrhœa of Infants," by Simon Baruch, M.D., The Medical News, July 6th, 1883.

multiplying bacteria. In the treatment of nausea and vomiting, rest of the stomach stands first and foremost. The stomach cannot be at rest until all fermenting material be removed from it. This may be accomplished by the copious administration, by the spoon or nursing-bottle, of warm water, to which a small quantity of saccharin has been added. Irrigation of the stomach, by means of a soft-rubber stomach tube of small dimensions, is a measure of the greatest value (see *Technique*, page 226). Every physician realizes that the enforcement of absolute abstention from food and drink in the early stage of diarrhœa cannot be too strongly impressed upon the mother. It will require all the *morale* she possesses to execute the physician's directions. She may be convinced by the argument that, since everything the baby takes is rejected, it is futile to continue to feed it or even give it water.

3d. To remove the bacteria from the intestinal canal is the leading indication. It is important that all fermenting material which offers a nidus for their development should be swept out. A full dose of castor oil, or when the stomach is irritable a dose of calomel, will remove the entire mass from the *upper tract*. It will not be necessary to repeat the purgative if it is followed by thorough irrigation of the large intestine with sterilized warm water.

Experience has convinced me that thorough irrigation of the large intestine, administered by the physician or by a competent nurse under special instruction, every ten or twelve hours, lessens the number and changes the character of the movements, and produces a most soothing effect upon the patient. I have frequently seen infants who had been tossing in pain, purging and vomiting, drop into gentle slumber while the water was still flowing. Almost invariably a quiet slumber follows the irrigation, the purging ceases or is much modified, and the whole aspect of the case is changed. The result of irrigation is the removal of bacteria, mucus, undigested food, and fermenting material. That this effect is feasible is evident from the anatomical lesions. The lesions in summer diarrhœa are most frequently found in the cæcum, sigmoid flexure, and upper part of the rectum.

Hence we may safely assume that the irrigations reach the diseased surface in most instances. Thus we follow the indications of modern therapeutics, to *treat local troubles by local measures*, as far as possible. The inflamed parts are not only soothed by these warm irrigations, but the materies morbi, which maintain the disease, are removed and neutralized in the most thorough manner.

4th. To meet the manifestations due to the diarrhœa, and probably to absorption of ptomains, is a plain indication. Prostration of the vital powers is often rapid and pronounced, threatening a speedy fatal issue in many cases, from the very inception of the disease. I

confess that, until recent years, the true cause of this alarming condition escaped me. Since the recognition of high body temperature from ptomain poisoning, and of this toxæmia as the chief cause of the prostration, the prognosis of these cases has become far more favorable.

An elevated temperature range frequently marks the advent of "summer diarrhœa," especially of the more alarming types. Indeed, if the rectal temperature were more systematically observed, it would be discovered that a large number of severe cases are ushered in with and maintain a temperature ranging from 102° to 106°. So deceptive are the cool skin (especially of the extremities) and the clammy sweat produced by relaxation consequent upon the nausea, vomiting, and diarrhœa, that the high internal temperature is liable to escape observation unless the thermometer is introduced into the rectum.

Baths.—In acute cholera infantum baths are of paramount importance, affording more positive relief and contributing more to the cure than all other measures.

This form of summer diarrhœa has by some not inaptly been regarded as a type of heat stroke. Whenever the temperature exceeds 102° F., a cooling procedure is indicated. It is important that the proper method of bathing should be adopted, and that its *rationale* be well understood.

In these cases there is usually profound involvement of the nervous system, frequently manifested by a dull, apathetic countenance, sunken eyes, deadly pallor, cool extremities, not rarely terminating in outspoken eclamptic seizures. Medicines and stimulants are useless, because the stomach and rectum do not tolerate them. The child should be put at full length into a tub of water at 90°, after its face and head have been bathed with cold water; gentle friction should be constantly made, while some one is removing with a pitcher the tepid water and replacing it by ice water poured over the side of the tub farthest from the patient's body. The temperature of the bath is thus gradually lowered to 80°. If there be marked cerebral disturbance, water at 60° may be poured upon the head and shoulders for five seconds. The child's body, except the head, must be entirely submerged. Its cries and protestations of chilliness must be met with gentleness, yet with firmness. For eight to ten minutes the agitation of the water and friction of the body should be kept up, unless cyanosis of the face or decided shivering ensue. The latter will be prevented by active friction, which stimulates the peripheral circulation.

After the bath the child is placed upon a linen sheet, previously laid smoothly upon a blanket. If the rectal temperature before the bath—and it should always be taken at this time—has been 103.5° or higher, the child is wrapped in the sheet so that every part of the

body and extremities is well covered by it, the blanket is snugly wrapped over and tucked under the body, which is thus left to dry. If, on the contrary the temperature has been below 103.5°, the child should be gently mopped dry and its clothing be replaced at once. Such a bath is almost invariably followed by a calm and refreshing slumber, from which the child awakens bright and comfortable.

Let it be understood that the object of this bath is not alone to reduce temperature, although this is an important incidental result. We have here a vasomotor paralysis, as evidenced by the pallor of the entire body, even when a high temperature is registered in the rectum. By immersing the entire body in tepid water we produce a mild cutaneous excitation, which is gradually increased by the removal of warm and the addition of cold water, and is enhanced by frictions of the body and constant agitation of the cooling water against the skin. These gentle shocks are not beyond the child's reactive capacity; they are succeeded by equally gentle reactions, so that the cutaneous vessels dilate, as evidenced by redness of the skin. If, in addition, the face and head are bathed with water at 60° or below, the shock and reaction are increased, the respiration deepens, and the heart beats with more vigor and less rapidity, the eye brightens, the color returns to the lips, the child becomes more animated.

The effect of a skilfully administered bath in the condition of nerve prostration incident, in many children, to acute summer diarrhœa, must be observed to be fully appreciated. In my experience it has been an inestimable boon, affording hope and comfort under the most trying and desperate conditions. My mind still retains vivid recollections of the days when I was a student and of the early years of my practice, when the condition of profound adynamia, usually associated with hyperpyrexia, was called spurious hydrocephalus, and the patients were allowed to die under blisters to the nucha and small doses of calomel, etc. These cases do not now come under my observation; they are forestalled by the bath and by more rational treatment, *foremost in which is judicious gastro-intestinal irrigation.*

When there is objection or prejudice to tub bathing, or when there is extreme jactitation, or when there are convulsions, the little patient may be placed in the wet pack, or the bath may may be followed by the latter to maintain the calming effect. The wet pack is prepared by wringing out of water at a temperature of from 60° to 70° a small linen sheet, folded into a third of its usual size, or a large linen towel, and smoothly laid (folded to suit the size of the child) upon a blanket. The child is snugly wrapped in the damp sheet, which may be made more wet if the temperature be high (see *Wet Pack*, page 109). The blanket is now snugly tucked around the child, so as completely to

envelop it, like a mummy, to prevent evaporation. This pack may be repeated two or three times, at intervals of ten minutes. The previously tossing child will usually drop into a tranquil slumber, from which it should not be aroused. After the wet pack the body should always be gently rubbed with a linen cloth not quite wrung out of water at 70° F., and dried.

The effect of the pack or of the bath is readily maintained by abdominal compresses or by the trunk pack at 70°, repeated every hour.

In the *subacute forms of summer diarrhœa* the general depression of the system arising from the great drain upon the blood and nervous system indicates hydriatric procedures. The pulse is usually rapid; the temperature ranges from 99° to 101°, with occasional exacerbations; the skin is inelastic; the face is shrunken and sallow; in short, the symptoms are those of chronic adynamia, due to imperfect nutrition. To stimulate the appetite, improve the general nervous condition—in a word, to refresh the entire organism—should be our therapeutic endeavor. The most approved tonics and stimulants often fail. In these cases *general ablutions*, morning and evening, are preferable to baths. The child is placed upon a soft woollen blanket; the abdomen, chest, and back are rapidly bathed, not sponged, as follows: From the hollow of the naked hand water at a temperature of 75° F. is poured upon the skin, which is then gently rubbed and patted with the same hand. This is repeated until the entire body has thus been treated as far as the knees and elbows. The body is now rapidly dried by placing it upon a linen sheet, using friction with a rough towel if the temperature is below 99.5°, and by gentle mopping if it is above 100° F. If the temperature reaches 102°, a general bath is indicated, beginning with water at a temperature of 95°, which is gradually reduced by agitation and friction to 85°. Gentle drying follows.

The refreshing effect of these procedures has been so frequently observed that I do not hesitate to commend them. Many modifications may be applied to meet the various symptoms in summer diarrhœa of infants, which a thorough mastery of the principles of hydrotherapy will readily suggest. Suffice it to say that no case should be regarded as intractable or too desperate until some form of hydriatric procedure (the adaptation of which to each case often requires more judgment than for that of medicinal agents) has been tried.

The following case illustrates graphically the results of this treatment:

P. S——, infant, six months old, vigorous and healthy, living in one of our best houses on the banks of the Hudson, had been weaned one month. Since that time he had been suffering from occasional diarrhœa, which had been treated

with more or less success by my friend, the late Dr. Frothingham, and myself for a week. Vomiting and choleraic stools prompted the mother to summon me in haste. I found the little fellow a changed being; his features were pinched, the skin was cold and clammy; the eyes were sunken; he could retain nothing, the bowels ejected a thin, green fluid about every half-hour, sometimes more frequently. Dr. J. Lewis Smith was summoned in consultation.

In the mean time the symptoms grew more and more threatening; the pulse began to fail, the child lay with upturned eyes, pinched features, rapid shallow respiration and cold extremities—on the brink of dissolution. The rectal temperature, to my great surprise, was 106° F. A cold bath was immediately ordered, although the proposition so shocked the mother that she wrung her hands in despair, lest the infant should succumb to the cold. A large bathtub was half filled with water at 90°. The infant, whose stony gaze indicated the approach of eclampsia or impending dissolution, was submerged in the water, except the head; the lower and upper extremities were held up and chafed. Cold water was turned on, and ice water was added, while the water was permitted to flow from the tub. In ten minutes the temperature of the water was reduced to 80°. A smile now passed over the baby's face, his eyes lost the stare, and he revived. His rectal temperature began to fall, and in ten minutes reached 100°. He was now wrapped in a cloth wrung out of water at 80°, from neck to knees; hot-water bags were applied to the extremities, and he was carefully covered. He fell into a sweet slumber, from which he awoke when Dr. Smith arrived, to find him rescued from immediate danger. A wet-nurse and careful attention restored the child in a few days.

The author has deemed it fit to enter fully into the prevention and treatment of entero-colitis, because these depend chiefly upon hygiene and water treatment for success. Hygiene has always been intimately associated with hydrotherapy; even those enthusiastic advocates, the water-cure doctors and hydropaths, always combine hygienic directions with their crude hydrotherapy.

CHAPTER XVII.

ASIATIC CHOLERA.

Despite the great advances made in recent years in the etiology and prevention of this dread disease, by the inestimable researches of Koch and his followers, the treatment still is an *opprobrium medicorum*.

A judicial review of the most reliable literature on this subject would lead to the same conclusion which Sir Thomas Watson reached thirty odd years ago, viz., that "we have made no impression upon the disease by medication."

The most reliable statistics* give the result of fifteen epidemics occurring between 1831 to 1873, in which 28,753 persons were attacked, of whom 65.8 per cent died. In the Hamburg epidemic 17,975 cases occurred, with a mortality of 42.3 per cent. Since this disease has resisted so successfully the most varied medication, it may be of interest to inquire what has been done and what may be done by non-medicinal management, especially by *hydrotherapy*.

In the prophylaxis of cholera cleanliness plays an important rôle. This is an accepted fact. Hence, frequent bathing with warm water and soap must certainly be sanctioned. But this is not all that is needed. We have the authority of Sir Thomas Watson for the statement that people accustomed to daily cold bathing were often exempt from cholera. It is reported that during the epidemic of 1850 not one member of the "Association of Water Friends" in Berlin was attacked by cholera. Upon general principles, as well as upon actual experience, the daily cool or cold plunge, or rapid ablution with friction, may be regarded as a valuable prophylactic agent during an epidemic.†

In the treatment of cholera subcutaneous and intravenous injections of a normal salt solution have in recent times been regarded as valuable. But the former did not afford brilliant results in the Hamburg epidemic; the latter proved only a good stimulant in the algid stage, and did not tend to save lives.

* Albu, in "Realencyclopädie," Bd. iv., p. 248.

† Hippocrates mentions the success of cold affusions upon the abdomen in severe diarrhœa. He relates the history of the wife of Antimachus of Larissa, in whom the diarrhœa was cured by this procedure, although the patient died. Rufus of Ephesus recommended about the middle of the first century cold sitz baths for the treatment of profuse diarrhœas.—Eulenberg's "Realencyclop.," 241–45, p. 152.

Hydrotherapy.—That water has proved itself superior to the opiate or other treatment of cholera, though attested by the most indisputable evidence, is still almost unknown and certainly unappreciated by the medical profession.

In 1831 Professor Guenther, director of the Allgemeines Krankenhaus at Vienna, ordered the entire surface of the body washed with sponges or cloths dipped in cold water, and active friction with pieces of ice made over the extremities and sometimes over the entire body, until it became warm, which was usually the case in five or six minutes. The patient was now wrapped up in hot blankets.

Professor Casper, of Berlin, placed the patient in an empty tub, if he was dry; or in one containing lukewarm water (92° F.) as far as the navel, if perspiring, and poured three to five buckets of ice-cold water over the head, chest, and back every two or three hours. After this the patient was dried, rubbed, and put into warm blankets. Casper correctly terms this a warming method.

Professor Sachs, of Königsberg, says that cold water is a remedy whose omission in cholera, when it can be used, *he would regard as an unpardonable violation of duty.*

Dr. Wagner, who was active in the epidemics of 1831, 1832 to 1836, regards the cold affusion as of the best service. "Its effect, when it is indicated and successfully applied, is brilliant and almost incredible."

The French minister of commerce sent Drs. Grimaud and Martin to Germany to study cholera, which was then advancing toward France. These gentlemen reported that "of all the methods employed, that by cold has proved the most efficacious, because the number cured is double the number of those who died, a proportion not obtained in any other country."

It should be borne in mind *that these citations are not from hydropaths,* or water-cure doctors and enthusiasts, but mostly from hospital physicians and professors of medicine at their respective universities. They are confirmed by the reports of Winternitz and Vogl, and this method is susceptible of a more logical *rationale* than is any other treatment thus far proposed in cholera.

To Wilhelm Winternitz we are indebted for a correct *rationale* of the action of water in cholera, which is the same as in other infectious diseases, viz., to counteract the toxic agencies under which the system is tottering, to improve the circulation, restore warmth, and increase urinary elimination. He has the patient rubbed with a sheet wrung out of water at 50°–60° F.; this is followed by sitz baths of 60°–70° F. for ten to twenty minutes, the patient is dried and placed into a warm bed. This is repeated every hour or two.

We have ample warrant for this rational treatment in its successful application in the algid, pernicious forms of malarial fevers, in which Dr. Osler advises placing the patient in a tub and douching with cold water, and of which George B. Wood says: "If there be any power of reaction left it is apt to be awakened by the shock." *Similar conditions exist in cholera.*

Dr. A. Vogl, chief of the medical army staff at Munich, says:* "Because of the lowered surface temperature in cholera, all the various methods of treatment hitherto in vogue were combined with the application of warmth. We may raise the temperature of a cholera patient's skin by wrapping him in hot cloths, wet or dry, just as we may do for a corpse. But the necessary reaction, which maintains the heat at the periphery and sets aside its concentration in the interior of the body, is lacking, or occurs only in slight degree. Indeed, hot applications act inversely by maintaining a passive heat.

"The majority of the reporters from the latest epidemic (1892) have declared themselves opposed to such warming, and especially to the hot bath; they are divided in favor of milder procedures in the form of tepid baths, packs, etc. Still, the middle course is not always advisable, especially when *we may expect results from decided treatment.*

"Even in the earliest times physicians thought ice rubbing the most effective means of correcting the icy coldness of the skin and weakness of the heart in the algid stage. Among members of our society such men as Pfeifer, Dietl, Leitz, Ernst, Buchner, Schleiss, Graf, have used this agent and declared themselves decidedly in favor of it. *Rubbing the calf muscles, when they are as tense as a board in cholera, with ice relieves more quickly than an injection of morphine.*

"In the epidemic of 1873–74, patients in the algid stage were energetically rubbed all over the body with large smooth pieces of ice until the skin became intensely red; they were then wrapped in warm coverings, and the procedure was repeated as indicated. After this treatment, reaction, with dilatation of the capillary area and perspiration, was a sure indication of progress toward recovery.

"*I consider it of the greatest importance to bring subcutaneous infusion to its desired efficacy. Infusion will accomplish results when nothing more can be expected of hydrotherapy,* when the circulation has been promoted by cold applications. The powerful diuretic effect of cold procedures, which is sure to ensue, must also be considered.

"The majority of medical men still fail to appreciate the intimate connection existing between the peripheral and central circulation. It has often been demonstrated that an attack of obstinate catarrhal

*"Ueber die Körperwärme und Therapie in den verschiedenen Stadien der Cholera," Münchener med. Woch., 1893.

colitis which has resisted all methods of internal treatment is easily controlled by the simplest external application of cold water, such as cold packs, and the diarrhœa of typhoid fever has often been checked by cold baths. Dietl's claim, that 'while cholera is one of the most dangerous diseases, it is also one of the most curable,' should not be ridiculed.

"*Method Practised in the Munich Military Hospital.—Early Stage.*—The rectal and axillary temperatures were taken; the patient was then enveloped standing in a cold wet sheet, and rubbed down until the surface of the body became warm. After three to five minutes' rubbing he was wrapped up in a blanket and put into a sitz bath at a temperature of 50° F., where he remained fifteen minutes, *being rubbed continuously* by the attendants. He was now put to bed with a compress wrung out of water at a temperature of 50° F. applied over the abdomen. By this time the patient began to perspire and feel comfortable. If diarrhœa appeard within four to six hours the same treatment was repeated, which was rarely needed. No internal medication was given. Of sixty-four cases of choleraic diarrhœa received into the hospital, not one received a grain of opium. Most of them were treated with the cold compress and cured in eight to ten days; only a few cases progressed to cholerine or cholera. Developed mild cases of cholera were treated in a similar manner and *absorption of the subcutaneous injection* was thus facilitated.

"*Algid State.*—When dejections were abundant we limited ourselves to rubbing with the cold wet sheet and cold abdominal wet compresses, with an early resort to subcutaneous saline infusions.

"Inject a syringeful every minute till the pulse returns; then, once in five minutes, and later once every half-hour. And not till the urine is secreted in considerable quantity should this procedure be stopped.

"Clinical as well as post-mortem observations have taught us that the shock in the pre-algid stage is due to the rapidity of transudation rather than to its quantity. Whatever may be its cause, the object of our treatment must be to strengthen the action of the heart and accelerate the circulation of the blood which has become stagnant. For this purpose no procedure is more effective than such a thermic and mechanical irritation of the skin, as is produced by the above-outlined treatment; and the greater the collapse the more urgent the indications for its employment."

The large material at Dr. Vogl's disposal and his responsible official position conspire to render his views of exceptional value. Since he dispenses with medicinal treatment, which has in other hands also proven so fatal, we invite the attention of the reader to a careful

perusal of this logical paper by a hospital physician who is not a water doctor, but who utilizes every remedial agent for the benefit of his patients.

The addition of enteroclysis enhances the effect of external hydrotherapy.

Enteroclysis has been referred to (page 239) as a valuable agent in the treatment of Asiatic cholera. It was brought prominently before the medical profession by Dr. Elmer Lee,* who applied it in the cholera region of Russia, Germany, and France, during the summer of 1892. Upon the theory that cholera is a disease resulting from the introduction of filth into the stomach and intestinal canal, he thought it desirable to bend every energy to the removal of this "filth." This should be done if possible before the system was overwhelmed by the toxin arising from its presence in the intestinal canal (see page 241). The effect of passing into, through, and out of the large bowel of two or three gallons of warm water with soap, is not only directly to remove the accumulated contents of the large bowel, but secondarily, through the sympathetic nervous action of the muscular organism of the small intestine, almost to completely carry off its liquid contents, including every form of bacterial life. When the intestinal canal is cleared of this hurtful and filthy mass, great relief is experienced. The full benefit, however, can be obtained only by early treatment.

"The plan, as finally adopted in St. Petersburg, was to take the patient from the ambulance to the bathroom, without delay, and when the clothes were removed, the patient was laid on his back on the irrigating-table, with the knees drawn up and the muscles of the abdomen relaxed; the long tube, after being lubricated with soap, was gently pushed into the rectum and urged by twisting and gentle pressure into the lower bowel, as high as it could be made to go, and the stream of the previously prepared solution of warm water and soap, making a soapsuds, was allowed to run into the colon. When the colon became filled, the pressure exerted would force the water to seek an outlet back through the bowel and out of the opening around the outer surface of the tube into a properly constructed receiving-vessel.

"After the bowels have been cleansed, the patient was placed in a bath of warm water and afterward conducted to his bed. The irrigation was repeated one or more times. The average number of times that irrigations were given in St. Petersburg was twice; occasionally a third irrigation was given, but frequently one irrigation was found sufficient. Within one or two hours after flushing of the bowel the patient would have from one to three or four evacuations, which would be followed by an interval of rest and cessation of from twelve to

* Medical Record, December 17th, 1893.

twenty-four or thirty-six hours. Relief of the spasm of the intestinal muscles, which produced the intense suffering, followed promptly upon the removal of the irritating contents, and the administration of morphine was not required. In nearly every case the stomach was also irrigated with a solution of salt and water. After this combined treatment vomiting and purging in most cases would subside. As an internal treatment I recommended and used hydrogen dioxide diluted with distilled water, given in cupful doses at intervals of three hours, with the object of further cleansing and disinfecting the intestinal canal.

"The first symptom of cholera is diarrhœa, a signal of warning which may be recognized even by the most ignorant peasant. If all cases, without waiting for a bacteriological diagnosis, were brought under this system of management

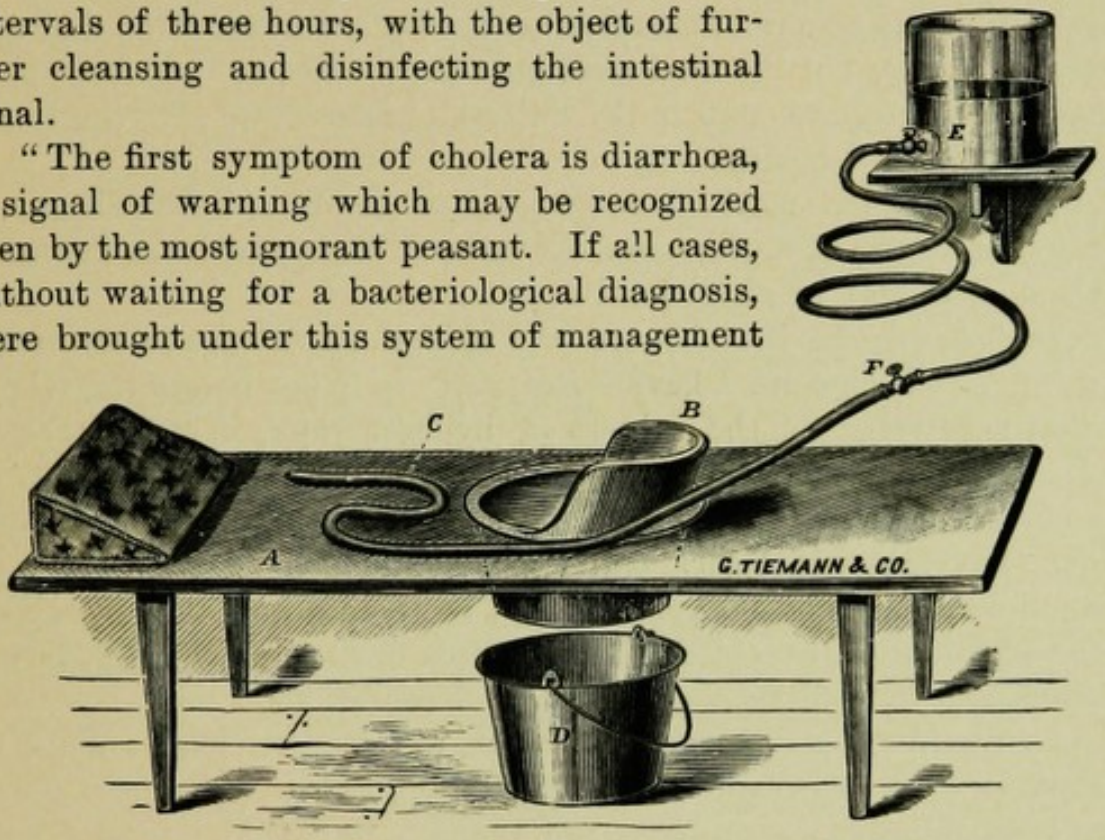


Fig. 67.—Dr. Elmer Lee's Irrigating Apparatus for Cholera Stations.

it would be reasonable to expect recovery, if not an entire escape from the disease. The lesson to be impressed upon those who have authority, and upon the poor and working classes, is that in times of cholera, upon the first attack of diarrhœa, they should use irrigation. And I would recommend to the authorities the establishment in the districts of towns and cities of a simple but effective apparatus, to cleanse the bowels effectually by a process of irrigation with soap and water.

"The irrigating-apparatus consists of a low table suitably made, as represented in the accompanying illustration (Fig. 67). Such an apparatus should be provided near the homes of the poorer classes as well as in every part of the city, and a physician should be detailed to receive and treat every person with symptoms of looseness of the bowels or abdominal colic. Then, if thought desirable, the patient should be transferred to a hospital, or permitted to return home.

"That the interval between the first symptoms of cholera and the time of treatment is ofttimes fatal, is a lesson which would go far toward relieving anxiety and terror in cholera times."

The number of cases treated by Dr. Lee personally was twenty-seven; the total number of deaths was three, and of recoveries twenty-three, with one whose recovery was not complete at the time of his departure.

The number of cases treated by this system in the hands of the physician of the hospital amounted to nearly one hundred at the time of his departure, but the final records of these cases are yet to be published. The hospital staff at St. Petersburg agreed to give the treatment a trial of six months.

Dr. Lee's experiments in the hospital at Hamburg were confined to two genuine cases of cholera, and its value in these cases was manifest to the cholera staff of physicians.

Conclusions.—In the absence of personal experience in the treatment of Asiatic cholera, I have endeavored to place before the reader all that is of value on the subject of hydrotherapy, in order that in future epidemics physicians will not be so helpless at the bedside of the cholera patient. The disease is fatal under the ordinary treatment. Favorable experience, based upon a judicious *rationale*, demands that external and internal hydrotherapy be given a fair trial, especially as the seeming boldness of these procedures finds ample warrant in the *rationale* and in their success in analogous conditions.

The treatment may be epitomized as follows: 1. Cases should be treated early by the cold wet-sheet rubbing (60°) (see *Drip Sheet*, page 101), followed by hip baths (75°) for five to fifteen minutes, with constant active friction by two attendants, to prevent chilling. When diarrhœa is abundant, the patient should be removed earlier. Several sitz baths should be provided, so that the patient may be removed from a soiled to a clean bath when required. After thorough drying and providing reaction, the patient should be wrapped in a warmed blanket and an abdominal compress (50°) applied. 2. As soon as another movement occurs, the patient should receive a thorough intestinal irrigation and a large subcutaneous saline infusion.

These procedures should be alternated, if not successful; rapid rubbing with ice may be substituted for the wet sheet. The temperature and duration of the sitz bath should be modified to suit the case and the character of the epidemic, in accordance with the *rationale* furnished above. Reaction is the aim of therapy in this dread disease.

CHAPTER XVIII.

INSOLATION.

In the management of cases of sunstroke, which have, not inaptly, received the appellation of "thermic fever," the application of water has for a long time played an important rôle.

All the most recent text-books teach erroneously that hyperpyrexia is the chief danger in this disease, and that every effort should be bent to reduce the excessive temperature, by bathing the patient in ice water and by similar methods. I desire to protest earnestly against this view of the therapeutic indications in thermic fever, and to direct attention to the fatal fallacy of regarding the coldest bath as the most useful heat-reducing treatment.

It is my purpose to show, as clearly as the principles and practice of hydrotherapy are capable of demonstrating, that *the ice bath and ice pack so universally recommended in this disease are absolutely contraindicated, dangerous, and based upon fallacious reasoning.* In avowing so decided a departure from the almost universally adopted view, the author is conscious of the antagonism he invites. But he purposes to establish the correctness of his opinion by theoretical and clinical data, which he hopes to make convincing, and thus contribute to the saving of many lives which are now sacrificed by reason of an erroneous conception of the disease and of the antithermic effect of ice-water baths.

The first proposition, viz., that the hyperpyrexia theory of the treatment of thermic fever is almost universally accepted, is demonstrated by the following citations from standard text-books:

Taylor's "Handbook of Practice" (London, 1890) says (page 771): "The temperature must be reduced as quickly as possible; if ice can be procured it should be put in the water used, or it may be rubbed directly over the body of the sufferer, *until the temperature in the rectum nearly, but not quite, reaches the normal.*"

Strümpell, "Text-Book of Medicine," translator's note, says (page 748): "Here the immediate danger is from hyperpyrexia, which must be combated by rubbing the patient with ice, placing him in a tub of water with lumps of ice, or similar measures, *until the temperature in the rectum is reduced nearly but not quite to the normal point.* In the application of refrigerating measures the head must not be neglected. The sole indication at first is the reduction of the temperature."

Osler says, page 1,019: "In thermic fever the indications are to *reduce the temperature as rapidly as possible.* This may be done by placing the patient in a bath of 70°. Rubbing the body with ice, practised by Darrach in the New York Hospital in 1857, is an excellent procedure to lower the temperature rapidly. At the Pennsylvania Hospital in 1887, the ice pack was used with great advantage. Of thirty-one cases only twelve died, a result probably as satisfactory as can be obtained."

The history of fever treatment offers a parallel, the consideration of which may aid the reader in appreciating the author's position. The text-books of fifteen years ago when referring to the treatment of typhoid or other infectious fevers, dwell in precisely the same manner upon the paramount influence of high temperature, upon the danger of hyperpyrexia, and upon the necessity of meeting this lethal symptom at all hazards. Cold water had been used in infectious fevers with more or less success from the earliest days of medicine. About twenty years ago Liebermeister, Jürgensen, and others urged the application of very cold baths as the best antipyretic in typhoid fever. To-day these authorities, like all other well-informed physicians, regard the cold bath as a nerve stimulant rather than as an antipyretic, and its technique (see page 144) has been modified in accordance with this view. If the reader would approach the consideration of the subject without prejudice, he should bear in mind the historical facts that for centuries the heat-reducing theory of fever has dominated the medical mind and controlled the selection of remedies for fever; that from 1860 to 1890, and even later, the medical profession, with very few exceptions, believed in and practised the antipyretic methods, and that cold baths were applied as the most valuable measure for this purpose. When the real medicinal antipyretics of the coal-tar series were discovered, the question of successful treatment of fever seemed to approach solution. If high temperature were the chief lethal factor in infectious fevers, it was argued that the positive antithermic properties of the coal-tar products offered a key to the solution.

How faithfully these antipyretics have been plied during the past fifteen years, how sadly disappointing they have proved, belongs to history. Slowly but surely have the seemingly victorious antipyretics retreated from the field, first in the large hospital centres, where exact observation more quickly relegated them to their true position as symptomatic remedies; gradually their true estimate is being discovered in the smaller towns and even in the rural hamlets of our country. The teachings of Delafield, Peabody, Osler, John C. Wilson, Hare, Tyson, and others, have penetrated, through instruction of the younger generation of physicians. To-day, the correct *rationale* of

cold applications in fevers is that furnished on page 141, which may be epitomized in the statement that they stimulate the vasomotor apparatus.

Moreover, while cold baths have always improved the mortality statistics of typhoid fever, their systematic use, as in the Brand method, which is distinctly an antifebrile rather than an antithermic bath treatment, chiefly by reason of the addition of mechanical irritation, has furnished the most marvellous reduction of mortality in the history of medicine (page 167).

When the writer made the first plea for this method before the New York State Medical Society in 1889, the *Medical Record* (February 16th, 1889) referred to it editorially (page 182) as follows:

"It will be difficult to persuade the profession, which has been so long under the dominion of the *laissez faire* policy, to adopt the heroic method of cold bathing. There seems, however, in the points made, sufficient ground to enlist our careful reconsideration of the whole subject. The *most important of these seems to us the emphasis placed upon the object of the cold bath being anti-febrile rather than merely antithermic*, inasmuch as its action is chiefly directed toward the neutralization of the febrile toxæmia due to the typhoid process. The secondary position assigned to elevated temperature as a lethal factor may be amply sustained by recent clinical observations. Lowering temperatures is not a curative measure."

The difficulty of winning the medical profession over to this view is apparent in the medical journals. But the truth was "mighty and did prevail." Seven years later, during a discussion of bathing in typhoid fever, one of the speakers said:* "The tubbing brought the circulation to the surface and acted upon the nervous system. A few years ago leading men in the profession had opposed the Brand method in this hall, while to-night no voice was raised in opposition."

I purpose to show that "history repeats itself" in the prevalent antipyretic treatment of thermic fever (sunstroke). While cold is even more universally utilized in insolation than it ever was in typhoid fever, we still fail to obtain the best results from it, *because the consensus of medical opinion favors its use as a temperature-reducing agent*—viz., for the hyperpyrexia—precisely as was formerly done in typhoid fever.

Whether the theory of Wood and others be accepted, that "thermic fever is due to a paralysis, under the influence of extreme heat, of the centres in the medulla spinalis which regulate the disposition of bodily heat, and owing to this disturbance more heat is produced and less is given than normally;" or the theory of Jacubowitch and others, "that there is usually an increase of heat from muscular action (in most

* Med. Rec., January 9th, 1897, p. 66.

cases it occurs during active muscular movements, as in labor or marching), and there is a diminished heat loss due to humidity and high temperature of the atmosphere"—the fact remains that the heat-diffusing function of the skin has become impaired. The latter we absolutely know and need not theorize upon. Another point which we absolutely know is that in the large majority of autopsies we find everywhere in the body enormous dilatation of the veins and pronounced narrowing of the arteries.

The rise of temperature is in the author's opinion chiefly, if not entirely, due to the failure of the enormous area of skin to carry off the rapidly accumulating heat. A heat stasis ensues, just as it does in typhoid fever. This is evidenced by the pallid or cyanosed appearance of the skin (excepting that covering the face). We have precisely the same cutaneous condition in typhoid fever—a paretic condition of the peripheral arterioles. So long as typhoid patients were plunged into tubs of very cold water* or were wrapped in sheets and sprinkled with ice water (see page 409), until the temperature was reduced, so long did typhoid fever continue fatal. When the *ignis fatuus* of hyperpyrexia ceased to affright the practitioner, and he learned to apply cold water as a nerve stimulant, the disease became more tractable (see *rationale* of the cold bath). In insolation high temperature is now regarded as the chief point of therapeutic attack, and this is combated by very cold and prolonged baths. I have endeavored to demonstrate the fallacy of the latter idea in typhoid fever treatment, and to show that by adding to the cold bath active friction (Brand method) the life-saving efficiency of the latter is enhanced. The antipyretic effect is also increased by friction, because it dilates the cutaneous vessels and admits of a large area of blood-vessels being exposed to the cooling effect of the bath. Having already entered very fully upon the subject elsewhere (page 167), it is necessary only to reiterate here that the reduction of internal temperature by cold baths is not due to direct cooling, which really contracts the cutaneous vessels and drives the blood from the surface, causing, if excessive or prolonged, their paralysis, but depends rather upon the extent to which the peripheral nerves and vessels are excited by the cold and friction or mechanical impact. This stimuulus is conveyed to the central nervous system and by reflex effect removes or ameliorates all the serious manifestations, including the hyperpyrexia.

It remains now to apply this physiological fact to the treatment of

*In the Archiv für klin. Med., Bd. 3 and 4, Dr. Krügkola reports from Duschek's Clinic sixty cases of typhoid fever treated by cold baths, with a mortality of 28.3. The patients were laid into a bath of 60–65° F. without friction, for ten minutes, from 6 A.M. to 10 P.M., whenever the temperature required to be reduced.

insolation. Does the ice bath or other heroic water treatment really furnish the best results? Shall we continue to follow the teachings of the text-books, and with might and main reduce the temperature of these thermic-fever cases to nearly a normal point? Let clinical observation answer this question, as it has answered it in typhoid fever!

The most reliable and extensive observations upon insolation that have been made in recent times are contained in a paper* presented to the New York Academy of Medicine, May 20th, 1897.

During the summer of 1896 a severe epidemic of sunstroke prevailed in New York City, which furnished during the week ending August 15th six hundred and forty-eight deaths—over one-third of the entire mortality.

The writer collected records from nearly all the hospitals in the city. "There were five hundred and twenty hyperpyrexia cases treated, with a mortality of one hundred and thirty-two. Among the patients treated by means of baths ranging in temperature from 50° to 75°, the mortality was 33⅓ per cent. In the Brooklyn Homœopathic Hospital, where baths of 90°–110°, reduced in from fifteen to twenty minutes to 72°, were given, forty-nine cases were treated, with a mortality of 41.17 per cent. In the same hospital another series of cases, treated by needle spray from a hose attached to a cold-water faucet, gave a mortality of 11.5 per cent.

"At the Flower Hospital the patient was stripped and put on a cot covered with a rubber sheet, an ice cap applied to the head, and three sections of hose with nozzles, giving a fine needle spray, were fastened to the cold-water faucet and the patient vigorously sprayed until the rectal temperature was reduced to 103°. The patient was then wrapped in two blankets. If the temperature rose to 104° or 105°, the spraying was repeated until it fell to 101°. Among twenty-six patients thus treated, with a body temperature averaging 108°, three died—11.5 per cent.

"At the St. Vincent Hospital the patient was wrapped in a cotton sheet and placed on a stretcher, which was covered with a rubber sheet. Dipperfuls of cold water were forcibly dashed on him from a distance of several feet. In the very severe cases every two or three minutes a small stream of very cold water from a pitcher was allowed to fall from a height of six or eight feet upon the patient's forehead. This treatment proved to be powerfully *stimulative*, and was continued until the temperature fell to 104° or 103°. The patient was then wrapped in blankets and surrounded with hot bottles. The body

* "Sunstroke as it Occurred in New York City during 1896," Medical News, July 24th, 1897.

temperature fell slowly to normal and no reaction occurred. Often after a short interval the warm pack brought on sweating and the patient slept. Of one hundred and ninety-seven hyperpyrexial cases twelve were fatal—six per cent."

These figures teach a valuable lesson, which establishes the correctness of the views I desire to impress. Although hyperpyrexia seems to be the dominant indication in this author's mind, he displays in several parts of his paper a correct estimate of the value of *cold water as a nerve stimulant.* He condemns the ice pack, because "it prevents proper friction and is not stimulating, as the cold bath, and therefore not so efficacious."

In order to emphasize the danger of very low temperatures, especially of ice baths* (*i.e.*, submerging the patient in cold water for five or more minutes) and ice packs, and to impress upon the reader the paramount import of mechanical irritation of the skin by pressure in the delivery of the water upon it, the following summary of the effect of the various treatments referred to above is offered:

1. Graduated bath (110° to 72°, fifteen to twenty minutes), mortality, 41.17 per cent.

2. Ice pack, mortality, 38.7 per cent.

3. Cold baths (50° to 75°, ten minutes or more), mortality, 33.33 per cent.

4. Needle spray (75°, stopped when temperature reached 103°), mortality, 11.5 per cent.

5. Affusions with force (ice water, as stopped when 104° or 103° was reached, O'Dwyer's practice), mortality, 6 per cent.

The fact that Osler regards a mortality of 38.7 per cent as "about as satisfactory as can be obtained" indicates how fatal is sunstroke under the customary antithermic treatment. The above figures demonstrate that *a change from the antithermic procedures* (ice baths and packs) *to the real nerve stimulating procedures* (douches and affusions) *would reduce the mortality in a marked degree.* They offer clinical proof of the correctness of the view expressed in the opening lines of this chapter, that theory and practice combine in condemn-

* "By an ice bath is meant a tub bath in which ice crushed into moderates-ized pieces is constantly kept floating. The temperature of the bath is about 40° F. Incessant and vigorous rubbing of every portion of the body is an absolute necessity. When the bath was given for ten minutes, irrespective of the height of temperature, the results were not good.

"The ice pack was given by placing a patient on a rubber sheet and packing large pieces of ice along and between the legs and along the sides of the body. The upper surface of the body was rubbed with the hands and pieces of ice. This procedure often required more than an hour. The temperature almost always fell."

ing the ice baths and ice packs recommended and reiterated in our text-books.

As in typhoid-fever treatment, I do not contend that hyperpyrexia is to be regarded with indifference. I plead for the recognition of *nerve depreciation as the chief lethal factor.* The latter is anterior to the hyperpyrexia and is most effectively treated by brief applications of cold water applied with considerable force to successive parts of the body. *The nerve centres are so overwhelmed by the atmospheric temperature acting upon predisposed individuals that they render the patient incapable of responding to the simultaneous impact of very cold water over the entire body.* Hence douches and affusions are superior to ice baths and packs. The correct treatment would be a judicious adaptation of the temperature of the water, the mechanical impact, and the duration to the indications existing in each case. The nerve depreciation being overcome by judicious management, hyperpyrexia will yield with the other manifestations of impaired nerve control. The following outline may serve as a guide to the management of thermic fever. It is based upon the principles enunciated in this work and it is borne out by the clinical data which have been marshalled.

If the pulse is feeble or rapid, skin pale, and the patient conscious, temperature above 103°, treatment may be begun by ablutions. The patient, lying upon a rubber sheet which is covered with a blanket, is rapidly bathed *and rubbed* for ten minutes with a wash cloth or large crumpled piece of surgical gauze saturated with water at 75°. If the skin shows reaction, this ablution may be repeated in half an hour with water at 70°, again in half an hour with water at 65°, and so on until the rectal temperature falls two or three degrees. *It is a serious error to continue bathing until the rectal temperature approximates the normal point;* the record shows that many succumb with a normal temperature, and that others rapidly and fatally fall to a subnormal temperature. It is far more prudent and effective to repeat the treatment after the system has had time and opportunity to react somewhat, and to decrease the temperature of the water and increase the force of its impingement by slowly pouring it from a greater height or using a jet or needle douche over successive parts of the body, *never continuing the application upon any part which is already cooled.*

The sheet bath (page 92) affords an excellent procedure in cases with very high temperature. In comatose cases water at 50° to 40°, delivered by a douche or by forcible affusion from basins at short intervals over successive parts of the body, will afford the best results. Here, too, care should be exercised not to depress the nerve centres by long-continued application of very cold water. Reaction must be induced.

Above all things, routine must be eschewed. Judgment and skilful adaptation to each individual case will afford in these trying cases the same good results which judicious hydrotherapy has achieved in other serious acute diseases. The lesson of history, presented by cold bathing in typhoid fever, needs to be earnestly accepted. I fear, however, that much time may elapse ere the warning here emphasized, "beware of the ice bath and ice pack," will succeed in neutralizing the teachings of the text-books, which in many instances are the reiteration of previous teachings rather than the outcome of bedside observation.

It is the chief aim of this work to impress upon the practitioner the true principles of hydrotherapy. In no disease are they so well illustrated to-day as in the true and false treatment of insolation.

CHAPTER XIX.

THE HOT-AIR BATH.

Directly connected with the application of water in disease, the hot-air bath has long been in use for enhancing the reactive capacity of patients about to be subjected to hydriatric procedures. An arrangement for home use may be improvised by seating the patient upon a chair provided with a wooden seat, the bottom of which is covered with tin or sheet iron. A large alcohol or gas lamp is placed under the chair, upon a tin pan. The patient is covered with a sheet which is secured around his neck, and over this a rubber sheet is similarly secured. When the lamp is lighted the air surrounding the patient may be heated to the required temperature.

An apparatus (Fig. 68) for use in bed, devised by Fulpius, appears to be practical. It consists of a wooden box seventy centimetres long, fifteen centimetres wide and deep. Into this box a pipe about sixty centimetres long, which is connected with the lamp, enters and conveys the heated air to a space formed upon the bed by two wooden poles, which reach and are secured to the pillow. The patient being placed upon the bed, the box is laid across the foot of the latter and the poles are secured. Blankets are now so placed that the patient is entirely surrounded by the hot air streaming upon him.

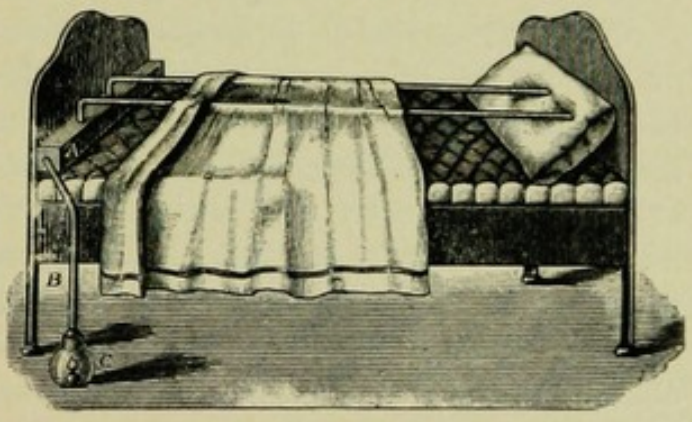


Fig. 68.—Hot-Air Bath for Domestic Use (Glax).

The dry pack described in the article on Phthisis Treatment is a useful procedure for surrounding the patient with hot air without subjecting him to agitation.

For institutions the hot-air cabinet is a complete apparatus. Rationally and not indiscriminately applied, as is done in the ordinary Turkish baths, but in the form of what the French call *étuve sèche*, the hot-air bath presents many advantages.

The apparatus in use in the Hydriatric Department of the Riverside

Baths, and at the Park Avenue Hydriatric Institute, consists of three wooden cabinets (see page 339). Practical experience with this apparatus during the past ten years proves it to be absolutely perfect, though very simple. The temperature of the air surrounding the patient is controlled by a valve, and may easily be raised to 180°. This is rarely necessary, however. The pulse and mouth temperature may be taken and recorded every ten minutes. After the desired rise of temperature and increase of perspiration are obtained, the patient is subjected to whatever procedure is indicated.

Rationale.—The effect of hot-air baths on man has been studied by Tetatmik,* who found that the number of leucocytes was diminished by from 5.45 per cent to 7.43 per cent. The studies of Tschondowsky demonstrate that there are abundant diaphoresis, an increase of two degrees in the body temperature, increase of pulse and respiration, diminution of muscular power and vital capacity of the lungs, enfeeblement of inspiration and expiration, decided enhancement of tissue change and assimilation, and diminution of arterial tension.

These observations have been confirmed by Gonsier and Polozow,† and also prove the correctness of the observations of Frey, of Baden-Baden.

Frey‡ has given us an admirable *résumé* of the *rationale* and effects of the hot-air and vapor baths. As has been shown (page 24) when the body is exposed to temperature changes, the principal effect is an irritation, accompanied by dilatation of the cutaneous capillaries after heat and their contraction after cold. How powerfully these manipulations affect the heart action and blood pressure, heat production and tissue change, indeed all organic functions, has been demonstrated. That the system protects itself against injurious temperature changes has also been demonstrated, chiefly with regard to external applications of cold. The same principle is applicable in explanation of the *rationale* of the hot-air bath.

We have here three factors—the thermic irritation, the heat supply and loss, and the protective action of the organism against these. The temperature equilibrium of the human body is due to two constantly active factors—heat production and heat diffusion. These are under control of the nerve-centres, which are connected on the one hand by cerebro-spinal and sympathetic fibres with the tactile nerves of the skin; and on the other, with the abundant capillary network of the skin and muscles, both of which respond to the slightest temperature impressions by narrowing or dilating the cutaneous or muscular capillaries. Thus are the production and diffusion of heat regulated. It becomes

*Thèse de St. Petersburg, 1893. † Wratsch, Nos. 39 and 44, 1893.
‡ Volkmann's "Vorträge," No. 332.

evident that this responsive action of the nervous system varies in different individuals, and even in the same individual at different times.

In five minutes usually the pulse rate begins to increase; five minutes more mark a rise of temperature and an increase of respiratory movements. The average normal patient may within half an hour be made to register an increase of thirty to fifty pulse beats, and one to three degrees of temperature.

The skin becomes hyperæmic and succulent, and its tactile and electrical sensibility is heightened. Owing to the absence of a muscular coat, the capillaries are really only thin structures, practically elongations of the inner arterial coats, and depend for firmness and elasticity upon the surrounding structures. As the latter are expanded by heat applied to them, it follows that the thread-like capillary must become dilated to many times its calibre, and be thus made to receive more blood.

It has been ascertained by the pletysmograph, which measures the volume of parts exactly, that not only does the body, especially the extremities, increase in circumference, but that the increased pulsation of the heart sends blood with more force to the non-resisting and enlarged capillaries. That such an enormous diversion of blood to the surface must change the existing conditions of the circulation, disgorging the venous system, the kidneys, liver, and spleen, may be easily understood. A. Frey has ascertained by the sphygmograph and sphygmanometer that the vicarious emptying of other organs cannot entirely compensate this centrifugal flow, but that there is a loss of pressure in the entire vascular system, a loss of tension of the vessel walls. The heart exerts less labor to send the blood forward, because the peripheral resistance is diminished. On this principle may be explained the faintness, tinnitus aurium, and the symptoms of cerebral anæmia which sometimes ensue, and which are more frequent in the Turkish bath, where hot air is inhaled and thus locally applied to the pulmonary capillaries also. As soon as the surface temperature is reduced by the cold bath or douche, the previously anæmic organs become again full of blood. Herein lies danger, if there exists a brittle condition of the vessel coats or a cardiac lesion.

For this reason it is best in elderly or otherwise feeble persons to lower the water temperature after the hot-air bath gradually, to allow the inner organs to accommodate themselves. If the proper douching and friction have been practised subsequently, the skin will remain sufficiently hyperæmic to present a rosy hue. But this is not a relaxation; it is a tonic condition which assists the heart in propelling the blood through the vessels. The pulse remains somewhat more frequent, becomes soft, and the blood pressure is lowered a little. The therapeu-

tic advantages arising from this condition are self-evident. The respiration is as much affected by the hot-air bath as the circulation.

The thermic irritation of the periphery excites reflexes which accelerate the breathing; besides this, the superheated blood stimulates the vagus also. I have often noted a respiration of 25 a minute, although the inspirations were deep. The subsequent cooling process reduces the number of respirations according to its intensity and rapidity, although they remain more frequent than normal for a time. It is fair to assume that the increased excretion of CO_2 and increased demand for oxygen indicated by the enhanced respiratory processes are manifestations of increased oxidation. The urine affords corroborative evidence on this point, and this evidence is the more valuable since we may obtain it with some degree of precision. The quantity of urine is reduced about one-fourth by the hot-air bath in persons who take constantly the same amount of fluid. This reduction is not so great at the time of the bath as during the four or five days succeeding it.

This may fairly be explained by the effort which the organism is called upon to make, in order to eliminate the waste products which the bath produces. The specific gravity of the urine increases in proportion to the diminution of the quantity, but this increase continues even after the urinary volume is restored to normal. Thus we have positive evidence of the increased production of the solid urinary constituents. Urea is excreted more abundantly; about one-third more is eliminated on the day of the bath, and this increased elimination continues in less quantity until the fifth day. If fluid is moderately drunk during the bath, the increase of urea is not so great immediately after the bath, but is greater during the five days succeeding it. There is evidently a retention of urea in consequence of insufficient urinary water, but the average for the six days is nearly the same, whether the patient drinks water or not, and *affords a positive measure of the increase of tissue change.* The *uric-acid* excretion produced is doubled and even trebled; it is greatest in the urine passed after the bath, but diminishes rapidly during the succeeding days. The quantity of sulphuric and phosphoric acids is also decidedly increased during and after the hot-air bath.

Under the influence of hot-air baths a decided acceleration of oxidation of nitrogenous substances (nutrient and tissue albumin) is inaugurated, which lasts several days. Since, however, it would be impossible to maintain an increased heat supply necessitated by the continued heat diffusion for so long a time, an increased combustion of fat becomes necessary. This is entirely in accord with the daily observation that hot-air baths are competent to produce rapidly a very con-

siderable reduction of fat in persons who have reduced their consumption of fats and liquids. Experiments upon animals also teach this lesson. Hence we possess in these baths a means of inducing and maintaining a considerable acceleration of oxidation. The body offers for this purpose the necessary nitrogenous and non-nitrogenous materials (Frey).

The quantity of perspiration produced by the hot-air bath differs greatly in different individuals and at different times. Persons who respond feebly to the first bath, requiring prolonged exposure to it, and many who have found it difficult to perspire in the Turkish baths, become more susceptible to the hot-air (cabinet) bath from day to day. The skin appears to be trained to better action by its daily exposure to high temperature followed by stimulating douches of low temperature.

In a case under my observation, a young man of sixteen, weighing one hundred and eighty-eight and one-half pounds, with a girth of thirty-eight inches, lost three and one-half pounds during the first hot-air bath. The urea, which was before the bath six grains to the ounce, increased to eight grains to the ounce in the urine passed after the bath. After three baths there was a total loss of three and one-half pounds, and a decrease of three inches in the girth, so that his trousers were perfectly loose. Before the fourth bath he had gained one pound; after the fifth bath the urea was eight and one-half to the ounce.

Therapeutic Indications.—The therapeutic results of hot-air baths are summed up correctly by Frey as being the outcome of increase of tissue metamorphosis due to the elevation of temperature and the elimination of its end products; they change the hæmostatic equilibrium by inducing a more active cutaneous circulation, and increase the elimination of water.

Obesity, chronic rheumatism, gout, and certain cases of *anæmia* offer indications for valuable therapeutic results from these baths.

In recent myalgias and neuralgias, lumbago, and other forms of muscular rheumatism, indeed in all those affections for which the Turkish bath is usually prescribed, the hot-air bath as here described, carefully observed and guarded by frequent examination of the patient, followed with douches of temperatures judiciously adapted to each case, must be regarded superior in value and extent of applicability to the empirically used Turkish baths.

Anton Frey has observed valuable results from hot-air baths in cardiac diseases, even in cases in which there is an insufficiency of the heart-muscles, or valvular disturbance, with consequent loss of compensation. In the latter greater care must be exercised, but we may accomplish a good deal in them, as in all cardiac diseases, by inducing hyperæmia of the skin and consequent removal of peripheral resistance

to the blood current and diminution of blood pressure. Care must be exercised, however, in the cooling process, which must be gradual, with friction to maintain the patulous condition of the cutaneous vessels. My personal observations on the value of these baths were illustrated in a paper before the New York State Medical Society, at the eighty-sixth annual meeting, February 6th, 1892.

In *syphilis*, when the system has been saturated by mercury, whose elimination is desired, we have a valuable eliminant in the hot-air bath. The experiments of Borovsky,* showing the comparative value of various baths, prove that "as a means for freeing the patient's system from mercury, hot-air baths should be preferred to all other baths; hot-air baths at 170°–180° of twenty minutes are borne better than those at 140°–160° of thirty minutes, and act better than hot-water baths, which sometimes give rise to faintness; hot-air baths, by inducing intense thirst, increase the ingestion of liquids and then enhance metabolism."

The *superiority of the hot-air cabinet bath* over the ordinary Turkish bath is evident. The patient is surrounded by hot air in the cabinet, and, the head being free, he breathes cooler air. Not only is he thus enabled to bear higher temperatures, but he is free from the dyspnœa, which is so distressing to many in the hot-air chamber of the Turkish bath, and which is doubtless due to a defective supply of oxygen; the latter, being expanded by the heat, is not breathed in sufficient quantity to fulfil its physiological function. If oxidation be the chief object of the hot-air bath, the cabinet bath must be far superior to the Turkish bath, because it permits a more abundant supply of oxygen as regards the temperature and thus facilitates oxidation. Besides, the patient is not subjected to the admixture of emanations from the large number of persons who often occupy the hot-air chamber simultaneously in the Turkish bath establishments.

* British Journal of Dermatology, 1889.

CHAPTER XX.

HYDROTHERAPEUTIC APPARATUS FOR HOSPITALS, ASYLUMS, AND OTHER INSTITUTIONS.

HAVING received many inquiries from hospitals, insane asylums, and private sanatoria, with regard to installation of hydrotherapeutic apparatus, I purpose to offer an outline of the proper construction and arrangement of such of the latter as I have devised. This may serve to further the systematic use of water. Such institutions being under the supervision of competent physicians, it is meet that the latter be thoroughly informed with regard to the best arrangement for easily regulating the temperature, duration, pressure, and technique of the various hydriatric procedures.

Two kinds of institutions exist, the rural and the town type. The former is usually situated in secluded mountain valleys, surrounded by beautiful scenery and offering the benefits of seclusion, removal from unfavorable environment, and systematic regulation of the patient's daily life and habits. This is the best type of hydrotherapeutic establishment. Unfortunately these are rare in this country and even in Europe. Although hydrotherapeutic institutions abound in Europe, in the large majority there is too much routine observed; there is too much of the old hydropathic, water-cure, cure-all spirit pervading many of them. Among twenty-eight institutions visited by the author in the summer of 1896, he found but two which fulfilled all the demands of scientific hydrotherapy. This is not written in a captious spirit nor with the intent to convey the idea that good work is not done in many—indeed in most—of these institutions. But *the best work* cannot be accomplished when there are no facilities for *positively ascertaining* the pressure used, by the "gauge;" the temperature applied, by the thermometer; and the duration by a proper clock. To ascertain the temperature of a douche by the attendant's hand, the pressure from the assumed height of the reservoir supplying the douche room, and the duration by the attendant's experience at guessing time, such practice is not sufficiently accurate to obtain the best results. And yet this is the method prevailing at many of the institutions referred to. In one of the two exceptions mentioned, the gauge truly indicated the pressure, but there were no facilities for changing the latter accurately,

a point upon which I have sufficiently insisted in the preceding chapters.

The large majority of cases demanding hydrotherapy cannot leave their homes and families; these, too, must be provided for. Domestic treatment is in a preponderating number quite sufficient, as will be shown in the succeeding chapters. When such treatment cannot be obtained at the hands of skilled nurses, or when the physician is unable to supervise the treatment, either for want of time, inclination, or imperfect acquaintance with the technique, the town type of hydrotherapeutic establishments, conducted by a physician, fills an important want. Here the patient who is not too seriously ill may obtain all the advantages of a thoroughly equipped institution, without being deprived of the guidance of his own medical adviser, without being removed from family and friends (which is not always necessary), and without sacrificing his earning-capacity—a very important consideration in many cases.

The facilities required for administering water in the various procedures may be arranged in a small compass. There is no absolute need for large buildings. A space of thirty by one hundred feet is abundant for all practical purposes, and may be made to accommodate fifty patients per diem easily.

The following description of an institution* which has existed for six years may serve as an example.

A waiting-room and a number of dressing-rooms having been provided, a room containing two or more cots for packs is set aside, and another for massage. A space, twelve feet or more square, is utilized for a douche room. This should be constructed with marble walls and be supplied with ample light and heat. Above a waterproof floor, which slants sufficiently to carry water into a pipe leading to the sewer, a level slatted floor should be laid in sections, to facilitate removal for cleansing, in such a manner that all the water used upon patients may readily flow through the interstices between the slats upon the waterproof floor beneath. Upon the upper extremity of this floor a circular douche may be secured (Fig. 69, *CD*). Adjoining this a large bath tub and sitz-bath tub may be placed, the latter leaving sufficient space to admit an attendant behind it. The douche table should be so constructed that its supply of hot, cold, and ice water is sufficient for all requirements.

The douche table (Fig. 69) is a box four feet long, three feet high, and two feet wide, covered with marble. Inclosed within the box is a combination of pipes connected with the hot and cold water and steam supply on the one hand, and with the hose or other terminal arrangement on the other. The hot and cold water supply is by the usual

* The Hydriatric Institute, 635 Park Avenue, New York.

contrivance controlled by stopcocks, the terminal rods and levers of which issue through openings in the upper flat portion or slab of the douche table, as may be seen in the diagram. The attendant, standing behind this table, is protected against receiving the water recoiling from the patient, and is perfectly free to regulate the outflow according to the prescription ordered in each case. An outflow pipe, controlled by the stopcock, *PR*, regulates the pressure of the water,

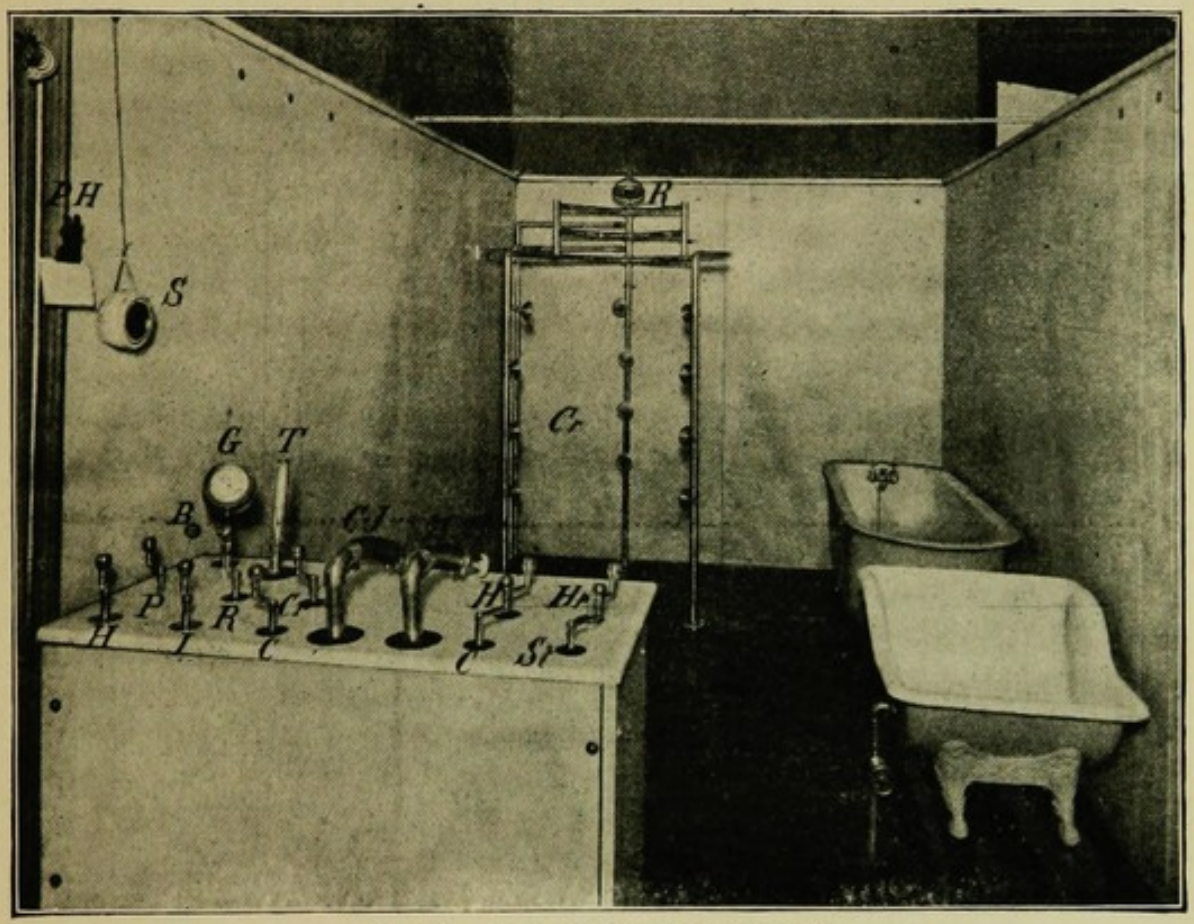


FIG. 69.—Author's Douche Apparatus.

P H, Prescription holder.
S, "Second" clock.
H, Hot water.
I, Ice water.
C, Cold water.
P, Pressure regulator.
B, Bell.
G, Gauge.
T, Thermometer.
R, Rain douche.
Cr, Circular douche.
C J, Cold jet douche.
H J, Hot jet douche.
H, Hot water for Scotch douche.
C, Cold water for Scotch douche.
Hp, Hip bath.
St, Steam douche.

which is plainly indicated upon the gauge. This enables the attendant to arrange any pressure required, either before the douche is administered or while it is flowing upon the body, the range being from ten to thirty-five pounds. The importance of this element in hydrotherapy is repeatedly referred to in this work.

A thermometer, *T*, is so arranged that its bulb, encased in an open-work metal tube, lies within the mixer, whose outlet pipe leads to the hose, and its upper portion, cased in metal also, shows through a magnifying glass-tube cover the temperature of the water flowing upon the

patient. A "second" clock, *C*, furnishes information regarding duration, while the clasp, *Cl*, holds the prescription out of reach of the spray. The apparatus is put into operation as follows:

The attendant places the prescription into the clasp after carefully scanning it, and opens the stopcocks which close the nozzle. He now opens the hot and cold water faucets, and, watching the thermometer, obtains the temperature required while the water is flowing. This may be done with the greatest ease after some practice. He now opens the pressure regulator until the gauge registers the pressure prescribed. The attendant having examined the thermometer again, and holding the faucet handle in the left hand, while the right holds to one side the hose from which the stream of water is issuing, requests the patient to place himself six feet in front of the douche table. Again looking at the thermometer to insure the exact temperature prescribed, he now directs the stream upon the patient's back; other parts are treated successively as ordered by the physician. If a circular douche is ordered, the water is also turned on before the patient enters it. This is important, not only because shock is thus prevented, but timidity of the patient is overcome.

The *circular douche* used in the Hydriatric Institute differs, as the diagram shows, from the usual needle bath, in not being supplied with semicircular perforated pipes. I found the effect greatly enhanced and much trouble from stoppage avoided by the substitution of eight roses, three inches in diameter. Each rose contains fifty fine openings in the plate, which, being screwed on to the connecting-tube, may thus be easily freed from accumulating sand and dirt. Moreover, the three upper roses are, by a device of Mr. Frank Richter, the excellent mechanic who has skilfully executed all my ideas, made movable. By simply turning these roses downward, an adult of any height may be treated without having the face sprinkled or the ears filled with water.

The douche table contains pipes, the outlets of which are controlled by lever faucets, which also open and close the perineal douche, the hip bath, and the full bath. The temperature of these may thus be controlled by the attendant by simply watching the thermometer of the douche table.

There should also be a steam douche, supplied with low-pressure steam from the engine-room, which may be made to issue from the hose by opening the faucet *St*.

The douche room of the Hydriatric Institute is twelve feet long and eight feet wide, its walls being covered with marble eight feet high. The floor of this compartment is slanting and covered with copper; the edges of the latter are secured by being turned up two inches behind the lower edge of the marble wall. Beams cut slanting on the lower

side to fit the watertight floor, and straight on the upper side, are laid horizontally, so as to support a slatted floor, through which all the water flows upon the copper beneath and thence to the sewer.

The perineal douche is obtained by leading a pipe connected with the hot and cold water supply in the douche table to a point three feet from the latter, adjoining the hip tub. Over this is placed a box or chair, twenty-five inches high (Fig. 70), open at the lower end and having a circular opening to admit the perineum at its upper extremity. The stream emerging from below may thus be made to strike the perineum under any required degree of pressure and at any required degree of temperature.

FIG. 70.—Perineal Douche.

The water supply comes from a reservoir (under the roof), to which it is pumped by a steam engine. The hot water is furnished from a drum which is heated by steam coils. Both cold and hot water flow through appropriate pipes to the douche table; and ice water, which is required in summer, is furnished by a cooling-apparatus constructed as follows: In the basement, occupied as a laundry, is situated a box, seven by five feet and four feet high, which has double walls four inches apart. A manhole, two and one-half feet square on top, admits of ice being thrown in. The box is lined with copper, so as to be watertight. At the bottom two boards, two inches thick and one foot deep, are placed from one side to the other. These have three semicircular notches, fitting three galvanized iron cylinders, for which they form a support (Fig. 71).

The cylinders contain thirty gallons each and are connected with each other by inch pipes. The first cylinder receives the water supply from a two-inch main. The water entering this cylinder passes to the second, thence at the opposite end to the third, from which it issues into an inch pipe leading to the douche table in the room above.

Six inches above the level of the cylinders an inch opening exists, which is connected with an outflow pipe connected with the sewer. A separate pipe, supplied with a stopcock, should also lead from the main directly into the box, for the purpose of filling the latter with water as high as the outlet above the level of the cylinders.

The box is elevated about one foot from the floor, and an outflow pipe with stopcock should be securely connected with the latter

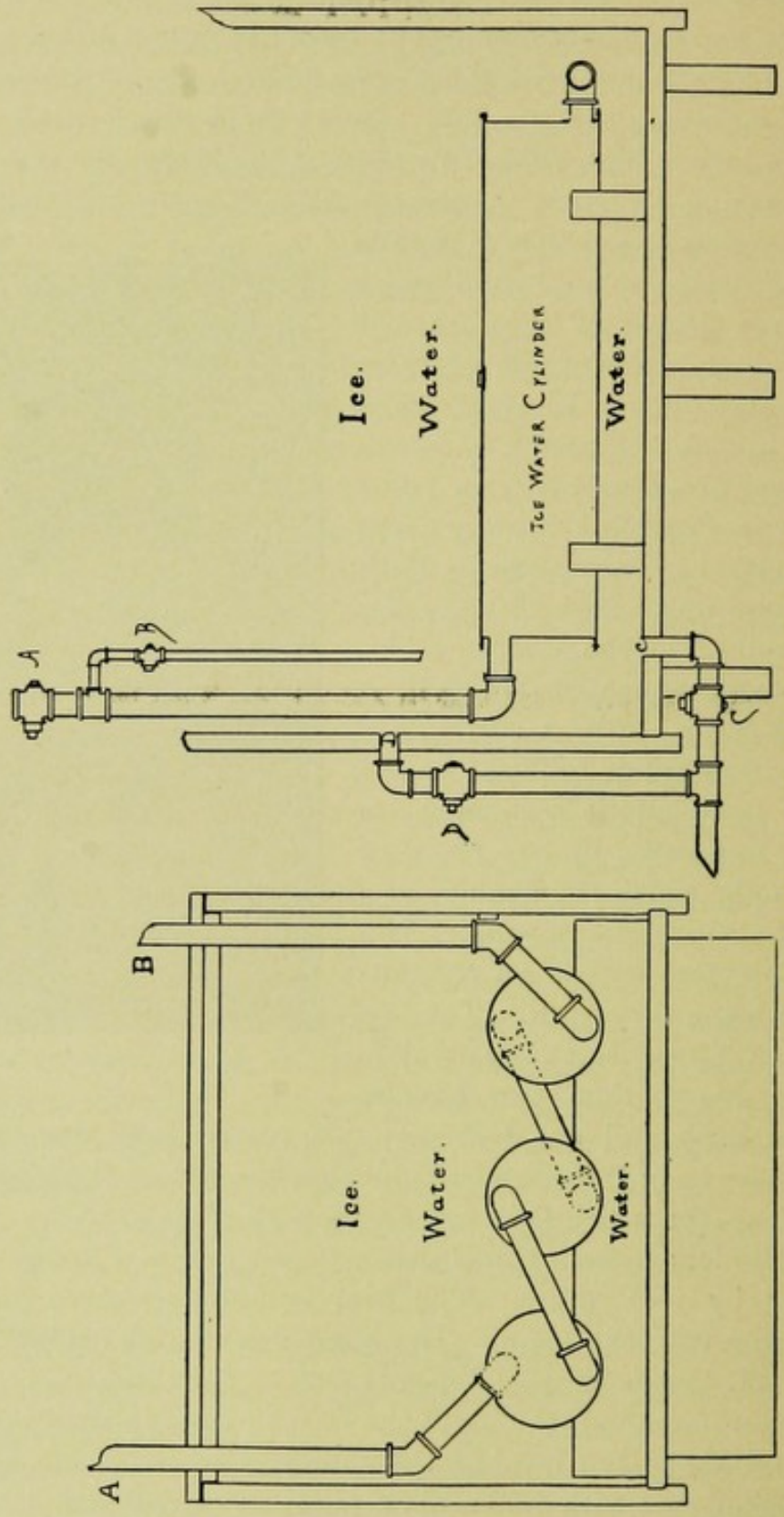


FIG. 71.—Diagram of (Water) Cooling Apparatus.

and lead to the sewer, for the purpose of emptying the box when necessary.

The apparatus is prepared as follows: The stopcock of the pipe *A*,

leading from the main, is opened for the purpose of filling the cylinders; the stopcock *C*, at the bottom of the box, being closed, the stopcock *B* is opened and water is allowed to flow into the copper-lined box until the cylinders are covered with water, six inches deep. Now half a ton of ice is put upon the cylinders. It will be observed that the lower portion of the ice supply lies in six inches of the water which covers the cylinders. Thus the latter are not only covered by ice but surrounded by ice water. As the ice melts the overflow of water issues through the opening *X* to the stopcock *D*, which is always left open.

After experiments with ice placed upon slats above the cylinders, and thus surrounding them below with cold air, I find the apparatus described above the most practical means for cooling water.

The necessity for this ice-water supply will be evident when it is borne in mind that in midsummer, when the Croton water ranges from 70° to 80°, a prescription for a douche of 50° to 60° could not be filled without such a supply. It is necessary only to open the ordinary cold-water supply cock and add as much ice water, by opening the ice-water supply cock, as is needed to reduce the former to the temperature prescribed. I am not aware of the existence of a similar combination apparatus for exact hydrotherapy in any institution in Europe or in this country, except those of the Montefiore Home, the German Hospital in Philadelphia, the Massachusetts State Asylum at Danvers, the United States Government Asylum (Elizabeth) in Washington, Dr. Parson's Sanatorium at Sing Sing, and others constructed under my advice. At some of the water-cure establishments which I have visited in Germany and elsewhere, such an arrangement is unnecessary, because the mountain springs furnish water at very low temperatures, 50° being quite frequent.

The hot-air cabinets are a very important part of the hydrotherapeutic apparatus. They are used for the purposes previously indicated. They are made of thoroughly seasoned wood, shaped as shown in Fig. 73, and constructed with movable tops and doors. An adjustable seat is securely installed within. The heat is supplied by steam coil radiators and the temperature is ascertained by a thermometer, the bulb of which rests within the box, while the indicator is above it. A circular opening, *O*, in the stationary and movable portion of the top of the box admits the neck. The patient, enveloped in a sheet, seats himself, allowing his head to project, presenting the appearance shown in Fig. 72. A large towel is placed around his neck in such manner that it covers the open space between the neck and the edge of the opening.

The head is swathed in a wet turban and the patient receives water from the attendant as often as it is ordered by the physician. Bright

sunlight and flowers contribute to the cheerfulness of this room in which the patient is prepared for water treatment (Fig. 73). After the doucheur has turned on water at the prescribed temperature, he touches the bell, *B*, which announces his readiness to receive the patient. The latter is now to emerge from the box, which has been opened by another attendant upon being informed by the bell. He drops

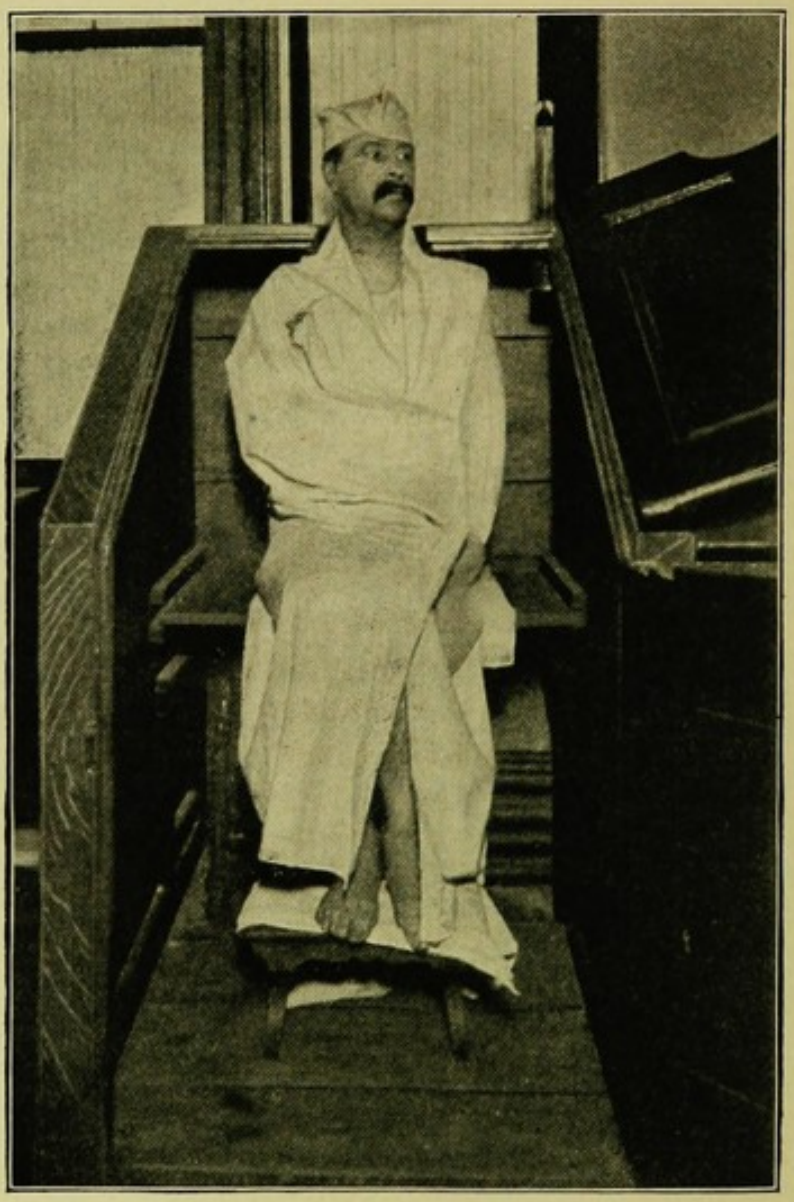


Fig. 72.—Hot-Air Box—Open.

the warm sheet which has enveloped him and places himself before the doucheur; after he has received his douche he comes forward, the warm sheet is thrown over him, and he is carefully dried, standing or sitting. He now retires to his dressing-room, makes his toilet, and immediately goes forth into the fresh air. The latter is usually insisted upon, although many patients cannot be rid of the idea of "resting after the bath," which they have derived from their experience

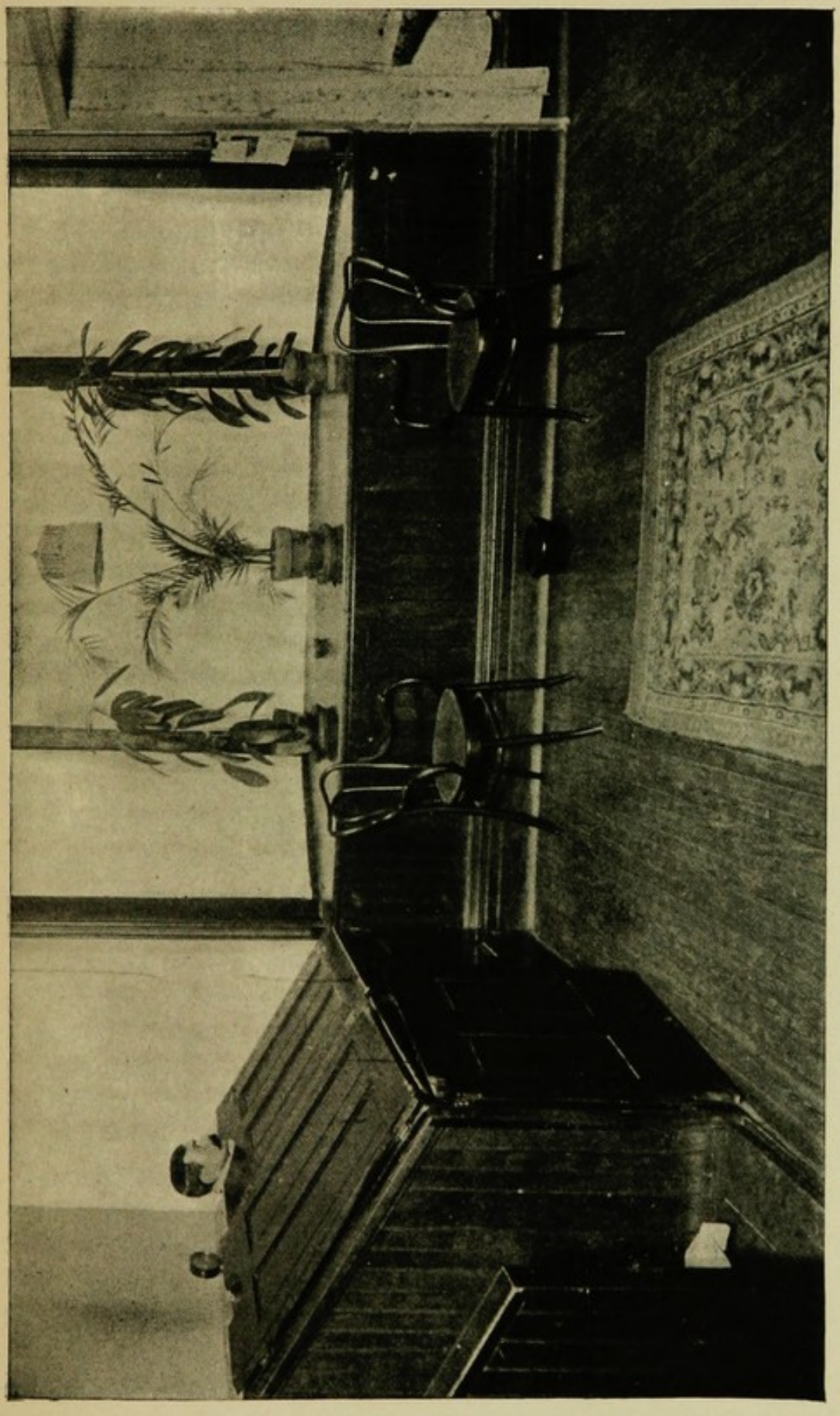


FIG. 73.—Hot-Air Bathroom, Showing Cabinet Closed.

in "Turkish baths." Inasmuch as the patient has not inhaled hot air and his reaction is fully established, it is far better for him to issue forth into the street or park and obtain the full benefit of the deepened inspiration.

The simple apparatus above described enables the physician to have every prescription for baths and douches executed. The temperature may be easily and quickly regulated to each degree, the pressure to each pound. Thus the utmost precision may be practised by means of this compact arrangement of pipes, faucets, and hose.

CHAPTER XXI.

CHRONIC DISEASES.

Those diseases in which nutrition, hæmatosis, and tissue change are disturbed afford a favorable field for the remedial application of water. The chapter on "The Influence of Hydriatric Measures upon the Functions of the Human Organism" points out clearly the effect of water applications in health, as ascertained by reliable laboratory experiments and observations. The application of these physiological effects in chronic disease will form the subject of the following chapters.

Anæmia and Chlorosis.

These affections are grouped together, because they present similar manifestations arising from imperfect hæmatosis. To enter into the symptoms and causes of these disturbances is not the province of this work. A few introductory remarks may afford an insight into the *rationale* of the action of hydrotherapy in these diseases, and the necessity of combining them, as is always indicated, with a strict hygiene.

Whether it be idiopathic or a manifestation of organic pathological processes, a faulty hæmatosis frequently demands the attention of the physician. The patient and his friends are justly anxious when pallor, accompanied or not by emaciation, points with unerring finger to some serious defect in the system. The remedies usually applied with more or less energy are nutritious diet, exercise, change of scene, and iron. Months and years are sometimes spent, with more or less success, in the treatment of failing hæmatosis. Of how little avail are a nutritious diet and iron if the appetite is feeble and the stomach incapacitated is a sad but frequent observation of the experienced practitioner.

In mild cases of functional anæmia, due to overwork, inattention to sanitary conditions, insufficient food, or mental disturbance, the removal of the cause is the chief end of treatment. But these may be powerfully aided by certain hydriatric procedures, whose effect has been demonstrated to improve the force of the heart, deepen the respiration, and enhance tissue metabolism. That water of low temperature, rapidly and briefly applied under good atmospheric pressure, produces these effects, clinical observation has frequently demon-

strated (see page 59). The result of careful examination with Hayem's hæmometer demonstrates that the judicious application of cold to the periphery increases the number of red corpuscles and improves their quality.

The necessity of promoting and encouraging tissue change in all diseases in which there is faulty hæmatosis is obvious. There exists abundant testimony as to the auxiliary value of hydrotherapy. Again and again I have observed cases of anæmia and chlorosis, which had defied prolonged iron treatment under my own care as well as under the advice of colleagues, yield readily when a suitable hydriatric method was added to or substituted for it.

Upon the recognition of the etiology of anæmia depends its successful treatment. So long as anæmia remains associated with iron treatment in the minds of physicians, so long will its management remain unsatisfactory.

1. Unfavorable environment is a frequent cause contributing to the development of anæmia. Confinement to badly ventilated schoolrooms, deprivation of outdoor exercise, digestive troubles due to these, improper and insufficient food, and mental anxiety are recognized factors. Of what avail would the administration of iron be in such cases so long as these etiological elements are active? Of what use would an addition of iron to the hæmoglobin be if its hunger for oxygen cannot be appeased by exposure of the patient to pure air? I would plead, therefore, first, for the provision of an ample supply of oxygen for anæmic patients; not oxygen artificially made and forced into the lungs, but oxygen obtained in the only perfect form—from natural sources, in the fields, in the woods, in the parks, freed from human emanations, which contaminate it even in the better class of city and town dwellings. Those who have done much dispensary practice will agree that among the patients of the tenement districts iron is particularly unsuccessful. The latter is also true of schoolgirls and boys, who are subjected to continuous study and are thus deprived of access to pure air and muscular exercise. The lesson taught by common sense would be to remove the patient from his unfortunate surroundings rather than to ply him with medicinal agents to improve his blood. Severe anæmics among the poorer classes must be brought to the hospital; here at least the air is pure, and other important agencies of restoration are available. It is surprising how such a change brings back the color to the pallid cheek of the factory girl and the store clerk. Though they may not be ill enough to have life threatened, these poor creatures are entitled to the same care as is a case of typhoid or pneumonia. A few weeks' residence in a clean, well-aired hospital ward will do more to restore such patients to health than iron or arsenic alone.

I desire to emphasize also the inutility, nay, the impropriety, of advising active exercise for every case of anæmia. Too often the direction is given to the anæmic who is in good financial circumstances: take plenty of exercise, good food, and (iron) pills three times a day. Many patients, especially those who suffer from dyspnœa and rapid heart action, would be more improved by being exposed for hours in the open air, quite at rest, in a hammock in summer, or on a steamer chair wrapped in furs or blankets in winter, with the windows thrown wide open.

Passive exercise by massage and Swedish movements once or twice a day would be far more valuable exercise than walking or even riding. Mary Putnam Jacobi has by careful observation brought out the value of massage in anæmia, and Weir Mitchell has demonstrated the importance of rest combined with massage and food, methodically administered. Their success after failure of active exercise and medication vouches for the correctness of the view here inculcated.

2. Systematic exercise in the open air may be useful in many cases. Special stress must be laid upon the adjective "systematic." Let the direction for exercise be as precise as it usually is given for pills; let the duration, variety, and frequency of repetition be distinctly ordered. Ranke has investigated the effect of muscular action upon the total blood in the body. He has shown that its first effect is diminution of the blood quantum, which becomes more marked as the intensity of the muscular action increases; but when the body becomes accustomed to active exertion the total blood quantum is increased. Thus is physiologically demonstrated the great benefit of methodical exercise, and especially the necessity of adapting it to each individual case of anæmia.

3. *Diet.*—The adaptation of a proper diet to anæmia is not a difficult problem. I plead only for more punctilious regard to the needs of each case than is usually given. The fancies and caprices of the patient should be less regarded than is the practice now, for many articles of food that seem repugnant to the patient may be gradually administered if a good nurse is instructed to persist in their systematic use. Weir Mitchell has in this respect taught us a lesson also. Many patients who were absolutely without appetite, and to whom all food was repugnant, have been systematically fed by properly selected attendants until the quantity consumed by them was enormous. We yield too easily to the predilections of the patient in this regard. It must be borne in mind that usually all appetite is lost or impaired, and that therefore a choice of acceptable food is impossible.

Careful attention to methodical feeding will accomplish more than simple direction to take good food, etc. The same precision which is

exercised in ordering medicines will in the case of diet produce more positive results than are usually obtained.

4. *Water.*—In connection with the methodical application of pure air, exercise, and food, the use of water upon the skin is important. I do not advocate cold baths for anæmic patients, *nor indeed for any patient except one suffering from an infectious fever.* The abstraction of heat should be always avoided in anæmia. It is my custom to produce an artificial surface heat before applying cold water. If the latter is done just after rising from bed, it will in many cases be sufficient. While standing in a tub of water at 100°, the temperature of the room being not below 68°, the patient receives a rapid ablution, *with friction*, of water at 80°, which is daily reduced two or three degrees. After this he is rapidly dried and induced to go into the open air. For weaker patients the dry pack, which is simply a snug wrapping in a woollen blanket until they are warm, followed by ablution as here stated, is useful. The abstraction of heat may be guarded against and chilliness prevented by accumulating heat on the surface before the ablution.

When the cutaneous surface has thus been daily disciplined and educated to bear the gentle shock from gradual impingement of cold water, larger quantities may be used. The dripping-sheet, so highly commended by Weir Mitchell; the wet pack, followed by the half-bath; and later rain baths and jet douches judiciously adapted to each case, offer the most valuable means for restoring the blood to its normal condition. Actual examination with Fleischl's hæmometer has convinced me of this therapeutic fact.

I treated a young lady who took six hundred Blaud pills without the slightest effect. She received twelve rain baths and steadily improved in color, strength, and ability to exercise without breathlessness.

The presence of organic disease does not preclude the application of hydrotherapy. This is amply demonstrated by its effective application in cardiac, renal, hepatic, uterine, and nervous diseases. Whatever tends to elevate the general tone of the system, stimulate the appetite, heighten the nutrition, give sleep, and refresh the body, is of value in cases of organic disease. We have ample warrant for asserting that the cautious application of water has no equal in these therapeutic qualities. Frequently the domestic treatment by a skilled nurse suffices to establish normal hæmatosis. This failing, however, a large and fruitful resource is open in institutional treatment.

The following clinical history furnishes a detailed outline of the most useful procedures, which may be varied to adapt them to each case, if the principles and technique have been mastered.

Miss H——, aged twenty, ill two years, under constant treatment by gynæcolo-

gists in Harrisburg, Baltimore, and Philadelphia, was brought as a last resort to Dr. T. G. Thomas, to be placed in his sanatorium. Dr. Thomas discovered no uterine trouble, and referred her on June 8th, 1892, for hydriatic treatment, with a diagnosis of chlorosis of aggravated type. Local and medicinal and institution treatment, iron, arsenic, diet, and massage and change of air, had been tried in vain by physicians in Philadelphia and Harrisburg, Penn. Although the patient was plump, a more pallid creature could not be imagined. Her appetite was poor, her bowels were irregular, her sleep was disturbed, and she was subject to frequent (hysterical) fainting spells. The slightest exertion produced difficult breathing and rapid heart action. The menstrual flow was regular, but scant and very pale. Blood examined by Fleischl's hæmometer registered thirty-one per cent.

June 10th. Preparatory treatment by hot-air baths and spray douche, to educate the patient's reactive capacity, was ordered. Fainting in the hot-air bath, she was removed. A spray douche of two seconds at 64°, with twenty pounds' pressure, was rapidly passed over her in a sitting-posture. She again fainted. Friction produced no reaction.

On the following day a milder course was pursued. She was gently wrapped in a long-haired woollen blanket for forty-five minutes. Parts of the body were then successively uncovered and splashed with water at 60°, thrown with some force from the hollow hand of the attendant. This was followed by friction, and continued until the whole body had received the ablution and friction. The same treatment was continued on the 12th and 13th, when she fainted twice. This was repeated without fainting until the 16th of June. She was now placed in a hot-air bath (167°), with a cold compress around the head, and given frequent sips of ice water. The head not being subjected to the heat, the patient was enabled to breathe the cool air of the room. When the cutaneous surface became tinged, she was seated in a tub containing eighteen inches of water at 100°, and thoroughly rubbed for three minutes. This was followed by an ablution at 60°, good friction drying, and general massage for fifteen minutes. She fainted twice during these procedures.

June 20th. The hot-air bath followed by the spray (fan) douche at 80° was substituted for the ablution, because her reaction had improved and her timidity had diminished.

July 8th. The last treatment has been continued with satisfactory results, temperature of the spray douche reduced daily one degree; to-day she had an air bath (160° F.), followed by a spray douche under thirty pounds' pressure for five seconds, beginning at 80° and rapidly reduced to 50°, followed by fifteen minutes' general massage. She reacted well and felt comfortable.

July 14th. Hot-air bath (175°), followed by a circular douche, thirty seconds, at 94° reduced to 69°; then spray douche, ten seconds, 79° to 54°, and general massage. Reaction good.

July 30th. Hot-air bath followed by circular douche of 95° and a jet douche at 45°. That she bore the latter without flinching testifies to the value of gradually accustoming the patient to lower temperatures. Dr. F. Armstrong, who examined her for me, reports: "Miss H. looks quite well, eats and sleeps well, and is certainly improved since I last saw her. The comparison test indicates about one hundred per cent. hæmoglobin."

Miss H. is now married and in good health.

This case certainly illustrates, first, the effect of the douche in improving the nutrition; second, that hæmatosis may be enhanced by the

stimulus conveyed from the periphery to the nerve centres, and thus reflected upon the blood-making functions; third, that the most feebly reacting patient may, by perseverance and proper adaptation of the hydriatric procedures, become accustomed to this treatment. The danger of shock from cold water is proven to be chimerical by this case. If this fragile and sensitive young woman could be accustomed to the douche by beginning with mild procedures, no chronic case that is not *in extremis* could fail to respond to it.

5. *Diaphoresis* is a method of treatment which, paradoxical as it may seem, has demonstrated its value clinically. Scholz, of Bremen, has recently written a monograph on this subject; his conclusions have been extensively reproduced in the medical journals and his practice has found imitation. The dry, livid condition of the skin of anæmic patients is aroused to renewed activity by exposure to hot-air baths. Excretion is thus rendered more energetic, tissue change is enhanced, and an increase of appetite and nutrition is thus induced.

It is my constant practice to order for anæmic patients one or more thorough diaphoretic (hot-air) baths a week, followed by gradually reduced douches, for the purpose of overcoming the spastic contraction of the arterioles and enhancing tissue change, and thus improving assimilation of albuminoids.

Prof. O. Rosenbach* correctly insists that, "in order really to cure chlorotics, control of the vasomotor neurosis which exist in these cases must be obtained, and in order that this may be accomplished by hydriatic procedures great care should be taken in their employment; they must be brief and used only when the corpuscles are not greatly diminished. Judicious hydrotherapy not only removes this disease, but also prevents the relapses which are so frequent. Dr. Rosenbach does not pretend that hydriatic treatment only is capable of influencing the vasomotor centres and completely curing chlorosis, for many chlorotics do recover without hydrotherapy. Nevertheless, it is proven that iron, arsenic, country air, the gratifications of ardent desires, pregnancy, etc.—*i.e.*, all influences which are capable of influencing chlorosis favorably—do so by modifying centripetal vasomotor irritation or by restoring normal conditions in the vasomotor centres rather than by reconstructing blood cells and plasma."

For the restoration of normal condition in the innervation, experience has demonstrated the exceeding value of hydriatric procedures.

Whatever the *rationale* may be, this treatment, together with systematic regulation of diet, exercise, and exposure to good air, has in my hands often been crowned with success after failure of medicinal agents.

* Internationale Klinische Rundschau, 1894, p. 877.

CHAPTER XXII.

PHTHISIS.

The hygienic management of phthisis has in recent years afforded such striking results that this method has attained the first rank among therapeutic agents. The search after specifics still continues, and should be encouraged, because this fearful scourge has always been an *opprobrium medicorum*. The possibility of obtaining a preparation which represents nature's antitoxin is still entertained, and not without reason. In the mean time the fatality of the disease remains unabated among those people who are unable to obtain the hygienic management which is so costly that an experienced observer has ventured the opinion that "the question of cure of phthisis is a question of money chiefly."

That phthisis is often cured has been demonstrated satisfactorily. The most recent authoritative statement is contained in the report of the royal health office of Germany on "Hospitals for Consumptives." "Evidence of healed tuberculous lesions is often seen by experienced pathological anatomists; not only do one-half of all subjects dying of tuberculosis show old scars of tuberculous lesions, but even among those who have died of other diseases, or in the full bloom of health by accident or suicide, these scars are often found. According to reliable authorities, healed tuberculous foci, encapsulated or calcified, are found in every third or fourth body examined. Koeniger reports from 'The Home for Invalids and Old People,' in Hanover, that out of 591 cases of tuberculosis received there for treatment, 248 were still under treatment, and 343 had been discharged. Of these 200 were discharged as well or considerably improved, giving 58.3 per cent recoveries."

It would seem fair to conclude that in those cases in which healed tuberculous lesions were found without previous history of the lesions, nature was competent to furnish all the remedial agencies for the cure. Efforts have been made to imitate the process by which this is accomplished, and it is really approximated in the modern hygienic treatment of phthisis, by which the organism is placed in the best possible condition, all its functions being kept up to their highest integrity.

Phthisis is a disease in which a serious and destructive local manifestation exists, which is due to an infection of the system by the in-

troduction of tubercle bacilli. Upon the recognition of this simple pathological fact, the modern management of phthisis has become exceedingly simple, and successful. Methodical treatment under conditions which afford the patient the best opportunity for outdoor life in air that is free from dust and other vicious elements, the promotion of the appetite, the enhancement of the circulation and respiration, are, in brief, the elements contributing to recovery.

There are two problems before the physician in the treatment of this disease, viz., the removal of the infectious element, and the enhancement of resistance to the latter. Aside from prophylaxis, nothing positive has been done toward removing the agent of infection. Hence the most important indications are to endow the system with the power of resisting the inroads of the established disease and to treat complications and sequelæ. These may be met by residence in an appropriate climate, by proper and carefully regulated exercise, diet, and hygiene, by certain medicinal agents, and last, but not least, by a *judicious hydrotherapy.*

With regard to exercise, the plan adopted by Dettweiler and Fallkenstein, Roempler at Goerbersdorf, and in our country by Trudeau and Hance, of exposing patients to the constant influence of pure air and sunshine, without incurring liability of being chilled, is the most useful, and may be accomplished in private practice also, as I shall show.

The lungs should be treated as is every other inflamed organ. So long as active inflammation exists, they should be kept at rest, or slowly and gently expanded. The *presence of fever precludes active outdoor exercise.* Simple outdoor life must then be substituted, with massage or passive movements to stimulate the muscular system. Much of the ill effect of absolute quiescence will be counteracted by hydrotherapy, if properly applied, and by lung exercises which expand gently.

Hydrotherapy is an agent whose power for good is incalculable, and *which has given me more valuable asssistance than all other means combined.* As in other diseases, the judicious application of cold or cool water to the skin evokes a stimulus to the sensory nerves, which is transmitted to the central nervous system, and thus *invigorates every function dependent upon the latter.* The inspiration is gently but slowly deepened, resulting in better circulation in diseased parts, removing stagnation, and furthering the nutritive processes in them. The heart is made to contract with more vigor when the peripheral circulation is improved by the shock, followed by contraction and dilatation of the cutaneous capillaries which take place. A superficial cutaneous hyperæmia relieves the congested condition of the pulmonary circulation. The appetite is improved; tissue changes are increased;

and, if there be a rise of temperature, it is subdued mildly but surely. The alkalinity of the blood is raised, more blood cells are driven into the general circulation, and toxins are eliminated, as has been shown by Robin (page 151).

The application of water in the treatment of phthisis was first recommended by Schedel, who became interested in hydrothrapy by observing its effect in the hands of others. Schedel never was connected with any hydrotherapeutic establishment. As a practitioner, he compared the hydriatic with the medicinal treatment of various diseases, deciding from clinical observation in favor of the former, not only in some acute diseases, but also for the sequelæ of valvular heart disease and *phthisis*. The French clinician Valleix was "surprised to see cold water applied in phthisis without the bad results which he had anticipated," and approved of its use.

Twenty years ago Salkowsky reported * 106 cases of phthisis; 60 in the first stage, 29 marked, 17 advanced. After six months' treatment by the cold douche, 39 were cured, 34 improved, 19 improving, 7 without result.

Prof. Ernst Aberg, of Stockholm, having himself been rescued from phthisis by ice-water ablutions, affusions, and plunges, and having treated many cases of phthisis during twenty-two years' experience, published his results before the Scandinavian Congress of Naturalists at Stockholm in 1880. This heroic treatment has not received imitation, because it has not been understood that the application is very brief, and free from possible harm in careful hands.

Professor Winternitz† refers to Aberg's ice-water treatment with favorable comments, stating that, while he does not use such low temperatures as Aberg, he obtains the stimulating effect by applying water of a somewhat higher temperature under very considerable pressure by the rain bath and douche.

For twenty years the Vienna clinician has used and advocated hydrotherapy as an important element in the treatment of phthisis, without having made any positive impression upon the medical mind regarding its value, outside of his few immediate scholars and disciples.

He published in 1887‡ the record of 160 cases, with cessation of the process or relative cure in 27 per cent; in 1896 he published 299 cases, with favorable results in 32 per cent.

The systematic application of douches was introduced into phthiseotherapy by Brehmer, of Goerbersdorf, the pioneer of the successful

* Bulletin de Thérapie, 1877.

† Blätter für klinische Hydrotherapie, May, 1896.

‡ "Klinische Studien," 1887.

hygienic treatment of phthisis. He says:* "It remains to mention two other remedies which I have also introduced into the therapy of phthisis, and which have found rapid dissemination, namely, the wet rub and the douche. I have been guided by the fact that by these means the most extensive organ of the body, the skin, may be brought into greater activity, especially to react promptly to external irritants, to increase the cutaneous respiration, and thus to invigorate the entire organism.

"For this reason I regard them as indicated only when the organism is capable of reacting to the irritant effect of cold, which is the chief action of wet rubs and douches. The patient must feel pleasant and comfortable after them, and the skin must remain red. Both of these procedures increase the vascular tone, as is demonstrated by the sphygmograph.

"The douche is especially valuable in pleuritic exudations, which are quickly absorbed under its action, and it acts equally favorably upon the absorption of infiltrations. But the douche is a dangerous remedy; it should always be given by the physician and never by bath nurses alone, as is unfortunately the custom in some health resorts. And the physician even should, as J. Braun remarks in his 'Balneotherapy,' understand the *technique*. A diploma does not suffice. The art of ordering douches correctly cannot be taught theoretically; it can be learned only by demonstration and practice. Moreover, all douches are not correctly constructed, which accounts for the difference of opinion with regard to their therapeutic value. For a good douche the water must be cold and be delivered with considerable force, so that the stream should have a homogeneous diameter. It must not be a mere sprinkling, but a strong douche. In most douche apparatuses the conducting pipes make so many windings that the active force of the water is almost neutralized before it falls upon the patient. The size of openings in the douche is also not a matter of indifference."

This quotation shows plainly that Brehmer correctly valued the douche if properly administered, an observation which I can confirm, especially with regard to the technique, pressure, and temperature.

The enhancement of nutrition being the chief aim in phthisis, hydrotherapy offers a powerful therapeutic agent, which, rightly used, must be of immense value.

Aside from this important consideration, the predisposition to repeated colds and consequent probable aggravation of the local processes and general symptoms may be diminished by the neuro-vascular discipline to which the skin is daily subjected by appropriate water treatment. This hardening process has long been recommended for

* "Die Therapie der chronischen Lungenschwindsucht," p. 327.

those predisposed to phthisis. Ziemssen speaks of it in his lectures on the treatment of tuberculosis as "*a remedy of extraordinary value* for persons who are predisposed to or have acquired phthisis."

The *technique* and procedures applicable in this disease must necessarily vary with each case. Brief applications of low temperature, as by douche or rain bath, or rapid ablutions, are followed by rapid reaction, and, if well borne, are exceedingly useful as tonics; while, on the contrary, in cases suffering from elevated temperatures and great debility, more gentle procedures, as the sheet bath, full bath, wet packs with perhaps higher temperatures of the water, are required. I have seen febrile cases seriously injured by too cold procedures, the latter being indicated in a febrile or mildly febrile conditions. This is contrary to views usually entertained on the therapeutic action of cold baths, which are regarded as heat-reducing in proportion to the lowering of their temperatures. My observations at the Montefiore Home for Chronic Invalids, in which cases of the most forlorn type, so far as previous hygienic surroundings are concerned, are received, have led me to adopt the following course, because the skins of many of these poor people have long been strangers to cold water, or, indeed, water of any kind. After a thorough cleansing with a warm bath or soap ablution, a day is allowed to elapse. The patient is now wrapped snugly, quite naked, in a woollen blanket, so that his body is excluded from air; other blankets are piled over him. The windows are opened and he is given a small glass of iced water every ten minutes. Having lain in this position an hour, a part of the body is exposed and bathed as follows: With a towel the face is well bathed in water at 50°. A basin of water at 75° is made ready, into which the attendant dips his right hand, covered by a mitten or glove of Turkish towelling. One arm having been exposed, it is rapidly washed and rubbed with the wet glove dipped in water at 75°, then dried and replaced under the blanket. Other parts are successively treated. At the termination of this ablution the patient is rapidly rubbed all over with a coarse towel. This treatment is repeated daily, the temperature of the water being reduced two degrees on each occasion, until 60° is reached.

The patient's reactive capacity having been carefully raised by this treatment, more active measures may be applied. The drip sheet (page 96) is now indicated. It should be carefully administered by a well-trained attendant; the technique described must be strictly followed and the patient carefully observed, for its success or failure depends upon ascertaining daily the reactive capacity of the patient, and increasing or diminishing the temperature, duration, and mechanical impact, according to the effect produced.

The most useful hydriatic procedure in phthisis, however, is the

circular douche (page 334). Unfortunately, this "finely divided douche" can be obtained only in institutions. The water should have a fall of not less than forty feet. A higher fall is better, because it fulfils the demand of Brehmer, which every experienced hydrotherapist will approve, that considerable force is a *sine qua non* to prevent chilling and too great abstraction of temperature. The patient should receive this or a fan douche, at 95°, gradually reduced in the course of one minute to 85°. The latter temperature may be decreased one degree daily until 75° is reached. The duration should not exceed one minute in the average case, but it may be modified to suit the indication of each case. The advantage of this douche over other baths lies in the pressure with which the water strikes the body, affording a kind of massage, which assists in producing reaction even in feeble individuals. But it should not be applied without previous training of the skin, as above described. The circular douche is an antipyretic of great value, if its temperature is not below 85°; it is a stimulant and tonic if between 85° and 75° F.

To enhance the tonic effect I have added the fan douche, which succeeds the circular douche for a very brief time. It is my custom to order this douche under a pressure of thirty pounds at 80° for ten seconds, moving it *slowly* up and down the back, to avoid the current of cold air which the rapid agitation of this fan-shaped stream always produces. This douche may be reduced daily one degree, until 70° is reached. It is confined to the back only. If the patient's reaction is good under this treatment, the general fan douche, *i.e.*, playing it over the anterior, posterior, and lateral portions of the body, may be substituted at a temperature of 80°, daily reduced one degree, until 65° is reached. Good reaction must always be provided for. The skin should approach a pink color while under it, and the patient must not be chilled by it; at least, any coldness he may experience should disappear after he is dried. This, indeed, is a test of the efficiency of all hydriatric procedures. Decided chilliness, continuing after thorough drying and friction, is an evidence of improper selection of the procedure—its temperature, duration, or mechanical impact. These should be modified as indicated by the effect observed each day and reported to the medical attendant, just as the effect of a Brand bath or of a dose of medicine is reported by the nurse and acted upon by the physician.

For the purpose of enhancing the reactive capacity of phthisical patients, the hot-air-cabinet bath offers an excellent substitute for the more tedious dry pack above described. It dilates the cutaneous vessels and renders the effect of the hydriatric procedure more pronounced. Care should be taken, however, that the patient be not permitted to perspire in the hot-air bath. This error may prove serious by destroying the patient's reaction and reducing his weight and strength.

As a palliative for the cough and for the reduction of febrile movement, the chest compress (page 114) is a valuable measure. It should be applied chiefly at night, or when the patient is resting, the chest being thoroughly rubbed with water at 60° each time it is renewed.

This treatment, viz., hot-air baths short of perspiration, followed by the circular bath and fan douche, gradually lowered and daily adapted to the patient's condition, especial regard being given to febrile conditions (when the milder antipyretic procedures come into play), may be continued for several months. The frequency of treatment may be reduced to three or even two a week. Now the patient may become accustomed to taking a morning plunge into a tub containing water at 60°. This must be a mere dip; preceded by saturating the head with water, a rapid emergence from the tub must be insisted upon, followed by thorough drying and good friction. A brisk walk into the morning air may follow, then a light breakfast, which the patient will eat with relish after such a dip. This daily training of the cutaneous nerves and vessels, with the consequent refreshment of body and mind, may contribute more to the recovery of the patient than any other single remedy. The result is usually an improved appetite, better digestion and assimilation, improved hæmatosis, deepened inspiration, vigorous circulation; in brief, an enhancement of all those functions which contribute to the maintenance of health, and on whose integrity depends the prolongation of life. No specific effect is aimed at; none is obtained. The patient is treated—not the disease. He is removed from unfavorable environment, out of reach of disease producing and maintaining elements; his organism is invigorated and steeled against the enemy which is "gnawing at his vitals." The prime essentials for this purpose are a good appetite and digestion. And these are the chief and most palpable effects of a judicious hydrotherapy in phthisis. Even in the most desperate conditions these may be observed sometimes. A young man from Charlotte, N. C., gained fifteen pounds in two months, despite the advance of his malady to the third stage. While evening exacerbation with high temperature and profuse sweats undermined his strength, his appetite was maintained, and he consumed during the first half of the day a sufficient quantity of food, of which cream cheese was a large proportion, to leave for Colorado with an increase of weight.

Professor Winternitz states that among twenty-four hundred patients treated at his institution in Kaltenleutgeben for various diseases, fifty-six per cent showed an increase of weight. A similar result has been observed during the past seven years in the Hydriatric Institute, when the cases treated for obesity or other diseases demanding increased tissue change are eliminated.

From the large clinical material at my disposal in hospital and private practice, the following brief histories are selected to demonstrate the value of hydrotherapy in phthisis, and to elucidate the procedures adopted:

Mr. S——, from Owensboro, Ky., aged 26 years, merchant, consulted me at Long Branch on July 29th, 1892. Looks pale, emaciated; states that he has been losing flesh and coughing seven months; is constipated, has no appetite. Caught cold during a fire. No hereditary predisposition. Temperature, 101°; pulse, 120. Physical signs: Percussion over left supraclavicular space dull, respiratory murmur in left apex harsh, expiration prolonged. Ordered calomel, six grains, and absolute rest.

July 31st. Feels better. Temperature, 99° F. Ordered to Hydriatric Institute for treatment. Here he weighed (nude) one hundred and six and one-half pounds. He received a hot-air bath until warm, to enhance his reactive powers. This was followed by a circular douche of 95° F., reduced gradually to 80°, for forty seconds under ten pounds' pressure, gradually increased; then a fan douche at fifteen pounds' pressure, gradually increased to thirty pounds for four seconds at 70°.

This procedure was repeated daily. He reported again at Long Branch ten days later, looking better, appetite improved, and with a gain of one and one-half pounds. A friend having advised him to have his sputum examined, the latter was found to contain bacilli. He was urged by another friend to see an eminent consultant, who, after careful examination, pronounced him phthisical, advised him to leave at once for Asheville, N. C., and ordered him to take creosote. As he was improving under hydrotherapy, I regarded his departure with disfavor and advised continuance of treatment by water.

September 8th. The hot-air bath, followed by circular douche, 80° to 70°, and fan douche, 70° to 45°, has been continued, until to-day the patient weighs one hundred and fourteen pounds, a gain of seven and one-half pounds in five weeks. Appetite is excellent; cough still troublesome; is very hoarse. Temperature, 101° Benzoin inhalation and one-fourth grain codeine every four hours improved cough in two days, during which time hydriatic treatment had been discontinued. It was now resumed.

September 12th. Temperature is 99°; cough reduced to a minimum; appetite excellent. Weight, one hundred and thirteen and one-half pounds. Has been taking six drops creosote, t.i.d.; as it nauseates him it is discontinued. Ordered maltine with peptones, t.i.d., in milk.

September 19th. Hot-air bath (170°) three minutes. Circular douche, 80° reduced to 64°, one minute, from which he reacted well. Cough troublesome. A spirometer test shows 190° before and 260° after treatment, which is 20° above the average for his height.

September 20th. Dr. J. S. Ely reports tubercle bacilli in small numbers.

December 30th. With occasional interruptions and loss of weight, patient has progressed well, and to-day weighs one hundred and twenty-one and a half pounds, looks well, coughs but little, has no pyrexia, and is anxious to go home.

Dr. Freudenthal, who treated his throat, wrote under date of January 12th, 1893, after detailing from his case records the physical signs he had found on July 27th, and again on November 11th, 1892: "Patient looks and feels much better, and has gained ten pounds in weight. Ulcerations of the ligamentum glosso-epiglotticum and of the vocal cords have healed under lactic acid and menthol oil

(twenty per cent). Although I am not so optimistic as you are regarding water treatment, I must acknowledge that the improvement in the case is remarkable."

January 21st. Patient is now almost free from cough and has good appetite. Weighs one hundred and twenty-two and a half pounds, a gain of sixteen pounds, and five pounds more than he ever weighed in health. Dr. Van Gieson reports that *no tubercle bacilli could be found* after examining several slides.

This patient remained well for six years, but has recently returned for treatment on account of throat trouble.

No change has been made in his diet and mode of life. This case is a clear illustration of the utility of a judicious hydrotherapy in improving nutrition in cases that usually thwart us.

A few brief histories from the hospital records * (Montefiore Home) may "point a lesson." The preparatory hydriatric measures adopted in these cases are omitted for the sake of brevity. The rain bath referred to in these histories is the circular douche.

J. D——, aged 36; ill two years and a half. Had hemorrhage two years ago, since then night sweats, cough, expectoration, and pain in left side. Has been treated twice at Mount Sinai Hospital for phthisis.

Physical signs on admission: Dulness over left apex, impaired breathing; pleuritic friction râles on right side along axillary space. Weight, one hundred and sixty-two and one-half pounds.

Treatment: General sustaining measures, with daily rain bath at 65° for thirty seconds; damp compresses to chest.

Result: Improvement of all symptoms, and gain of fourteen pounds and a half during ten weeks.

December 16th, 1890. He was subjected to tuberculin treatment until April 29th, other treatment being suspended.

The patient lost so much in weight and general appearance that I frequently felt misgivings as to the propriety of subjecting him to the experiment. The rain baths were resumed, and his general condition at once improved and appetite returned.

At the present time there are no cough, the least amount of expectoration, and but few pleuritic friction sounds over left apex. His weight is one hundred and seventy-eight pounds and a half. Dr. Hodenpyl reported: First examination, about ten bacilli to the field; second examination, very few bacilli; third, fourth, and fifth examinations, no bacilli.

This patient may be regarded as recovered, judging from physical signs, subjective symptoms, his general condition, and the absence of bacilli.

J. J——, aged 33, admitted February 2d, 1890. Family history negative. Illness of one and one-half years' duration. Began with pulmonary hemorrhage, followed by cough; spat blood two days, and felt better after it. Continued to cough until December, 1889, when he had a most severe hemorrhage, became very weak, and was confined to bed.

Continues weak; cannot work; coughs a great deal; expectorates a little mucus, often mixed with blood. Complains of pains in back, tickling in larynx; appetite is good, bowels are regular.

Physical signs: Dulness over right upper lobe, as far as first rib, posteriorly

* Transactions Medical Society of New York.

to border of scapula; slight dulness over left apex; uncertain and accentuated breathing, with prolonged expiration over right apex, feeble respiration over left. Temperature normal; pulse, 84; respiration, 28.

February 18th. Weight, one hundred and thirty-five pounds. Treatment, one-minim creosote pill, two t.i.d., with cod-liver oil, ʒ ss. Circular bath at 65° for thirty seconds daily.

March 1st. Coughs only a little in the morning. Weight, one hundred and forty-two and a half.

March 20th. In fair condition; quite a little cough in the morning. Weight, one hundred and forty-nine and a half.

April 25th. Weight, one hundred and sixty-one and a half.

May 5th. Appetite not so good lately; otherwise feels very comfortable. Coughs sometimes in the morning; no expectoration. Weight, one hundred and sixty and a half.

Dr. Dessau examined the patient. He found very slight broncho-vesicular respiration in the left apex. Impaired resonance on percussion of the same, and very few mucous râles. On the left below the scapula very few subcrepitant râles, probably due to old pleuritic adhesions.

May 11th. Right apex, vesicular respiration, and very slightly impaired resonance, which is often found normally in the right chest; so practically we can find now only a very slight infiltration of left apex, with some old pleuritic adhesions. Weight, one hundred and sixty-one, a gain of twenty-six pounds. Discharged at his own request, as he desired to go to work.

H. S——, aged 31 years, admitted May 2d, 1890. Family history negative; always well until May, 1889, when he had first pulmonary hemorrhage; was confined to bed eight weeks with cough, night sweats, and afternoon fevers. In September, 1889, and January, 1890, he had hemorrhages, and went to Mount Sinai Hospital, whence he was discharged improved in seven weeks. He had cough, expectoration, and pain in the chest; no appetite when admitted.

Physical examination: Dulness over right third anteriorly and posteriorly; subcrepitant and friction râles; broncho-vesicular respiration, with prolonged expiration. On left side, prolonged expiration, with some friction sounds over left apex. Weight, one hundred and twenty-nine and three-quarters pounds.

August, 1890. Sputum found to contain bacilli.

In September, 1880, he had a hemorrhage. During this time he received rain baths, syrup of hypophosphites, and creosote; at times cod-liver oil. Under this treatment he steadily improved, so that when he was subjected to tuberculin injections, on December 6th, 1890, he weighed one hundred and forty-six pounds—a gain of sixteen and one-quarter pounds in six months and a half—and no bacilli were found by Dr. Hodenpyl in his sputum.

There were still, however, dulness over right apex, broncho-vesicular respiration, and subcrepitant râles. His temperature was 99°. April 15th, tuberculin injections discontinued.

There being no tubercle bacilli in the sputum and no cough or expectoration, and the physical signs being only a slight, jerky respiration, he was discharged as cured, April 29th, weighing one hundred and forty-nine. He had increased twenty pounds since his admission, and three and one-half pounds since injections were begun, during the continuance of which he lost very considerably. He went to work at Bronxville, N. Y.

A. V——, a nurse in the Montefiore Home, weighed, in the summer of 1890, one hundred and thirty-eight pounds. She was constantly engaged in the wards, in which her mother was also a nurse. She began to lose flesh while at

work; cough and expectoration were pronounced, and she had two small hemorrhages.

Physical examination revealed impaired resonance over left apex, jerky, exaggerated respiration; fine, moist, and pleuritic râles. Bacilli abundant in the sputum. Weight, one hundred and twenty-six pounds on January 5th, when she was subjected to tuberculin injections.

She received twenty-one injections, progressively increased. They were always followed by decided febrile reaction. The last injection of 45 mgm. was administered on the first of April, and was followed by very slight reaction. During the entire treatment she had daily rain baths.

April 10th. Cough, expectoration, night sweats, and physical signs had ceased; her weight had increased to one hundred and thirty-two pounds, and, no bacilli being found in the sputum, she was discharged at her own request as cured. Last year (1896) she was still working as a private nurse, feeling perfectly well.

In these cases the effect of tuberculin was either deleterious or negative, while that of the rain bath was excellent.

B. S——, aged 18 years, architect, admitted November 19th, 1890. Mother died of chronic phthisis. Has been ill since he had an attack of pneumonia two years ago, with night sweats, troublesome cough, and loss of flesh.

Physical signs: Those of a cavity. Tympanitic dulness over the upper third of left lung anteriorly, cracked-pot sound, cavernous râles, tuberculous breathing, signs of catarrh in right apex. Complains of palpitation greatly. Weight, one hundred and fiften pounds. Bacilli numerous.

Treatment. Rain baths, 70° to 65°, thirty seconds; cod-liver oil and creosote.

December 16th. Up to that time his weight had increased eight pounds, although the physical signs were the same as on admission. Temperature normal. He was now subjected to tuberculin treatment, under which he increased (as an exception to the rule), on April 10th, to one hundred and thirty-eight pounds. Cough did not trouble him now, and he expectorated very little. A few bacilli at every examination. Physical signs not so pronounced. Râles few, and there was evidence of contraction of cavity. The palpitations, which troubled him greatly, had disappeared.

Dr. Hodenpyl's report is interesting:

December 16th. One hundred tubercle bacilli to each cover glass.

March 1st. Two bacilli to field.

May 7th. His weight is one hundred and thirty-nine pounds. He has been receiving rain baths since the injections were stopped. *He looks well*, and may be regarded as markedly improved.

He was discharged on July 14th, weighing one hundred and forty pounds, and looking the picture of health. He settled in Denver, Col., and when last heard from was following his vocation as an architect.

This case offers another illustration of the influence of hydrotherapy on the nutrition.

Dr. Bloch's Montefiore Home report for 1892 says:

"This remarkable success is chiefly due to the water treatment, the most characteristic feature of our institution. S. K——, after having gone to Europe for his health for one year, came to the Home with a cavity in his left apex and considerable organic change in the lung. After one year's treatment he was dis-

charged well; not only fever, night sweats, cough, pain, but even the objective signs of the cavity having disappeared, and with a gain of twelve pounds. He has been working hard as a painter for the last six months, and feels well."

In the report for 1893, of Drs. Bloch and Frankel, house physicians of the Montefiore Home, the following sentence occurs:

"Too much praise cannot be given to our hydrotherapeutic arrangements, which constitute a most powerful element in our therapeutics. We have succeeded in curing thirty-one patients last year, all of whom have been discharged. Twenty-nine more have been discharged improved. Among those cured or essentially improved, there have been six consumptives, some of whom had come to the home with cavities."

A case from the report for 1894, by Drs. Bloch and Frankel, is briefly told:

E. F——, 33 years old, came to the Home in November, 1892, after a large hemorrhage, with the physical signs of a small cavity in left apex and infiltration of right apex. He was discharged June, 1894, "cured," having felt perfectly well for a whole year; expectoration, bacilli, and physical signs, after contraction of cavity, having disappeared, and with a gain of twenty-seven pounds.

The records of this institution, which contain a large number of phthisical cases, present abundant evidence in detail of the influence of systematic hydrotherapy, chiefly circular douches. The brief outline histories furnished above, suffice as examples.

In view of the results obtained in this large institution from the judicious and systematic application of douches, it is remarkable that the average medical practitioner in this country is still so unacquainted with it that he shrinks with horror at the very mention of applying "cold water" to the skin of a consumptive. The proof of its value is so abundant that "he who runs may read."

A sufficient number of clinical histories has been cited from private and hospital records to demonstrate the hydriatric methods pursued. A larger number of histories would burden the reader without convincing him more fully that hydrotherapy furnishes a precious auxiliary in the hygienic management of phthisical patients. The latter are too often condemned to exile from home and friends, when the employment of hydrotherapy would invest the case with a favorable aspect that would encourage patient and physician alike, and enable the former to remain among his dear ones.

CHAPTER XXIII.

MALARIAL DISEASES.

ALTHOUGH we possess in quinine a curative remedy for true (plasmodium) malarial fever, cases do occur which resist its influence, or in which the medicine cannot be taken or retained. Moreover, there are certain forms of malarial fevers of great severity, in which it is well-nigh impossible to obtain absorption of quinine; and there are other forms in which quinine has been found rather deleterious than otherwise. The former are those chronic forms in which the paroxysmal habit has been set up, as it were. This type of cases is not infrequent in malarial regions; they usually arise from neglected cases and continue during the winter months, despite atmospheric conditions which would prevent the recurrence of the disease *de novo*. When medicinal, dietetic, and climatic treatment have failed to restore these cases to health, hydrotherapy may prevent the recurrence of the paroxysms and so improve the general health that a favorable issue may result.

The malignant types of malarial diseases, especially the hemorrhagic form, have proven very rebellious to quinine treatment, probably because the absorption of this agent is rendered difficult by impaired circulatory conditions. Steudel,* who is an enthusiastic advocate of quinine, concedes that the development of pernicious forms of malaria failed to be prevented by the most energetic prophylactic use of quinine in fifty per cent of the cases. The malarial cachexia of furloughed men from Africa developed despite the careful and extensive prophylactic use of quinine. Ziegelroth states that many officers have claimed that the prophylactic administration of quinine has not only failed to prevent pernicious malarial fevers, but has even aided in the development of the hemorrhagic form. This is corroborated by Plehn,† who claims that the tendency of the prophylactic use of quinine to destroy hæmoglobin causes the development of hemorrhagic fever. Similar observations have been made by others.‡

Has the application of water in this disease demonstrated its clinical value sufficiently to warrant a resort to it, when quinine has failed,

* "Die perniciöse Malaria in Deutsch-Afrika," Leipzig, 1897.

† "Ueber Schwarzwasser-Fieber," Deutsche medicinische Wochenschrift, Nos. 25 and 27, 1895.

‡ Below's Report to the Berlin Medical Society, June 30th, 1897.

or when its application was inexpedient or impossible? This question will be answered in this chapter.

In the early part of this century Currie reported that several times he prevented the development of intermittents by affusions of cold water, given about an hour before the expected paroxysm; and that four or five affusions caused the cessation of the paroxysms.

The pioneer of scientific hydrotherapy in France, Fleury, applied douches of 55°–60° F., one or two hours before the paroxysm in over one hundred cases, and came to the following conclusions, which were investigated and confirmed by a royal Belgian commission in the Military Hospital at Brussels: 1st. In simple recent intermittents, with or without enlarged spleen, cold douches may replace quinine. 2d. In old, regular, or irregular intermittents with relapses, cachexia, anæmia, etc., cold douches should always be preferred to quinine.

The history of this subject, gathered since the days of Fleury, tends to maintain the correctness of his conclusions. In the large preponderance of recent (plasmodium) malarias quinine is of undoubted value. When rightly administered, to the production of cinchonism, three hours before the expected paroxysm, the effect is specific—the only real specific in therapeutics; we can predict the result with certainty. To recommend any hydriatric procedure in these cases is unnecessary, and its preference to quinine can be entertained only by a water enthusiast. When, however, for some known or unfathomable reason, quinine is not absorbed so as to produce cinchonism, or the paroxysm is too irregular in its return to be forestalled, the records show that hydrotherapy "may replace it" very satisfactorily.

In the malignant forms of malaria Southern practitioners have reported excellent results when quinine has failed. The standard textbook of my student days* says: "In treating pernicious fever, some practitioners in the West and Southwest habitually employ cold affusions or the cold bath. Dr. Richmond, of Indianapolis, was in the habit of causing the patient to lie naked at full length, and of pouring cold water from a pitcher upon him from head to foot, until he began to shiver, when he was wrapped in a blanket and plied with stimulants diligently. This measure proved effectual in several apparently desperate cases. Dr. Barbour, of St. Louis, Mo., esteemed the affusion of cold water above all means in the treatment of this disease. A similar view was taken by Dr. Frazier, of Knoxville, Tenn., after much experience with different methods of management."

These observations by men who well knew the value of quinine, because it was their life mission to combat malarial fever in its worst haunts, deserve the utmost respect and offer a valuable resource in

* "Practice of Medicine," by Geo. B. Wood, M.D., vol. i., p. 339, 1866.

cases which baffle the physicians practising in the malarial sections of the tropics and subtropics.

That quinine should be replaced by hydrotherapy in the old, irregular cases, as Fleury recommends, may at first thought be deemed to be a water enthusiast's view. But those who have, like the writer, often been baffled in these trying cases will gladly welcome so simple a measure as a cold douche, affusion, or hip bath as a trustworthy refuge when quinine fails.

The author, who practised for fifteen years on the banks of the Wateree River, near Camden, S. C., where the adjoining plantations breed malaria of the mildest as well as the most malignant type, realizes how much he lost at that time by reason of his unfamiliarity with this valuable therapeutic function of water in malaria. Since his residence in New York he has had but one opportunity to treat an obstinate case of intermittent by water, the relation of which may be instructive.

P. S——, aged 13 years, applied for treatment September 14th, 1893. He had been suffering from a quotidian fever since the summer of 1892. The attack yielded to quinine for weeks, but continued to recur at the most unexpected periods during the following winter. He regarded himself cured, paroxysms having been absent for several weeks, when on his way to the Chicago Fair he had a chill when crossing Niagara Falls Bridge. On his return home he again submitted to a course of quinine and arsenic with occasional good result. The paroxysm returning in September, I was called during the absence of his able medical attendant, Dr. W. T. Alexander, and found that he had had several daily recurring attacks, which compelled him to retire from the schoolroom about 11 A.M. every day. The spleen was enlarged about one-fourth; the boy was anæmic and despondent, although he felt well during the early morning hours. I prescribed quinine, but failed to cinchonize him, even with the solution in large doses (20 gr.). About a week was thus wasted, when I advised his intelligent mother to give him, at 10 A.M. daily, a cold douche upon the back, while standing in twelve inches of hot water in the bathtub. The boy's residence being in Audubon Park, on the eastern bank of the Hudson River, the water pressure was quite strong, probably thirty pounds. The temperature of the water was 60°; the duration five minutes. The effect was simply marvellous; the boy has never had a return of the malarial paroxysm since the first douche; the latter was continued daily for one month, and he was advised to take cold plunges daily during the winter. His health was completely restored.

This experience has been frequently repeated by others. Fodor* reports seven cases of malarial fever, from five weeks' to four years' duration, which had been treated with quinine *secundem artem* without success, and which yielded to douches and hip baths very rapidly. These and other histories recorded by Fischer, Strasser, and others, are remarkable for minuteness of description and for the rapid effect of the treatment which they record.

* Blätter für klinische Hydrotherapie, p. 139, 1892, and 1895.

Alois Strasser,* in detailing one of these cases, offers the following explanation of the *rationale* of hydriatric procedures in malarial affections. "Quinine and hydrotherapy act alike by rendering the plasmodium harmless. The antipyretic action of quinine is well-known, as well as its enormous inhibitory effect upon fermentation and decomposition of organic substances, and its property of checking the amœboid movements of white cells and of the protoplasm of the infusoria. It is not unreasonable to suppose, therefore, that quinine destroys the plasmodium, or so weakens it that sporulation and reproduction are inhibited. The biology of the plasmodium and the condition of the blood during and after the paroxysms must be considered, in order to explain the action of hydriatric procedures in malaria. During the apyrexia there are, as is well-known, no plasmodia found in the blood. Only a short time before the paroxysm or during its initial stage they are found in the red cells, making amœboid movements. As soon as the parasite is developed in the cell, the febrile paroxysm begins; the hæmoglobin of the red cell is destroyed; toward the end of the paroxysm the cell itself is broken up. Hence the natural course of the paroxysm consists of the entrance of the parasite into the blood current, its growth in the red cells, the destruction of the latter and of the parasite, and the admixture of the products of this decay with the leucocytes. Cold applications act by causing a breaking down of the red cells, which have been weakened by containing the plasmodia in the act of breaking up, before the fever occurs, and by furthering destruction of the plasmodia which have left the cells, either by phagocytosis or by increased oxidation."

Ziegelroth† amplifies this explanation by assuming that "the malarial paroxysm is produced by the entrance of a quantity of toxic material issuing from the detritus of the broken-up red cells and parasites which remains after sporulation, as stated by Flügge. Treatment is ineffective after this pyrogenous material has entered the blood. The fever is really a conservative process for rendering the toxins harmless by the reaction of the system. The more complete the oxidation is, the better. He regards pernicious malarial fever as the result of inadequate reaction. Hence neither quinine nor water is effective unless applied before the paroxysm begins. Quinine is supposed by Binz and others to destroy the parasite itself, but cold water can act only by enhancing the normal antiparasitic power of the blood serum, the tissues, and cells of the organism. Cold water acts as a whip, which drives the latter to the highest development of its reactive capacity. The vital energies are heightened; the action of the heart, lungs, and skin is

* Blätter für klinische Hydrotherapie, p. 19, 1894, and p. 190, 1897.
† *Ibid.*, 1897.

excited. The resisting and bactericidal power of the cell is enhanced. This increased capacity for work is evidenced by the rise of alkalescence of the blood and by the mobilization of leucocytes circulating in it after cold procedures. We are therefore justified in regarding the action of the latter as an effective measure for combating the pathogenic germ and its toxins."

Strasser adds that the aborting of a malarial paroxysm by cold water may be explained by the fact that the chill is really a retention fever, in which the contraction of the peripheral vessels, which gradually reaches a high degree, prevents the giving off of heat from the skin, to the extent of showing a difference of 40° F. between the rectum and skin. Maragliano has shown that this contraction of the peripheral vessels begins two hours before the temperature begins to rise. The retention of heat is therefore colossal, not only in malarial, but in other fevers beginning with chills. By an artificial removal of this contraction of the peripheral vessels we may remove the heat retention and abort the paroxysm. If this is done two hours before the latter is due, it may be prevented entirely. The cold procedure is most efficient for the purpose of dilating the cutaneous vessels by the reaction which ensues; the more thorough the latter is, the better the result, especially if perspiration is promoted by exercise when the patient is able to take it.

We have, therefore, a double effect for cold procedures before the paroxysm, namely, the furtherance of destruction of the red cells which have acted as hosts for the plasmodium, and the removal of the detritus of both by enhanced oxidation and eliminative action, and by counteracting heat retention. Strasser cites two hundred and seventy-two cases of malarial fever, which have been treated successfully by hydriatic procedures, by several reporters.

The procedures which have been found most useful are as follows: If the patient has been much depreciated by the long existence of the disease, if he be anæmic, the treatment should be as indicated on page 344. By careful investigation the time of the expected paroxysm must be ascertained. About an hour before the time, a douche should be applied, preceded if possible by a dry pack or hot-air bath. The patient, standing in water at 100°, receives over the spleen, liver, and spine a douche or affusion of 60° or less, lasting thirty to fifty seconds, with the object of producing decided reaction after the shock. This should be repeated in half an hour, to insure proper effect. In many instances the treatment will prevent the paroxysm. Whether it does so or not, it should be repeated every day at the same time for a week or two.

If the paroxysm develops, the full bath at 75°, wet pack at 65°, or ablution at 60°, with abdominal compresses at 60°, should be applied for antifebrile purposes. The chief purpose, however, should be the prevention of the paroxysm by a daily cold douche, repeated twice within an hour of the expected paroxysm.

CHAPTER XXIV.

NEURASTHENIA.

By consensus of many authorities, hydrotherapy is indispensable in the management of the large majority of neurasthenics. Indeed, there is probably no chronic disease in which its application contributes more largely to the betterment of the patient's condition and which renders the effect of changed environment, removal of etiological factors, diet, electricity, and medication more pronounced and enduring.

Long before neurology had become a specialty or neurasthenia had been recognized by our own Beard as a distinct disease, Griffin* prescribed lukewarm and cold ablutions in "spinal irritation."

Romberg† advised cold affusions over the head for vertigo, and recommended warmly a systematic cold-water treatment for cases of "psychical hyperæsthesia."

Preiss‡ said truly, forty years ago: "Prolonged continuance of anomalies of the nervous system not rarely derange important functions, including those of the chylopoietic organs. Since all functions depend upon nerve action, and no other remedy is capable of altering the nervous system in a mild manner so rapidly, surely, easily, and thoroughly as water, this simple remedy must occupy the first rank as a nerve tonic."

Eulenburg§ regards balneotherapeutic procedures in the form of cold-water treatment among the most important agents.

Jolly prefers, in his treatment of hypochondriasis, hydrotherapy to electrotherapy. He recommends the consumption of large quantities of water to promote renal and peristaltic action, and regards the external application of water as very useful "in those cases in which increased excitability is combined with tendency to exhaustion." Jolly regards this favorable influence due to the cutaneous derivation and improvement in the circulation and tone of the vessels, as produced by cold rubs, half and full baths with friction and douches, always care-

* "Observations on Functional Affections of the Spinal Cord and Gang lionic System of Nerves," London. 1834.

† "Lehrbuch der Nervenkrankheiten des Menschen," Berlin, 1851, p. 20.

‡ "Physiologische Untersuchungen," Berlin, 1858.

§ "Lehrbuch der Nervenkrankheiten," 1878, vol. ii., p. 697.

fully adapting the temperature, etc., to the patient's condition. He advises sending obstinate cases to institutions where treatment may be applied judiciously.

Krafft-Ebing* writes: "In the management of neurasthenia the water treatment is of the greatest value, because as applied preferably in institutions, it admits of all possible excitant, calming, and alterative effects upon the diseased organism and its tissue change." He recommends hydrotherapy in insomnia, and regards its good effect in neurasthenia as due to regulation of cardiac activity, dilatation of peripheral vessels, diminution or increase in the cerebral circulation, general calming, etc., according to the procedures used, and which he carefully indicates.

Strümpell prefers to send severe cases of neurasthenia to institutions. He advises cold rubs, half-baths, and douches upon the loins.

Bouchut† uses most hydriatic measures, but advises that the physician familiarize himself with them, and *exercise great caution in their application.* He emphasizes that the skin is invigorated, tissue change stimulated, and hæmatosis enhanced. He furnishes many clinical histories to illustrate the effect of hydrotherapy.‡

Erb§ says: "Cold and cool baths, the application of cold water in its various forms, belong to the most important and most active agents in the treatment of nervous diseases. Its results in all possible forms of chronic nervous diseases are extraordinarily favorable. It is evident that we possess few remedies which produce an equally powerful effect upon the nervous system."

Klemperer,‖ chief of Professor Leyden's clinic in the Berlin University, says: that "in hydrotherapeutic effects we observe quite an extraordinary and incomparable stimulation of the nervous system which is reflected upon the various organs."

Dr. William H. Draper¶ says: "In persons whose nutrition has been enfeebled by chronic disease and in neurasthenia, hysteria, and hypochondriasis, its good effects are very striking. *It seems to be more effective than any treatment by medicine* in stimulating the nerve centres, in restoring the equilibrium of the circulation, and reviving the activity of the organic functions.

"Its best results require the appurtenances of a well-ordered establishment, where all the various methods of applying water can be wisely and skilfully directed."

* "Ueber gesunde und kranke Nerven," p. 146.
† "Du Nervosisme," p. 350.
‡ "Handbuch der Neurasthenie," F. C. Muller, 1895.
§ Ziemssen's "Cyclopædia."
‖ Publications of Hufeland Society, 1896.
¶ Medical Record, April 22d, 1893.

Dr. Frederick Peterson* holds that the "water treatment certainly has many features which appeal strongly to our sense of rational treatment. Who can calculate to what degree we may thus influence the biochemical processes of the body, the metabolism of tissues, the carrying off of degenerated and toxic substances, or determine how much we may affect the vascular neuroses, the local anæmias and hyperæmias of the brain and spinal cord?

"With reference to general nervous diseases, I am sure there is a tendency everywhere among neurologists to look with more and more complacency upon this means of treatment as one of great value. I know that this is true in all parts of Germany, Austria, and France. In some conversations with Professor Winternitz, of Vienna, I learned that, in his practice of over thirty years, fully three-fourths of his patients were sufferers from nervous disorders, and his remarkable success in relieving and curing bad cases is everywhere attested."

These comments upon the value of hydrotherapy in neurasthenia (and other neuroses) are not cited from hydrotherapists, but from writers and teachers on neurology; they have been selected in order to demonstrate that the charge of "unwarranted enthusiasm," which is so often made against the advocates of hydrotherapy, is unfounded in fact.

In order clearly to outline the hydriatic treatment which I regard as the most useful in neurasthenia, it will be necessary to divide the cases into three classes, viz.: the torpid or hypochondriacal, the excitable or hyperæsthetic, and the intermediate or mixed type.

1. *The torpid type* has been most frequently under my observation among the cases referred for hydrotherapy by colleagues, especially among those sent by neurologists. The reason is probably to be sought in the fact that these cases do not yield so readily to domestic treatment as the excitable type. Moreover, the prognosis with regard to hydrotherapy depends much upon the patient's blood state. The depressed neurasthenic, agoraphobic, nosophobic, or hypochondriac responds more readily to treatment than the hyperæsthetic neurasthenic; and both will respond better to hydrotherapy if the general nutrition and hæmatosis are decidedly impaired.

A somewhat extensive acquaintance with the literature, together with clinical observation of the enormous material received in the Park Avenue Hydriatric Institute, which receives private patients, and in the Hydriatric Department of the Riverside Baths, which receives patients from several large city dispensaries, has convinced me that many of the manifestations of neurasthenia in the large majority of cases are traceable to defective nutrition of the nerve centres, arising from circulatory disturbances in the cerebro-spinal sphere. Since this

*American Journal of the Medical Sciences, February, 1893.

view is entirely clinical, and I may say empirical, *i.e.*, based upon observing the effect of treatment, I shall not here venture upon the theoretical basis for my belief. Inasmuch as many excellent authorities, as Beard, Erb, Axenfeld, Bouchut, Eulenburg, Krafft-Ebing, and Strümpell, confirm this view more or less, it requires no further discussion in this practical work to establish the remarkable effect of a judicious application of water, carefully observed by the medical attendant in each individual and modified according to its effect upon the pulse, blood pressure, corpuscular elements of blood, etc. The best authorities insist upon a careful technique, and yet the latter is too often neglected. Directing the patient to take a *cold* sponge bath every day, or trickle cold water down his back, or to take a cold plunge bath, or a warm bath gradually cooled, or a Charcot douche, does not suffice to obtain the best results. The experienced neurologist may, and doubtless does, by watching his patients closely, succeed in restoring health by adding such perfunctory hydrotherapy to his other treatment. But how often are such patients seen only once a week or less frequently, and how much mischief may be done the patient by leaving him for several days to his own or to some nurse's water treatment? The writer has observed a case of "insomnia" of two years' standing which had been unsuccessfully treated by justly eminent physicians in Germany and in New York, including the most active hydrotherapy. The patient also failed to recover under the most judicious rest cure, and, being referred to the author by Dr. Wharton Sinkler for water treatment, began to improve, and he eventually recovered entirely under hydrotherapy, which was assiduously watched every day and modified to suit existing conditions.

I have recently returned a patient to San Francisco in perfect condition after a three-years' peregrination from one specialist to another, from asylum to sanatorium, from rest cure to diversion. This case (psychopathic) recovered under a gradually adapted hydrotherapy (p. 378).

Hydrotherapy often, alas! too often, fails, as do other remedial measures, but it is the author's belief that failure of the former is often the result of imperfect and unsystematic application by the patient, his friends, or by untrained attendants, of a treatment which may have been carefully ordered by the physician. I plead for the same watchfulness in chronic diseases which the physician maintains in acute life-endangering maladies. Results approximating those so commonly obtained in the latter may by assiduous care not infrequently be reached in the former. The observation of this fact must be my apology for entering somewhat minutely into the hydriatric methods I have found most useful in neurasthenia.

In neurasthenia of the torpid type of patients whose nutrition is below par, the object of treatment is the elevation of the general nutrition. If the patient has not been accustomed to cold water in any form, he may receive a dry or alcohol rub every morning before rising; a brief exposure of successive parts of the body to the air is useful, and aids the effect of the dry rub or rubbing with a bath glove or wash rag, wrung out of equal parts of alcohol and water at 75° (alcohol being added to allay these patients' frequent fear of cold water), in bringing about a cutaneous hyperæmia. After continuing these rubbings several days, the patient will be prepared for the dry pack and ablutions (see page 351) gradually reduced in temperature. This treatment "feels the patient's hydriatric pulse," as it were; for, if he reacts well, and is not excited by the procedure, we may at once advance to more decided measures. In domestic practice the wet pack, always followed by the half-bath, provided a trained attendant may be obtained, is perhaps the most useful procedure, but long training of the reaction is required ere the patient is able to bear so decided a procedure. The shower bath, which usually has insufficient pressure and is but too frequently applied over the head, is "a delusion and a snare." The drip sheet and cold rub are very useful domestic procedures if applied by a skilled attendant. It should always be remembered that the patient requires mechanical aid from an attendant to bring about the proper reaction, and that the stimulus conveyed to the central nervous system is the aim of the procedure. This point must never be lost sight of. The depressed patient may find all kinds of hypercritical objections to the treatment; these should lead the physician to observe the patient if possible before, during, and after the treatment, to examine the pulse by the sphygmograph and count the respiration, ascertaining by dermography the capillary cutaneous reaction; and, if possible, the blood should be examined by the hæmatocrit and hæmometer. Thus, and thus alone, may the physician satisfy himself of the correctness of the patient's estimate of the treatment; he will find the latter usually unreliable; and the nurse's impression is not always a trustworthy guide.

Another very useful procedure, applicable chiefly in cases presenting psychic manifestations, is, according to Strümpell, whose observation the author can confirm, the *hip bath*. My usual practice is to raise the patient's general nutrition by the procedures above referred to, and when this is accomplished to order a hip bath of 90°, daily reduced one degree until 80° is reached, of five to eight minutes' duration, with good friction, terminated by three affusions upon the back with a pitcher or basin of water at 75°, daily reduced until 60° is reached. In addition, the patient is advised to consume daily three portions of

eight ounces each of cold boiled water, containing as a placebo and reminder a tablet of lithia or other alkali. Two or three times weekly a thorough intestinal irrigation, which removes all fæcal, gaseous, and other accumulations, enhances the favorable effect of the other hydriatic measures.

If this treatment does not restore the patient, his diet, exercise, rest, etc., being carefully adjusted to indications, a more active method should be adopted. The general or spinal (Charcot) douche (one or both) is the most powerful agent for arousing the lethargic patient, stimulating his nerve centres, and increasing cardiac vigor and tissue change. (See *Rationale of Douche*, page 213.) This procedure, like all others, must be gradually and carefully adapted to the requirements of the case, until the lowest temperature and highest pressure are borne without flinching. I have often succeeded in training the patient's reactive capacity to accept a jet douche of 40° for twenty seconds, under thirty-five pounds' pressure, or the Scotch douche, which is the most stimulating procedure. My usual course is to place the patient in the hot-air cabinet, for the purpose of improving his reactive capacity by dilating the cutaneous vessels. He is removed before he perspires. Once a week he is allowed to perspire five minutes for the purpose of enhancing tissue change. After removal from the cabinet the patient receives a circular douche of one-half to one minute's duration at 95°, gradually reduced to 85°, to avoid too great shock from the subsequent procedure. A general fan douche, under twenty pounds' pressure, follows at 85°, reduced gradually during ten to twenty seconds to 80°; the latter daily reduced one degree. The patient is now rapidly dried and sent out into the open air for a walk, which he is ordered to continue until somewhat fatigued. After one week of this treatment a fan douche to the back is added, beginning with twenty pounds' pressure, at a temperature of 75° for five seconds, and increasing pressure and duration and decreasing temperature daily. This is administered after the circular douche, and followed by the general fan douche for fifteen seconds, at 78°, daily reduced, and at thirty pounds' pressure. Then the jet douche to the back is substituted for the fan douche.

The prescription at the beginning of the third week, provided the treatment is found appropriate to the patient's reactive capacity (not to his own ideas), will read as follows:

℞. Hot-air bath to beginning perspiration. Circular douche, 25 lbs. pressure, 1 min., 95°–80°. Jet douche back, 30 lbs., 5 sec., 75°, daily reduced one degree. General fan douche, 30 lbs., 20 sec., 78°, daily reduced one degree. Friction. Walk slowly in the open air.

Owing to the cumulative effect of this neurovascular training, daily

treatment is preferable. Usually Sunday is omitted for city patients, but included for extramural patients whose stay is limited.

As the patient's reaction is improved, less friction is used in drying; he may be lightly dried and allowed to clothe himself and take active exercise.

Well-nourished neurasthenics of the depressed type are more difficult to cure. In these cases the patient's response to water treatment must be ascertained in the manner above mentioned, the difference being that the dry pack is continued until the patient perspires well, which may be facilitated by copious drinking of cold water. Successive parts of the body are cautiously exposed and well dried before ablutions are begun (see *Ablutions*). The succeeding treatment is the same as above, with the exception that the patient is allowed to remain in the hot-air bath until he has perspired five to twenty minutes. If the patient's weight is reduced too much by this treatment, the hot-air bath may either be shortened, discontinued, or brought only to cutaneous warming. The internal use of water should be increased to four portions of water, eight ounces each, an hour before meals and at bedtime, two being hot and two cold water. Intestinal irrigation is also an essential part of this treatment.

2. *The irritable or hyperæsthetic neurasthenic* does not offer so favorable a field for hydrotherapy as the opposite type. Here, again, it is necessary to differentiate in our procedures between the poorly and the well-nourished individual. Both types require very cautious management. The dry pack may "set him wild;" he objects to being confined in it and fears lest he may be burned or otherwise injured. This is not an uncommon incident with other patients; it must be met by quieting assurance from the constant presence of a calm and self-possessed nurse. The hot-air bath also has terrors for many patients of this type. It is difficult to persuade them to go into it; but patience and the presence of other patients in the adjoining cabinets usually overcome such fears.

The patient requires only a slight warming up before he is subjected to a circular douche with fifteen pounds' pressure, for one minute, at 95°. He is now dried without being rubbed, and sent home to rest an hour. Walking slowly in the open air immediately after the treatment is far better than resting in a warm room before returning home, when he will probably be inclined to sleep. The temperature of the circular douche is reduced daily one degree, until 80° is reached. *In these cases strong pressure and low temperature are not tolerated;* nor is active friction so useful as in the first type. Prolongation of the treatment by adding a fan douche one degree lower than the lowest temperature of the circular douche, and with five pounds' more pressure, will be all

such patients may bear without increasing excitability. A gradual increase of pressure is better borne than a lowering of temperature. Occasionally the fan douche may be applied to the back as low as 75° for one or two seconds as a tonic, and if well borne repeated oftener. Home water treatment is apt to aggravate such cases, unless given by thoroughly trained nurses and unceasingly watched by the physician.

The well-nourished hyperæsthetic neurasthenic may begin with half-baths at 95° for ten minutes, daily reduced one degree until 85° is reached. Affusions may excite him, and must therefore be omitted or gently and gradually added. Hip baths at 90° for eight minutes at bedtime are useful, the feet being kept warm and the bed linen warmed during the bath. Institution (cabinet and douche) treatment is exceedingly useful in this type, when the proper temperature, pressure, and duration are ascertained with great care. This type of neurasthenics is the bane of the hydrotherapist, because the treatment must be advanced very slowly, and changed often according to its effect upon these impressionable individuals. These patients are almost certain to abandon it before the proper procedure has been sufficiently tried, a not uncommon occurrence with all neurasthenics.

A very prevalent error in the treatment of all neurasthenics is committed in yielding to the patient's inclination to have local treatment. He wants applications to his head for headaches, to his stomach for dyspeptic symptoms, to his spine for "spinal pains," to his perineum for "impotence," etc. Such applications fix his mind more firmly upon his real or imaginary ills and tend to aggravate them. He should be firmly informed that he has lost his "nerve equilibrium," that these ailments are but manifestations of the latter, and that the object of the treatment is a restoration of the "nerve tone," and must therefore be of a general character. Exceptions to this rule may be made in cardiac neurasthenia, when bradycardia or tachycardia with feeble pulse, etc., are pronounced. Here the ice coil (see page 129) is often useful, applied for periods of half an hour and intermitted for fifteen minutes. The quieting and slowing effect of such a procedure on the pulse is sometimes striking and helps the patient materially by suggestion, in removing his apprehension of heart disease.

The wet pack, 60°–70°, followed by the half-bath, 80°, for five minutes, is perhaps the most valuable procedure in cardiac neurasthenia, in which douches with strong pressure and low temperatures must be avoided.

3. *Intermediate or Mixed Cases.*—A large proportion of neurasthenics cannot be classed with either the irritable or depressed types. For these we have a valuable resource in the wet pack at 65°–70°, fol-

lowed by affusions at 75°–85°, or the circular douche at 90° for one minute, and by the fan douche at 85°, reduced gradually every day, but not below 60°. When the case partakes more of one or the other type described above, the wet pack may be advantageously followed by the treatment detailed for the respective types, or it may be alternated with the hot-air bath and douche treatment.

The experiments of Max Schüller have so clearly demonstrated the calming influence of the wet pack upon the cerebral circulation that we have an exact basis upon which this treatment may be applied in many cases of neurasthenia, especially those troublesome cases in which insomnia is a pronounced manifestation.

This procedure is one of the most effective means of quieting the entire nervous system, whether the irritable condition be due to an essential increase of reflex excitability or to a cerebral hyperæmia. The pronounced sinking of the brain substance, the positive diminution of the respiration and heart beat, the weakening of reflex excitability and of activity of the cerebral ganglia observed in trephined rabbits during the wet pack, combined with the positive diminution of the vessels of the pia mater, represent the fundamental conditions for psychical calm and sleep. These are probably also the result of the wet pack in man. Sleep is accompanied by a decided diminution of blood in the cerebral vessels; indeed the latter has been accepted as an essential condition for the production of sleep. This may explain why the wet pack, properly applied, is a useful procedure in the insomnia of neurasthenics. Sleeplessness probably depends in most instances upon abnormal hyperæmia of the cerebral cells, or upon abnormal vascular instability or a more or less morbid condition of the nutrition of the cerebral cells. When sleep is vainly sought, these vascular conditions probably become emphasized. Dwelling upon his wakefulness and its possible serious consequences, which he magnifies, the patient becomes a prey to apprehensions of evil. This mental state enhances the brain disturbance. As has been shown, the wet pack is calculated to contribute to cerebral calm by diminishing peripheral exciting influences. The interdependence of the cerebral functions with the condition of the sensory end organs is well known; the perfect functionating capacity of the cerebral centres is distinctly related to the integrity of the vast network of sensory nerves distributed upon the cutaneous surface. The striking changes produced in the psychical and intellectual individuality of persons afflicted with deafness or blindness may be explained upon the supposition that in these individuals sensory impressions are received and felt differently, and consequently do not produce normal and active object pictures upon the brain, by reason of the lowered activity of the organs involved. May not a similar

effect be produced by lowering the activity of that great organ, the cutaneous network of sensory nerves? The effect of the wet pack upon the cutaneous nerves is aided by the diminution of blood in the cerebral vessels, which it has been shown by positive experiments to produce. Thus a double sleep-inducing influence is set in motion by the wet pack. Sleep is ordinarily the result of a primary exhaustion or fatigue of the cerebral centres; it is favored by the removal or diminution of the capacity of the latter for receiving exciting impressions. The relaxation which so often induces sleep in persons subjected to the wet pack is also produced mainly by an inhibition of this receptivity to exciting impressions, aided by diminution of the supply of blood and nutritive material to the cerebral ganglia.

The demonstrated calming effect of the wet pack not only renders it a valuable agent for producing sleep, but it may also be utilized for the purpose of restoring the lost general nerve equilibrium and for the enhancement of the general nutrition (see *Rationale*, page 111). When the wet pack is followed by douches as above described, this double effect may be evoked with certainty, if the procedure be properly adapted to the case.

It may, however, become necessary to add other measures to "ring the changes" in our therapeutic activity. The most important element of treatment is judicious individualization and the avoidance of routine.

In addition to the above-detailed procedures, I have found in the treatment of insomnia, that *opprobrium medicorum*, which taxes our resources to the utmost, hip baths of short duration, two to four minutes at 80°, reduced each night two degrees, until 50° is reached, very useful. They render the brain hyperæmic, but this effect is followed after removal from the bath by reaction or the abdominal circulation, which fills this large vascular area and thus *removes* cerebral hyperæmia. The duration and temperature of this hip bath must be carefully watched by a trained attendant; or, better still, by the physician, if the best result is to be obtained. It is intended to increase the pelvic blood flow and to be followed by a calming effect upon the general condition.

Warm full baths can be made useful only if the bed is warmed for the reception of the patient, and he is very rapidly dried and placed in it. Exposure to the air of the bedroom, which usually is 70° or less, after a full bath of 100°, brings on a reaction which counteracts the effect of the warm bath. The latter contracts the cerebral vessels; the former dilates them again. This is the reason why the warm full bath so often fails in insomnia. A much better procedure, based on Schüller's experiments, is the Neptune girdle at 65°, carefully covered with flannel (page 117). This produces, first,

hyperæmia of the cerebral vessels, which is quickly followed by anæmia, when the skin under the pack begins to warm up, and its vessels dilate. Wet compresses around the legs have also been recommended for this purpose, and the old hydropaths recommend the wearing of woollen socks wrung out of cold water and covered with dry woollen socks. This is a method much used in the Zimmerman Naturheil-anstalt at Chemnitz in Saxony.

The author does not wish to be understood that the procedures mentioned in this chapter are the only methods to be recommended. They simply represent an outline of his method, from which he deviates readily, and often with satisfactory results when indicated.

In dealing hydrotherapeutically with neurasthenia or with other diseases, the chief demand made upon the medical attendant is familiarity with the technique and *rationale* of the most useful procedures. If he takes into careful consideration the therapeutic indications of each case, whether he aims for stimulation or calming effects, for alterative, reducing, or perturbating results, he may adapt the procedure to every case. He must individualize more cautiously in neurasthenia than in any other disease, because these patients are easily discouraged. I have not infrequently observed otherwise intelligent patients refuse to continue after the first treament, although this is always mild. I have less difficulty in persuading my own patients to continue, than the patients of colleagues, who are sometimes influenced by the graphic description of the shock (?) endured (from water at 95°), or from the tremendous (?) force of the stream (ten pounds pressure), or from the terrible (?) chills experienced, or the cold contracted after this heroic (?) treatment—a treatment which hundreds of the feeblest nervous women have endured without complaint.

Such cases are favorable subjects for hydrotherapy, if they can be induced to persevere, and I desire to warn against accepting their statements. The value of the mental discipline arising from thus overcoming their objections and groundless fears will be evident to the practised therapeutist.

That injustice will not be done the patient by disregarding his objections is evident from my observations. Among seventy-eight thousand treatments, of which I have reports and knowledge, the complainants do not number fifty. Among these about a dozen have contracted colds on the day of treatment—an infinitesimal number even if their accounts be always correct, which is doubtful. Reaction is usually so well provided for that the injunction to go into the open air after hydriatic treatment may be obeyed without hesitation or apprehension of colds.

Clinical Histories.—The following clinical histories are selected

from a large number, to illustrate the treatment (domestic and institutional) of neurasthenia, which may serve as a guide to the practitioner:

I. *Neurasthenia Gastrica—Home Treatment.*—Miss W——, daughter of an Ohio physician, aged 23 years, was referred by Dr. Francke H. Bosworth, the well-known rhinologist. Pale, emaciated, despondent, the picture of woe and despair, she was brought into my office by her sister. She had been ill three years; suffering first from fainting-fits at the menstrual period, afterward from violent pains in the right hand, traversing the body and concentrating in the epigastrium. For these her father, a physician, had been compelled to administer morphine for a month. Her stomach became irritable, and had continued so up to the present time; she vomited and spat up nearly all her food, mostly the solids. Sea baths did not improve her. She studied hard and grew worse. She lived on milk and farinaceous mush, and her stomach was regularly irrigated, witnout improvement.

She grew worse, became emaciated; she took peptonized milk for a month, but vomited it; meat produced the same effect. She now lived on grapes, which agreed with her; had tonics, pepsin, and all possible medication which her father and brother could muster, without avail. She was sent to Dr. Bosworth, who is a friend of her brother. After she had been in the city for three weeks without improvement, the doctor sent her to me. She now vomited every day; she traced her ailments to painting-lessons, but I drew from her the history of a potent psychical factor as a cause, in the sudden violent insanity of the favored nurse of her childhood which occurred just previous to her attack. The stomach was washed out twice a week to remove mucus and fermenting material, which were not abundant and ceased after a few irrigations. She received general faradization daily and every morning she was treated with the dripping-sheet at 60° F., while standing in warm water, with three affusions of 50° upon the sheet, after which she was well dried and sent into the open air. Under this systematic management she improved slowly; vomiting ceased entirely; she went to the seaside greatly improved. On her homeward journey she called to tell me that she had grown stout and felt perfectly well. Two years later she wrote me that despite reverses, which necessitated her adopting teaching as a means of livelihood, her health had remained perfect, and that I would scarcely recognize her as the same person.

II. *Neurasthenia, Agoraphobia, and Insomnia.*—Mrs. ——, aged 30 years, was referred to me April 16th, 1895, by Dr. A. A. Smith, as an obstinate case of neurasthenia, with gastric complication.

After returning from a long walk in 1887, she was suddenly taken with a curious attack. According to her own written history, which is here abbreviated, her vision became dim and hearing far away; the tongue got very thick, and the heart palpitated tremendously. She thought she was dying. She had never been sick in her life before. She was put to bed for two weeks. These attacks continued. She consulted for a throat trouble Dr. R. P. Lincoln, who treated her for a long time. She then sought advice from Dr. A. A. Smith, on account of severe indigestion.

Dr. Smith washed her stomach; he found no food, some mucus, very little foam, the mucus being perfectly white and clear. She improved after lavage and other treatment, but the nervous attacks did not wholly leave her. She had a dread of being alone in the street or in the house, and a great deal of palpitation. She could not go into a theatre, church, or anywhere else, "without going to pieces," and did not go out into the street without an attendant for several

years. Finally, Dr. Smith sent her abroad; she travelled for six months; she went to Schwalbach, took the iron baths, and drank the water for almost four weeks. She improved wonderfully for a time. Her appetite was good, and she slept well and gained considerable flesh, and felt almost as well as ever, when suddenly, while in her seventeenth bath, she was seized with another of the attacks; these continued to recur during the rest of her stay in Europe. She lost flesh, sleep, and appetite.

On her return to New York she again received lavage from Dr. Smith, with the same satisfactory result as before. During all these years she had suffered intensely from insomnia; she was obliged to take narcotics more or less, and always was oppressed by the intense fear that she had heart trouble; her heart and stomach seemed to be the only two organs that were very uncomfortable. She had severe pain on the top of her head and the back of her neck almost incessantly; she felt as though a weight was dragging her down. She never had any uterine trouble, and had never suffered during her menstrual periods.

She now tried the Zander mechanico-therapeutic treatment for two months; felt much broken up from its effects at first, but thought she was somewhat improved.

She was not seriously afflicted again until this winter, when she had the grippe, which brought back the old attacks, making her most unhappy, perfectly helpless, and useless.

Present Condition.—Patient presents the symptoms described above. She is spare, tall, brunette; all organs normal; no objective symptoms except restiveness alternating with enforced calmness, and a pessimism which seemed warranted by her past experience. She complains of insomnia, loss of appetite, agoraphobia; no introspection.

Treatment was begun April 18th, 1895, by testing her reaction. She received the usual preparatory treatment—a hot-air bath until warm, followed by a circular douche of twenty pounds' pressure for one minute, 95° reduced to 90°, and a fan douche, same pressure, reduced to 85°, for half a minute; good friction after drying and Swedish movements of extremities, with stroking-massage of trunk ten minutes. This was continued for four days, when the pressure of the douches was increased five pounds; the fan douche was given at 85° and reduced one degree each day for five days. Menstruation now ensued. On the fifth of May treatment was resumed. The hot-air bath and circular douche remained as at first; the fan douche was given for 85° to 78° for half a minute and thereafter at 78°, reduced daily one degree.

May 10th. One jet douche to three fan douches were alternately given for one minute at 73°. Reaction being good and patient improving, the douches were now given at thirty pounds pressure.

May 20th. Patient being too nervous to come to the Institute, she received at home a dry pack for fifteen minutes, followed by ablution at 65° and general massage, ten minutes. Continued for three days.

May 27th. There being no improvement in her condition, the hip bath, six minutes at 85°, was substituted, followed by the fan douche, twenty seconds at 60° F. She became hysterical after the treatment. Being now afraid of the hot-air cabinet, patient received a dry pack until warm, followed by circular douche at 90° and fan douche at 65° for one minute. (The dry pack is a good substitute for the hot-air cabinet, for home treatment or for timid patients.)

May 29th. Patient's condition became worse; she complained very much of "pain in ovaries and head." She was depressed.

June 30th. This treatment had been continued, the Scotch douche to upper

spine and epigastrium being added and the fan douche reduced to 50° as a stimulant. She was now entirely restored and went into the country.

May 4th, 1896. Patient returned for the purpose of fortifying herself for the approaching summer; expressed herself as feeling fairly well; no feeling of apprehension; sleep sometimes unsatisfactory. She was again subjected to preparatory treatment, with Scotch douche to abdomen, which she regarded as the most valuable element of treatment, affording relief of distention.

May 31st. Complaining still of occasional insomnia, the wet pack, forty minutes at 69°, followed by a one-minute circular douche, 95° to 90°, and fan douche, one minute at 69°, was ordered, to alternate every other day with the hot-air bath and the same douches.

June 29th. Under this treatment she has steadily improved, and was discharged cured to-day.

Patient has remained well for two years.

Neurasthenia Psychopathica.—Mrs. ——, aged 40 years, from San Francisco, has four children; perfectly well for eighteen years. Since birth of last child, seven years ago, has been ill; at that time, her husband being very sick, great demands were made upon her. Went to the World's Fair in 1893 in charge of a party, but found herself suddenly incapable of continuing and was compelled to return home. During the next three years she spent most of the time away from home on account of "distressing nervousness." She now went to Japan on account of her husband's health. She "could not account for her great depression during the sojourn in this interesting country, and constantly trembled at the thought of resuming her rôle in life, because she had misgivings as to her ability." On her return in October, 1895, to use her own language: "I was careless, forgetful, indifferent to everything, and excitable, restless, and fickle-minded to a distressing degree. My ordinary duties became a burden, a decision on any point, however trivial, was an impossibility." She took a partial rest cure at home, but found it necessary to go to a private sanatorium. She was nervous, distressed, dissatisfied without cause, felt she was no use to any one, a detriment to those nearest and dearest to her, and she was therefore willing to live apart from them. She "remained away a whole year without feeling maternal ambition, lost interest in everything. She had massage, steam and shower-baths triweekly; she lived and dragged herself wretchedly, feeling that she had sacrificed her position in the home."

On her return home she suffered unspeakably; was now, as she had always been since her illness, subject to insomnia. She again felt impelled to leave home, and went to relatives. Her uterus was now curetted. She felt better until she got up; then "doubts, fears, questions as to the best course to pursue," returned; she "felt that she had lost her grip." Her hearing, being much impaired, added to her mental distress. She now came to New York.

October 5th, 1897. Mrs. D. presented herself in order to try systematic hydrotherapy as a last resort. She stated that her "life during the past year had been spent in idleness, dreading the coming of sunshine in the morning and of darkness at night; the thought of her husband and children deserted was maddening; sorrow had taken the place of peace, irresolution was her bane." She presented no organic disease; weight, stripped, one hundred and seven pounds; nutrition much below par, appetite poor, sleep imperfect. Ordered careful regulation of diet, exercise, rest, and a gradually developed hydriatic treatment, patient being placed in charge of a nurse.

October 7th. A preparatory douche, 95° to 85°, produced a hysterical attack.

October 20th. Becoming gradually accustomed to the treatment, she took to-

day a circular douche, 95° to 90°, of one minute, followed by Charcot (fan) douche, 78°, for ten seconds. Her weight has increased three pounds.

Mental condition unsatisfactory. Nurse is suspicious of suicidal intent.

October 22d. Lost one pound in weight and is much distressed by the fact. Ordered hip bath, 85°, for five minutes, followed by fan douche to back, 78°, ten seconds, to be reduced daily one degree.

November 13th. Took the same hip bath followed by fan douche, 74°, for ten seconds. Has gained four pounds, but expresses no satisfaction over gain. Is extremely despondent, sighing, and irresolute.

November 28th. Hip bath, 85°, for eight minutes, followed by jet douche to back, 65°, for fifteen seconds, and fan douche, 70°, for ten seconds. Has lost two pounds; greatly dejected by this loss.

December 5th. Treatment continued with daily reduction of douche temperature and increase of duration. To-day she took a jet douche to back, 58°, for twenty-two seconds, and general fan douche, 65°, for ten seconds. Weight increased three pounds without remark by patient.

December 12th. Weight increased two pounds, total increase being eight pounds. Mental condition better; patient "sees some ray of hope."

The hip bath was now ordered, alternated with a perspiration bath to stimulate tissue change. The urine had become scant, with an increase of urates and phosphates.

January 1st, 1898. Under this treatment she did not improve. She was saddened over a loss of three pounds.

January 25th. She has continued regular treatment. Took to-day hip bath, 85°, for seven minutes, followed by jet douche. Her weight is one hundred and thirteen and one-half pounds, a gain of six and one-half pounds. Her complexion is good; appearance bright; mental condition decidedly improved. There was a lingering degree of dissatisfaction, but I deemed it advisable to send her home with the injunction to her husband to insist upon occupation.

June 8th. Frequent reports have reached me stating that Mrs. D. is a changed being; she is cheerful, active, and "the life of the house."

This satisfactory result is in my opinion due chiefly to the effect of a judicious hydrotherapy upon the nutrition of the central nervous system. Suggestion had no place in this result; she attributes no effect to my treatment, even now.

Conclusion.—The author's observation leads to the conclusion that, while many cases of neurasthenia may be effectively treated without water, mild cases will be hastened to a favorable termination by adding water to the therapeutic measures applied. Those who cannot obtain skilful treatment by water at their homes will do better without it altogether, unless the physician teaches some member of the family the more simple procedures. In no other disease is hydrotherapy a two-edged sword to the same extent as in neurasthenia.

Whenever institution treatment can be had it is preferable, because it may be more skilfully and judiciously applied, as Dr. Draper has shown. An additional and very great advantage of institution treatment lies in the fact that it requires the patient to withdraw from his or her unfavorable environment for several hours, days, or months.

Many cases which have resisted treatment may thus be carried to a favorable issue, even if they devote only a part of the day to the treatment.

Neuralgia.

Pain in the course of a nerve has received the appellation neuralgia whenever the distressing manifestation is not due to actual disease of the nerve or of some organ.

The experienced observer has frequent occasion to realize the correctness of Romberg's saying, that "pain is the prayer of the nerve for better blood." In a large proportion of cases of neuralgia the pain is but the expression of some pernicious influence exerted upon the blood by malaria, gout, or other toxic agent. Moreover, there exists in many cases of neuralgia a distinct anæmia. Hyponutrition is also not infrequently marked, either as the cause or the result of long-continued nerve pains.

Next to ascertaining and removing the causes of neuralgia, our therapeutic measures must be directed to the building up of the failing nutrition. These objects may be most effectively accomplished by rest of the affected part in the acute stage, and by alternating rest and exercise in the chronic. Hydrotherapeutic measures, judiciously adapted to each individual case when the patient is anæmic, enhance the efficacy of other treatment, and often suffice alone. The methods detailed above for improving hæmatosis are useful.

It is essential so to manage all hydriatic treatment in this affection that good reaction ensues. By this means active fluxion through the diseased as well as the healthy parts is determined. Not only are metabolism enhanced and noxious products eliminated by the increase of renal and cutaneous activity, but the increased alkalinity of the blood tends to neutralize any acid toxic products circulating in it and endangering the integrity or otherwise interfering with the normal condition of the nerve trunks and their branches. The general nutrition is always enhanced by increasing tissue change, improving the quality of the blood, and restoring the normal resisting-capacity of the patient to atmospheric changes.

In gouty conditions, the wet pack, followed by half-baths or the hot-air bath until perspiration is free, as far as the condition of the patient warrants, and by a circular douche of 100°, reduced gradually during one minute to 90°, and this by a fan douche for ten to thirty seconds at 85°, daily reduced one degree, has given me the best results. The local pains are relieved in the majority of cases by hot fomentations applied as detailed in page 128, until free perspiration over the entire

body ensues, followed by the circular douche at 90° for one minute, and then by the Scotch douche (alternation of 110° and 70°) for one minute over the affected nerve, if accessible. This, in turn, may be followed with advantage with a general fan douche at 85°, daily reduced until 70° are reached. Occasionally the local application of ice bags to the sciatic or other accessible nerve is required.

Mr. R——, referred to me in 1895 by Dr. Hayd, of Buffalo, had been under treatment for several months. His sciatic nerve had been stretched by Dr. Roswell Park; he had been pronounced incurable by eminent counsel in Philadelphia. This case demonstrated the value of the course of hydrotherapy outlined above, the patient being restored to perfect health and so accustomed to cold water that he has taken a daily plunge at all seasons with marked benefit to his general health.

A number of trifacial and brachial neuralgias and sciatica have been carried to a satisfactory issue after failure of prolonged medication, some after an unsuccessful rest cure, in the hands of the author and of colleagues of the highest attainments. Many failures have also been recorded by the writer, whose misfortune it has been to have mostly desperate cases referred to him for hydrotherapy.

I have found sciatica the most amenable, and brachial and trigeminal neuralgia the most rebellious to hydrotherapy.

In the earlier stages the dry pack and hot fomentation, described on page 129, afford the most marvellous results, if followed by gradually reduced douches (95°–75°) or affusions of the same temperatures. In the more chronic cases of sciatica and other neuralgias, the same treatment is useful; but a difference in the after-treatment is required. One or more hours' rest in the dry pack, while actively perspiring, not only gives rest to the diseased parts, but stimulates tissue change and consequent elimination of toxic products. Such treatment may be given at the patient's home with great advantage. It has succeeded in my hands after the salicylates, quinine, salol, the Paquelin cautery, and electricity have failed. My own observation is confirmed by many contributions to the subject.

Professor Winternitz reports: * "In the institution at Kaltenleutgeben, five hundred and eighty-five cases of neuralgia have been received during the past twenty-five years. Among these many were symptomatic of other general diseases. The lancinating pains of tabes, the gastric pains of dyspeptics, and cases of toxic neuritis are not included. Only those cases are included in which the characteristic pains, involving only certain nerve trunks, formed the entire disease picture.

"Among the cases here considered we find hemicrania; frontal,

* Blätter für klinische Hydrotherapie, January, 1892.

supraorbital, infraorbital, maxillary, cilio-temporal, and occipital neuralgias; also neuralgic affections of the trunk and extremities in the course of most of the sensory nerves.

"Most numerous were cases of intercostal, cervical, brachial neuralgia, and especially sciatica; also many cases of testicular neuralgia and coccygodynia.

"The result of the treatment of these five hundred and eighty-five cases, mainly by means of physical procedures, thermic, mechanical, and electrical, show fifty-two per cent of recoveries. Only five per cent were dismissed without being benefited; all the others were improved.

"These figures entitle hydrotherapy to great consideration as an antineuralgic application. They do not cover my entire experience with neuralgia. At least as many cases were treated among my private clientèle and at the polyclinic.

"More or less energetic hydriatic procedures have effected cure in the most obstinate and inveterate cases.

"I have seen a case of prosopalgia, which had lasted several months, disappear after a single rain bath at 8° R. (50° F.), and not recur for three months, the length of time the patient remained under observation; we cannot often expect so fortunate a result. However, it is not rare to see the pain in old and obstinate neuralgias stop for a greater or less interval or become much milder after the first hydriatic procedures. The Scotch douche is especially recommended in this connection, being not only of curative, but also of decided prognostic value, when it relieves the pain early."

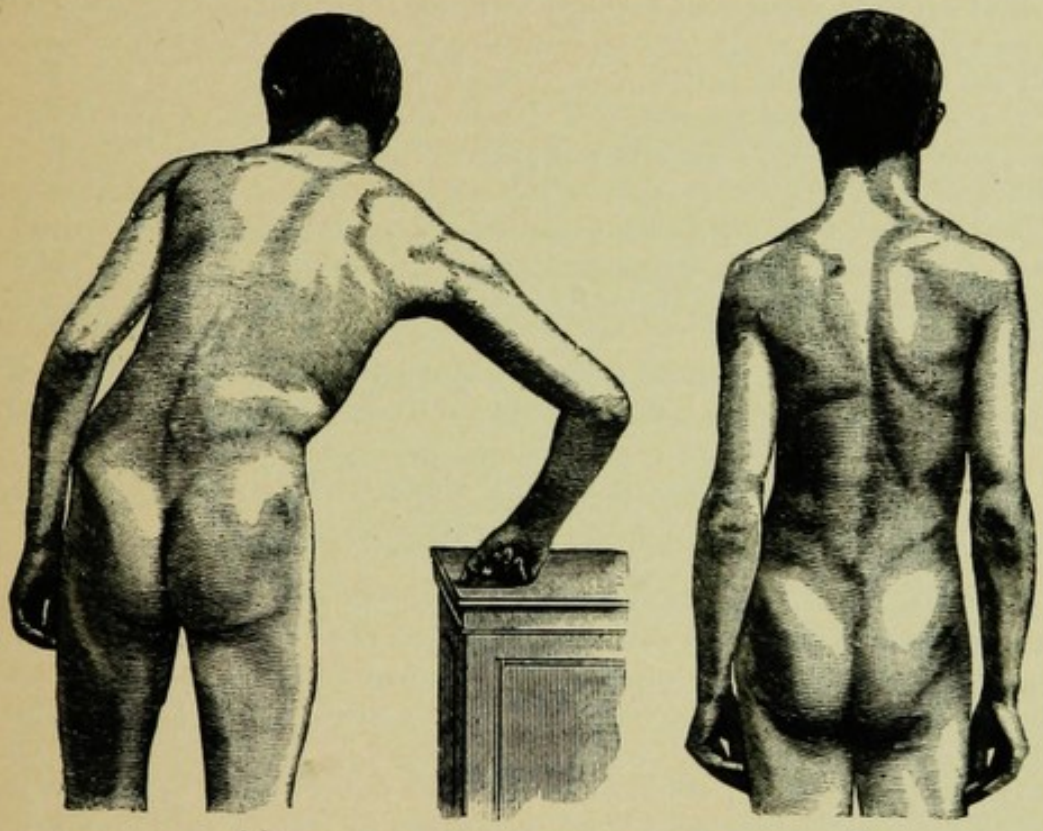
Winternitz was the first to demonstrate the value of alternations of heat and cold in neuralgia. He claims that "heat renders the nerves more receptive for the changing innervation and revulsion which the succeeding lower temperature produces.

"We may, with advantage, precede our applications of cold by direct heating or warm compresses.

"To summarize, the treatment employed was as follows: Great temperature contrast, intense, but of short duration; mechanical influences, as thermal, massage, sweating, resisting movements, energetic active exercise when possible, passive motion when necessary, friction, mechanical manipulation, electricity, warm drinks, and in some cases internal medication. The intense nervous influence, the revulsion and nerve excitation, the powerful primary and reflex action upon the circulation, the production of active fluxion to the various organs, their influence upon secretion and excretion, seem to be the factors which have cured fifty-two per cent of my cases and produced marked improvement in so many of the others."

Sciatica.—Dr. Otto Pospischl furnishes * a report of one hundred and thirty-five more or less desperate cases of sciatica treated at Kaltenleutgeben during twenty-five years, of which only six per cent left without being cured, fifty-seven per cent were completely restored to health, and thirty-seven per cent were decidedly improved. He cites a very interesting case which was much benefited by this treatment, and which is here reproduced in abstract as an illustration of correct hydrotherapy in a desperate case and as a guide to its management.

A——, aged 24 years, acquired a most severe and painful sciatica in the left leg by sitting on cold wet stones. The spine had become bent to the right and forward, and could be straightened only with great difficulty and pain. He was treated assiduously by various physicians without obtaining relief. He then applied for hydriatic treatment. The accompanying picture (*a*) shows the patient at rest one week after beginning treatment. It was impossible to photograph him at first, because the pain was so intense that he could not stand. He was compelled to take morphine every night for four weeks; during which time he had thirty baths, one-quarter to one-half hour in duration, at 104° F., and 8 gm. salicylic acid daily without much effect. The sciatic nerve was now stretched under chloroform without permanent result. His reactive capacity being feeble, treatment was begun with ablutions at 63.5° F., reduced gradually to 52°, in order to prepare the skin for the *pièce de résistance* of sciatica therapy—the Scotch douche. But his reaction remained poor, until much colder water was



(*a*) (*b*)

FIG. 74.—Sciatica.

* Blätter für klinische Hydrotherapie, 1891.

applied with considerable friction of unaffected parts of the body. These cold wet rubbings produced a refreshing and alleviating effect, which gradually aided the task of weaning him from morphine. Now the Scotch douche was applied. After a general rain bath of ten seconds, with water at 86° F., to prepare the skin for thorough warming up by steam, the latter was applied at about 120° over the entire body, but especially the affected part. This was followed by a fan douche of 48° for three to four seconds over the entire body, especially the affected parts. These hot and cold applications, changed three to five times, effected an intense cutaneous hyperæmia. Now the patient was exposed to a rain bath of 48° for three seconds, rapidly dried, and taken out into the bright sun. This thermic massage was used three times a week, and on alternate days he was subjected to a cold fan douche for fifteen seconds, which produced almost the same reactive effects as the douche.

An intestinal irrigation of one-half litre of water slightly impregnated with salt at 77° F. was daily applied for six weeks, even when the bowels acted regularly, to insure against scybalæ.

An important part of the treatment was the trunk compress (Neptune girdle) and a wet compress, well covered with dry flannel over the affected extremity. After the first week the patient was so much better that he could take half-baths at 77°–80° for three or four minutes, which calmed and gave him sleep. Two weeks later he received a general wet pack of three-fourths hour's duration prior to this half-bath.

The second figure (*b*) shows the result of eight weeks' treatment. The sciatica was cured and the deformity corrected, patient looked robust, and a previously existing tuberculous consolidation of the apex of the right lung had disappeared.

Patient continued treatment for two and one-half months, showing a result from judicious hydrotherapy which could not be obtained by any other treatment.

Buxbaum* reports from the University Poliklinik, at Vienna, four unsuccessful cases, one of which was the following:

Ischias scoliotica in a man 38 years of age; suffered eight months; his body was drawn to the right and forward; he could not move without excruciating pain; had received routine medication. Patient received a short general cold rain bath (temperature not given), followed by directing steam at 122° upon the affected part for one minute. This was succeeded by a cold fan douche upon the extremities. The steam douche and cold fan douche were thus alternated for five or six minutes; treatment being concluded by a short cold rain bath. No result after several weeks treatment.

He also reports the following successful cases, which are here given in brief outline:

Case II., 27 years old, has been suffering from sciatica for three years, having been treated by all kinds of liniments, massage, electricity, sulphur, etc. He received daily the Scotch douche, alternating steam and cold water, which gave him some relief at once. In fourteen days he was discharged cured, and was well two months later.

Case III., 34 years old, sciatica six months; constantly under treatment,

* Blätter für klinische Hydrotherapie, April, 1894.

which included Turkish baths, every other day for three months. After Scotch douche daily for eight days he was entirely cured.

CASE IV., 39 years old, locomotive engineer; ill six years, using hypodermics of morphine and all other routine treatment. He could attend the clinic only every third day, when he received the Scotch douche. A cold compress over the affected limb, to be worn over night and followed in the morning by a cold ablution, was ordered. He was entirely restored in three weeks.

Buxbaum claims, and I can confirm the validity of this claim, that recent sciaticas may often be removed by one or more Scotch douches; and that hydrotherapy belongs to the most precious antineuralgic remedies.

Borischpolosky* reports thirty-two cases of sciatica treated by Scotch douches, of which twenty-three were cured and seven improved. He regards this effect as due to the furtherance of the nutritive and tissue-change conditions in the diseased nerves, produced by the thermic and mechanical action of the douche.

Dr. Julius Fodor mentions, in his report for 1893 of the Hydrotherapeutic Pavilion of the Vienna University Poliklinik, thirty cases of sciatica, of which twenty-four were cured and six improved.

Conclusion.—The clinical observations of Winternitz, Buxbaum, and others are here reproduced in order to afford the reader an insight into the hydriatic methods of various practitioners of hydrotherapy. It is unfortunate that similar observations are not accessible in the records of our own hospitals and clinics. This arises from the circumstance that while some of our text-books refer to douches, packs, hot-air baths, in a cursory and indefinite manner, they do not offer the same detailed instructions for their application which they devote to the discussion of the salicylates, electricity, nerve stretching, blistering, firing, etc. The practitioner who has not had special training in hydrotherapy treats the latter with indifference, and allows his patients to wander into the hands of lay and medical quacks rather than apply a treatment which has been, as shown above, satisfactorily utilized.

The author has made, in the hydriatic treatment of sciatica, precisely the same observation as in other diseases. *Obsta principiis* should be the motto of the therapeutist always. This principle is more essential in hydrotherapy than in other branches of therapeutics. The most brilliant results from the water treatment are obtained in recent cases of sciatica, which are usually so rebellious to medication. Very few of these fail to respond to the daily application of the dry pack with hot fomentations to the affected part, and subsequent ablutions or circular and fan douche at 80°–60°. In sciatica of long standing, the beneficent effect of this treatment may be disputed, the effect

* Wratsch, 1896, No. 17.

being charged to the time element, many cases recovering sooner or later without treatment. But even in these cases the rapid improvement following upon judiciously adopted hydrotherapy in many desperate cases is so striking that some hydrotherapists regard it as a rule that, if improvement does not ensue quickly after beginning the treatment, it should be changed or abandoned altogether. In other forms of neuralgia the same results are obtainable by means of hydrotherapy in a lesser degree, but still to a far greater extent than by medication alone.

Hysteria.

Patients suffering from this hydra-headed malady have always been the bane of doctors. They are usually peripatetic individuals, who travel from one office to another to pour their lengthy stories of woe into the doctor's ear.

The aim of treatment is here, as it is in neurasthenia, to restore the lost "mental equilibrium" by improving, through more favorable environment, diet, rest or exercise, and hydrotherapy, the nutrition.

What has been said in the chapter on "Treatment of Neurasthenia" is also applicable here. Indeed, while these two functional maladies differ very materially in most respects, their treatment is closely allied.

The great neurologist Charcot was the most successful neuro-therapeutist of his day, because he not only commanded the highest attainable knowledge of nervous diseases, their diagnosis and pathology, but his large clinical material enabled him to test various methods of treatment, many of which have become permanent. Among them stand easily foremost the spinal douche and other hydrotherapeutic measures, which he practised with marvellous success. Charcot says:* "Hydrotherapeutic health institutes in Paris have treated such patients with complete success for the last fifteen years, because they possess admirable arrangements for this purpose."

Charcot's success appears to have given rise to the fallacious idea that, inasmuch as pouring cold water upon a girl writhing under a hysteric spasm or lying lifeless in a hysteric swoon, often restores her, this heroic method may be indiscriminately applied to all cases of hysteria in and out of the paroxysmal stages. Charcot's douches are often pictured as the playing of streams of cold water from a hose upon the trembling forms of these sufferers.

My own observation of the action of these spinal douches in hysteria leads to the conclusion that they are useful in many forms of hysteria

* "Clinical Lectures on Certain Nervous Diseases," translated by E. P. Hurd (G. S. Davis, 1888), p. 181.

to stimulate the nerve centres and to restore the disturbed equilibrium. The spinal douche is effective chiefly because it may be applied at very low temperature without depressing effect. This is due to the fact that only a small portion of the cutaneous surface is attacked, and, this being on the muscular and bony back, the blood is not driven to the interior portions of the body thus treated. Moreover, whenever only a portion of the body is subjected to a cold procedure, the remainder is left unembarrassed to aid in evoking reaction. In addition, the spine is capable of accepting douches of the strongest pressure.

I am not disposed to attribute any specific effect to spinal douches; there is no evidence to prove such an effect. The real benefit is derived from the building up of the lost nerve tone, the improvement of appetite, digestion, and assimilation; and especially from the enhancement of the resisting-power of the nerve centres by transmission of the tonic effects from the peripheral cutaneous nerves, which receive them from the impact of cold or cool water under strong pressure.

As has been shown in the hydriatric management of neurasthenia, we have here also, with regard to water treatment, two types of hysteria—the *excitable* and the *depressed*. In the excitable type low temperatures and active mechanical procedures should be avoided. The wet pack, so ably discussed by Dr. Mary Putnam Jacobi, is the most useful procedure. The patient should be daily enveloped in a wet pack, the sheet wrung out of water not below 60° nor above 70°, and lie in it with open windows for an hour or more, doubling the sheet if the procedure is to be prolonged. This should be followed by a half-bath for ten minutes at 80°, or the circular douche for fifteen seconds at 85°, under twenty pounds' pressure. Once or twice a week the wet pack may be followed by a circular douche for ten seconds at lower temperature and higher pressure — say, 90°, reduced quickly to 75°, under twenty pounds' pressure; and the fan douche, five seconds at 85° F., and not lower than 65° F., same pressure.

The depressed type is benefited by daily cold (80°, daily reduced two degrees) affusions at home, while standing above the ankles in warm water. The hot-air bath, to bring the cutaneous vessels into activity and fill them with blood, is an excellent preliminary measure in institutions, where it may be followed by the circular douche under twenty-five pounds' pressure for thirty seconds at 85°, reduced gradually to 70° during the first few applications, and later to 60°. This may be followed by the spray douche for five seconds at 65° F., and later by the jet douche for three seconds at 65° to 55° F. If the lowest (50°) is well borne, the pressure may be increased two pounds every day until thirty pounds are reached. The strong jet douche over the back alone is perhaps the most valuable single measure

in this type, provided it is daily lowered in temperature and increased in pressure. These patients should not be hastily dealt with; gentleness, combined with firmness, will bring success in this, as it does in all hydriatric practice, especially if the physician is broad-minded and does not trust to this or any *one* remedial measure. In this, as in many other diseases, the addition of hydrotherapy will often produce surprising results. Clinical illustration of this fact abounds. The following are cited from hospital practice, because the records are more reliable.

The annual reports of the house physicians of the Montefiore Home usually contain brief outline histories of cases of hysteria which had been treated in vain for years, and, being regarded as incurable, were on that account admitted to the home and were here treated with hydrotherapy. A case of this type is referred to by Dr. Ettinger (Report for 1890) as follows:

"A young girl came to us with a complete palsy of the left arm and blindness of the left eye, of functional origin. For two years she sought relief everywhere without avail. She was then referred to us as a hopeless case; but it has been our good fortune completely to restore the power to her arm and vision to her eye, and to remove her intense depression of spirits. She is now supporting herself as a domestic.

"This is the type of a number of similar but less severe cases in which we have been equally fortunate. In all cases hydrotherapy has been the important therapeutic agent. In one case of severe hystero-epilepsy in a man, it has been the one agent to which improvement is due.

"J. S——, aged 58 years; Dutch; negative family history; gives history of convulsive seizures of twenty-five years' duration, often from ten to fifteen times a day. After admission he had from one to three seizures daily. Diagnosis, hystero-epilepsy. Treatment, Charcot douche daily to spinal column, resulted in gradual diminution of convulsive attacks to complete cessation at the end of three months. After complete freedom for another three months he was discharged."

Dr. Rosenthal relates (1891): "The use of water as a therapeutic agent in Bright's, rheumatism, and various diseases of the nervous system has maintained its past record.

"T. R——, cataleptic hysteria, has been discharged as cured and has been engaged for months in the service of a prominent house of this city, without any recurrence of her disease.

"T. H——, representing another and severe type of hysteria, with partial palsy of right arm and complete of the fingers, with severe contracture of the fingers, with signs of organic changes in the fingers and wrist, is now gradually recovering from those conditions. For four years she had been treated by some of the most eminent men outside of our institution with no apparent result."

Dr. C. Bloch reports (1892):

"L. H——, subject to epileptoid convulsions and choreic attacks, at times combined with hallucinations, aphasia, and complete paralysis. There were 'hysterogenic zones,' the touch of which would call forth one of those spells. For three years she had been treated by many prominent specialists and been in various hospitals, with partly no, partly passing, improvement. On her arrival she had the described attacks as frequently as six to ten times a day. After five months' treatment in the Home she gradually lost all symptoms and will soon be discharged cured."

Drs. Bloch and Fränkel (1893) relate: "Of the several cases of grave hysteria, we mention but one combined with Ménière's disease, who for seven years had been an inmate of a hospital. The patient was confined to bed and suffered terrible agonies for years. He now walks about and will soon be entirely cured."

The report of the same institution for 1894, made by Drs. Bloch and Fränkel, contains the following brief histories:

"B. M——, 22 years old, servant girl, after a fall from a stepladder, contracted the following series of symptoms: Her right arm and the muscles of back and neck and tongue and jaws were paralyzed and in the state of rigor; on trying to walk she would frequently tumble over and fall; sensibility all over the body nearly lost. She is now well and will shortly be discharged. Previous to admittance to our institution, she had for two years been treated by many physicians.

"L. R——, 55 years old, admitted October, 1893, stricken with paralysis of all four extremities, has now fully recovered his health and will shortly be discharged."

The following brief outline of a case, which is admirably detailed in all its scientific aspects by Dr. Bourneville in *Progrès Médical* for August 26, 1882, may also serve as a clear illustration of the capabilities of hydrotherapy in the most severe types of hysteria:

"The father and grandfather of the patient were nervous and had migraine; the mother had convulsions and torticollis in infancy; one maternal aunt is an idiot; brothers and sisters died of convulsions; the patient had convulsions for nine months. An attack of hystero-epilepsy, which is admirably portrayed, occurred in February, 1880; then sensorial hemianæsthesia, hysterogenic zones, and aura. The convulsive attacks and contortions, recurring with great regularity, are fully described; they were followed by laughing and delirium. The treatment had consisted of tonics, bromide of camphor, baths, and gymnastic exercise. Cold douches, rain and jet, were now administered from thirty to forty seconds, from April 16th to May 3d; a vigorous hydrotherapy was next pursued, once a day until the end of the year. In August the attacks became more rare and brief, and ceased entirely on December 13th. During the first three months of 1882 the child showed great irascibility, and was subject to nervous laughter. The douches were resumed. On August 24th, 1882, the child's condition was good, and there have been no new attacks." (Cited by Duval.)

The following brief history from my private case records may be of interest as a guide to hydriatic treatment:

A. F——, aged 15 years, was brought to the Hydriatric Institute July 19th, 1892, by his father, who said that on the 31st of March, 1892, on the day of his daughter's burial, the boy "fainted." Ten days later he fainted in school, and again two days later. The family physician investigated the case at school, concluding that it was a form of epilepsy. The boy was kept from school and put on potassium bromide. The attacks becoming more frequent, a prominent neurologist was called in consultation; the same treatment was continued. He continued to have attacks every day and very often twice a day, lasting from five to ten minutes. At first he lay unconscious, without any movement whatever; then the attacks became violent, frequently requiring several men to hold him down and prevent him from doing himself bodily harm. The former consultant was again called in and made an unfavorable prognosis. Several neighboring physicians who had been called during the attacks gave him hypodermics of morphine. Patient also has received electrical treatment from his own physician.

Status Præsens.—Face pale, covered with acne, eyes restless, hand tremulous, gait unsteady, appetite fair but capricious, gastric oppression after meals, bowels constipated. Patient appeared to be brominized.

Treatment.—Resorcin, three grains in half a pint of hot water, an hour before lunch and dinner. He was ordered to be at once well scrubbed with soap and water. This was followed by a wet pack, sheet wrung out of water at 70°, reduced daily two degrees; this to be followed by a rain douche at 90°, twenty-five pounds pressure, gradually reduced during thirty seconds to 75°.

August 20th: This treatment had been used daily, the temperature of the douche being reduced two degrees every day. He had a slight attack five days after treatment was begun; none since. He was ordered to Long Branch to take surf baths.

September 29th. Patient has called on me several times, reporting steady improvement. He was discharged cured. The patient has remained well.

Résumé.—Hydrotherapy is regarded by the author as an essential element in the management of hysteria; not, however, by reason of any specific effect of cold spinal douches, but solely on account of its effect upon the general nutrition, and consequently upon the nutrition of the nervous system. With this aim constantly in view, the physician will accomplish far more if he includes some form of water treatment with isolation, rest cure, medicinal, or other agents which he may be applying. These are often sufficient to restore the patient to health, but the path to recovery will surely be shortened and rendered more agreeable and satisfactory to physician and patient alike by the judicious addition of water in some procedure best adapted to the case. Permanency of restoration is insured by hydrotherapy, inasmuch as the patient is thus trained to bear and like some form of home treatment, as daily cold affusions or plunges, which maintain a good general and nerve nutrition.

Functional and Other Neuroses.—The author has obtained striking results from hydrotherapy in many neuroses, especially in *Graves' disease, chorea, obstinate headaches, paræsthesias of various types, the traumatic and occupation neuroses.*

The hydriatric management of these affections depends upon their etiology, the condition and environment of the patient, and the duration of the disease. In the discussion of hydrotherapy of neurasthenia and hysteria, these points have been sufficiently elaborated to warrant avoidance of repetition, inasmuch as all neuroses may be treated on the lines laid down for these diseases. The following history is selected from a large number:

False Angina.—Mr. D——, merchant, aged 40 years, weight one hundred and ninety pounds, of robust appearance, has suffered for several months from agonizing pains in the precordial region whenever he attempted to walk briskly, especially after meals. He was completely disabled from business. His family physician regarded the case as one of angina pectoris, and this diagnosis was confirmed by an eminent consultant. He was advised to use amyl nitrite pearls for the attacks and give up business. In consequence of this decision he became melancholic and when he applied for treatment he was the picture of woe. He gave a gouty history; urine normal but loaded with urates; digestion impaired; pulse of high tension. He was restricted to a non-meat diet, put upon glonoin and strychnine. A wet pack, water at 60°, was ordered daily for one hour, followed by rapid ablutions with water at 50°; a wet compress to be worn all day, wrung out of water at 60°. No preparatory treatment to ascertain his reactive capacity was needed, because he was a robust man of splendid physique. The aim of treatment was the enhancement of tissue change, a calming effect with stimulating sequel. This was happily accomplished, because the patient was careful, and frightened. He did not neglect treatment. He almost invariably slept in the pack. In three months the frequency and intensity of the attacks had so far diminished that I permitted him to take a journey of some weeks. On his return dyspeptic symptoms were more pronounced. He was put upon chopped beef, preceded by a pint of hot water for breakfast and dinner, oysters and hot milk for luncheon. Compresses were discontinued; wet packs resumed daily at 70° F. Four months later he was entirely free from pain, had lost some flesh but was able to bear the worries of business. Although five years have elapsed, he remains in good health.

The same result has been achieved in other less intense cases by more mild hydriatic procedures, ablutions, and douches. Failures are, however, not rare. In a case referred to me by Prof. William Osler, of Baltimore, the most assiduous hydrotherapy for a period of four months failed to make any impression.

CHAPTER XXV.

CHRONIC RHEUMATISM AND GOUT.

The prognosis in these diseases is unfavorable, chiefly because the diagnosis is not always exact, and the treatment consists mainly of medicinal agents. Large clinical material has convinced the author that cases of pure chronic articular and muscular rheumatism offer a prolific field for physical remedies. Skilful massage and resisting movements, combined with judicious hydrotherapy, are capable of accomplishing, as Professor Semmola* has truly said, "marvels of restoration in the most desperate cases."

Winternitz has observed that faradization of painful rheumatic joints produces an anæsthesia furthering hydriatic and massage treatment, which is otherwise precluded by the pain.

The cases of chronic rheumatism which have come under my own care may be divided for therapeutic purposes into the well-nourished and the anæmic.

In the well-nourished rheumatic subject, full baths of eight to fifteen minutes' duration, in water at 95°, gradually raised to a higher temperature up to tolerance, with gentle massage, are the most useful procedure, combined with the free internal use of water to stimulate excretion by the kidneys. As is customary in the excellent baths at Mount Clemens, the hot springs of Virginia and Arkansas, in Baden bei Wien, Gastein, Aachen, and other more or less renowned thermal resorts, the patient should receive a prolonged warm bath, with massage during the bath; perspiration should be promoted by a prolonged dry pack in woollen blankets. The elimination of pathogenic elements is the chief aim of this treatment. The marvellous results from bathing in these hot springs are not attributable, in the writer's opinion, to absorption of the mineral ingredients of the waters, but to the excellent method of their application by experienced physicians, together with the freedom from business or other cares and the influence of a changed mode of life.

Many will be inclined to be sceptical upon this point, so firmly rooted is the idea in the minds of medical men that these baths produce their effect largely by absorption of their chemical constituents. Fortunately we have sufficiently positive experiments to decide this ques-

* Lectures on Therapeutics at Naples University.

tion and to remove any doubt that may exist. Among many of these observations are those of Stas,* who subjected himself on three successive days to baths of 86° to 90°, containing fifty milligrams of arsenate of sodium to the litre. Although he remained in this bath for prolonged periods, not the slightest absorption was noted. The same result was obtained from baths of iodide of potassium and other salts, which could be readily recognized in the urine if they had been absorbed. I do not claim that this negative result militates against the general impression that such mineral baths are exceedingly useful and effective therapeutically. On the contrary, we have here suggestive climatic and hygienic elements, besides the local and general temperature effects. Just as the imbibition of mineral water, strongly impregnated with purgative or other salts, offers immediate evidence of their imbition, there is in the *temperature effect* of baths similar evidence of action. The heat or cold conveyed by the peripheral cutaneous nerves to the central nervous system, and thence reflected through the motor tracts, is the really effective element in the mineral baths. The latter are aided by only such ingredients as stimulate the cutaneous nerves, *e.g.*, strong saline or CO_2 constituents. Other mineral ingredients are indifferent in their effect upon the skin, and, as has been shown, utterly incapable of entering the system by cutaneous imbibition. These are facts substantiated by exact experimentation—facts which must unsettle long-cherished ideas and arouse a healthy scepticism in the minds of medical men, and induce them to trust more frequently to the thermic and mechanical effect of pure water, *i.e.*, hydrotherapy.

If physicians would more carefully study the practice of the excellent medical men who devote their lives to the study and application of mineral waters in disease, they would become familiar with facts and methods which would enable them to imitate the effect of these waters at home, in such individuals as are unable or unwilling to be removed to the hot mineral springs, which must always remain the most valuable remedial agents in *chronic rheumatism and gout.*

Prolonged hot baths, therefore, followed by sweating in blankets, are useful for robust-looking rheumatic and gouty people. These may be repeated daily, as the physician's judgment may decide. During the interval between the baths, wet compresses at 65°, covered with flannel or wadding, left on until nearly dry, may be profitably wrapped around the tender or swollen joints. These may be worn during the night also.

After the subacute condition has subsided, the hot-air bath, in which the patient is allowed to perspire for five to fifteen minutes, followed by the circular douche at 100°, reduced gradually to 90°, during

* La Presse Médicale Belge, 1886, No. 13.

one or two minutes, with a pressure of twenty-five pounds, followed by a strong Scotch douche to the joints for fifteen seconds, is a useful procedure. The elimination of retained products of tissue change is greatly enhanced by this procedure, if it is resorted to daily or at least triweekly.

The Scotch douche is a procedure which also aids the absorption of local deposits.

Without detailing the histories of his own cases, the author will follow the plan of adducing the testimony of reliable observers.

Prof. Max Schüller* presented to the XXI. Surgical Congress his views on this subject. He acknowledges the value of diet and climate, but claims to have obtained no result from potassium iodide and mercury, etc. Massage of the muscles (not the joints), combined with baths, is his chief reliance. His best results have been obtained from sweating in woollen blankets, followed by cold wet rubbing. Most of these patients go year after year from one hot spring to another. *He has had better results from the use of the Scotch douche than from the other forms of hydrotherapeutic applications in this difficult class of cases.*

"The Scotch douche consists of the quick alternation of streams of hot and cold water, in a stream of about the size of the little finger and of a constantly varying pressure, delivered from the same nozzle. This douche is not so well known, says Dr. Schüller, as it should be, and was not found in a number of bathing-resorts visited by him. Its good effects are shown by a restoration of the thickened joint capsule and by a strengthening of the muscular apparatus. The douche should always be used after warm baths, which are often administered at too high a temperature at the bath establishments.

"The Scotch douche has other advantages in the facts that it can be regulated very easily as to temperature, that it can be borne by weak patients, and, above all, that it conveys a distinct mechanical effect, along with its thermal effect, upon the vessels and muscles. This treatment is ordinarily soon followed by a diminution of pain and an increased motility of the joint. Many cases can be kept for years in an endurable condition by this means, which would otherwise be attended by great suffering. In cases that are marked by a relative immobility due to a shrinking and contraction of the capsule, but not due to true ankylosis, the Scotch douche, with an especially delicate massage and passive motion, will assist materially in the increase of mobility. Schüller has practically observed this among those of his patients who had been affected in the wrist and ankle joints. The great susceptibility to pain which attends these cases will not admit of

* Langenbeck's Archiv, Bd. xlv., 41.

the most delicately applied massage, if the latter is tried without the douche; but with the combination these patients feel better, walk or move their limbs with less difficulty, and experience much less pain, so long as the treatment is continued."

2. In the *ill-nourished sufferer from chronic rheumatism*, the hot-bath treatment must be used with great caution. The relaxation incident to these baths and the subsequent sweating procedures are useful, if they be not repeated too often. Twice a week is the maximum number. The debilitating effect may, however, be counteracted by other hydriatric procedures. A daily ablution with water gradually reduced one or two degrees for each occasion, and followed by the procedures as indicated under the caption of anæmia, not only counteracts these effects, but tends to raise the vascular tone and with it increase elimination. The lowest possible temperatures and brief duration consistent with good reaction are the acme of treatment for this type of rheumatics.

The Scotch douche to the joints and subsequent wrapping in wet compresses are useful auxiliaries. An excellent mode of managing these depreciated individuals is the dry pack (described on page 351), after which the whole body is rapidly dried and treated to friction, the joints are wrapped in damp compresses at 60°, and the underclothing is resumed. By this method many patients suffering from subacute or chronic rheumatism may be rendered capable of locomotion, their nutrition improved, and gradually restored to health. If this treatment be not sufficient, the hot-air bath may be resorted to twice or thrice a week, followed by rapidly reduced rain baths and douches, as detailed above. On alternate days the hot-air bath short of perspiration and followed by a one-minute circular douche of 90°–85° and a fan douche for fifteen seconds under pressure of twenty pounds daily increased one pound, and of a temperature reduced daily until 50° is reached, and succeeded by a fifteen-second Scotch douche to the swollen or painful parts, offer a most efficient tonic and alterative measure.

This gradual accustoming of the usually timid patient to lower temperatures and higher pressure educates the reactive capacity, refreshes and invigorates him, improves oxygenation, and sends the blood in joyous currents through his sluggish circulatory apparatus. Local congestions are removed, the circulation of the joints is improved, stiffness is diminished; not infrequently not only is the patient restored, but recurrences which have embittered his life are prevented by his accustoming himself to cold ablutions or plunges on rising every morning.

In very rebellious cases of chronic rheumatism and gout, the douche-massage, as practised at the Arkansas and Virginia Hot Springs in

this country, and at Aix-les-Bains and Aix-la-Chapelle, is very useful (Fig. 75).

The mineral ingredients of the water are of little consequence, as has been shown above. The temperature and pressure under which it is delivered, and the skilful manner in which the douche is combined with massage, however, render this treatment extremely effective. Each joint may be separately treated by douche-massage. In these thermal resorts the patient is advised to lie in warm blankets, being carried in a Sedan chair at Aix-les-Bains, or upon an elevator, as in the new

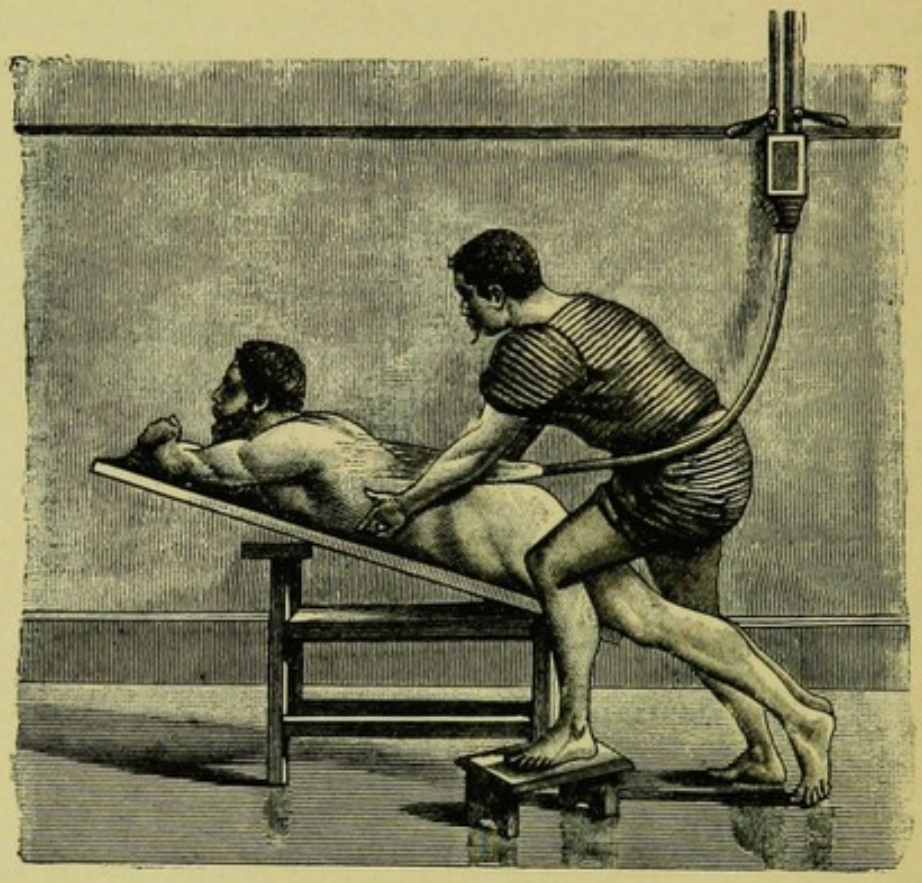


FIG. 75.—The "Aix" Douche Massage (after Glax).

Kaiserbad at Aix-la-Chapelle, to his rooms, or, as is better done at the Virginia Hot Springs, placed on a cot adjoining the douche room, upon which he remains until perspiring abundantly.

This bath may be imitated in any institution where an apparatus for douches exists with facilities for regulating temperature and pressure, but it is impossible to imitate the environment.

The treatment of chronic rheumatism, which is now left too often in the hands of lay and medical empirics, may become satisfactory to physician and patient alike, if judicious hydrotherapy be made the chief factor, applied in accordance with the demands of each individual case, and as carefully watched as in a case of pneumonia or other acute dis-

ease. Slipshod treatment, be it medicinal, dietetic, climatic, hydrotherapeutic, or otherwise, may be charged with many failures in these as in other chronic diseases. The assiduous study of the peculiarities of each case, on the other hand, and the adaptation of the temperature and duration of each hot bath, will enable the family physician to retain these cases under his own care and thus prevent the necessity of their leaving home and family.

CHAPTER XXVI.

DYSPEPSIA.

Although but one manifestation of functional and organic diseases of the stomach, dyspepsia or difficult digestion—*i.e.*, abnormal digestion—is the chief symptom, and this is the author's reason for grouping all functional diseases of the stomach together for the purpose of illustrating their hydriatic treatment.

Without entering into a detailed account of the gastric diseases with abnormal digestion, it is my purpose to consider the two most prominent types—1, gastric catarrh; and 2, nervous dyspepsia—because in both the patient is conscious of abnormal sensations in or around the stomach, and his general discomfort occurs chiefly after meals. In all cases proper attention to environment, diet, exercise, rest, and favorable hygienic conditions are of prime import.

In *gastric catarrh* we have to deal with a stomach whose motor and secretory capacity is more or less impaired. The circulation in the mucous coat is sluggish; hence the secretions are diminished and absorption is greatly embarrassed. Sooner or later the motor capacity fails decidedly. To restore the mucous coating to a normal condition, to remove accumulated mucus and products of fermentation, and to enhance the peristaltic action of the organn, are the chief indications of treatment. The restoration of normal circulation in the diseased mucosa is accomplished by general tonic procedures. For the removal of abnormal products lavage may be applied, as directed on page 226.

The defective motor capacity of the stomach in these cases is favorably influenced by heneral tonic hydrotherapy. These patients may be more quickly trained to bear water at low temperatures and under strong pressure than any other class. If they are anæmic, it is my custom to order daily ablutions, beginning with 85°, followed by good friction, as detailed under the caption of *Anæmia*, page 344. If these measures do not fulfil all the indications, the dripping-sheet (page 218) or cold rub may be administered on rising from bed, followed by friction and a brisk walk. Next in order follow jet and fan douches of 80°, daily lowered two or more degrees. These will be more effective, the therapeutic aim being an enhancement of circulation in the muscular structures and removal of the hypochondriasis often

incidental to this malady. The latter is often diminished by adding strong spinal douches of very low temperatures (Charcot) to the general treatment. This treatment must be judiciously adapted to each individual case, and modified according to effects and indications.

As a local motor stimulant I have found the Scotch douche (alternating from 60° to 110°) to the epigastrium, a little below and to the left of the ensiform cartilage, a very valuable auxiliary, if begun with a pressure of ten pounds and increased daily two pounds up to thirty.

It is not unreasonable to suppose that the general enhancement of circulatory conditions must react favorably upon the gastric mucous membrane and its glands. Clinical proof of this claim is abundant.

Nervous dyspepsia is an affection which prevails to the greatest extent in the large commercial centres, where sedentary life renders the individual more receptive to the pernicious influences of the strain which the nervous system is called upon to bear by reason of the struggle for existence, the competitions, the worries, and the anxieties of modern life.

It may be mentioned *en passant* that next to out-door exercise, which is rarely to be commanded, the daily cold plunge is, as the author has elsewhere endeavored to impress, the most valuable prophylactic against this overstrain.*

In the treatment of these cases, removal from unfavorable environment is the prime indication, but one which is rarely capable of being met. When the patient cannot leave home, or is not benefited by the usual treatment, a course of hydrotherapy offers the best chance to him, provided he limit his work or abandons it entirely. The following illustrate the treatment in such cases, and afford an insight into the procedures best adapted to them.

Case I.—Mrs. O——, aged 28 years, resident of Florida, consulted me on May 5th, for "catarrh of the stomach," because of agonizing pains after meals. She has been living on mush and milk, and has had medical treatment for several years, with diminution but not disappearance of the pains. She is emaciated; her voice is feeble; she is depressed and hopeless. Her wan face and prematurely old appearance bear evidence of a life of constant physical suffering. There is not a particle of the hysteric element in this case. Ordered at 12:30 P.M. a full test meal at Delmonico's, which she reluctantly accepted because of dreaded increase of pain. Five hours later the stomach was washed out without difficulty, Mrs. O. displaying marked patience. To her great surprise, my prediction that her dinner would be digested was verified, a little tomato peel being the only remnant visible.

The diagnosis of a gastric neurosis being clear, she was ordered a mixed diet, chiefly consisting of hot milk and stale bread and hominy for breakfast, adding

* Article "Hydrotherapy and Mineral Springs," by Simon Baruch, M.D., p. 454, vol. i., Hare's "System of Practical Therapeutics."

eggs (soft boiled) later, same with fish or oysters for luncheon, and steamed rice and roast beef for dinner. Desserts and salads forbidden.

The general invigoration of the entire system being the chief indication in this case, she was placed upon daily hydriatic measures adapted to her case, by gradually accustoming her to lower temperature and stronger pressures.

May 6th. She received a hot-air bath (169° F.) for six minutes, which produced cutaneous hyperæmia and some perspiration. This was followed by a tub bath of 98° for five minutes, with friction. Upon emerging she was subjected to a rain douche of 95°, reduced to 90° during half a minute, at twenty pounds pressure. The treatment was terminated by a spray douche at 80° for five seconds, with friction.

She received no warm tub baths on the following day, but was at once subjected after the hot-air bath to a rain douche of 90°, reduced to 80°, for thirty seconds and a fan douche of 70° for five seconds. Reaction was fair.

May 25th. A jet douche to back at 60° was added on account of hypochondriasis.

June 12th. Same treatment, except that jet douche, having been daily lowered one degree, now reached 48°. She improved steadily, gaining flesh and being brighter and more cheerful.

June 18th. The jet douche, proving too exciting, was suspended.

June 20th. She complained of epigastric pain and received the constant current, twelve miliamperes, applied by a large flat sponge electrode over epigastric and a small one over lumbar region. Temperature of douche was raised to 75°

June 27th. Temperature of douche was now reduced; she was again depressed; the jet douche given at 50° for three seconds. Reaction good.

July 9th. Electricity having been unavailing and fermenting material having been found in the stomach, the Scotch douche has been daily applied to epigastric region for thirty seconds after the rain douche, 70°–45° daily, and followed by jet douche at 50° for three seconds. Patient returned to Buffalo to her parents.

On November 26th, 1892, she wrote that she had gained fifteen pounds in weight and was much stronger; had continued the diet prescribed, because, like most of these neurotics, she "feared her stomach was not equal to much of a change." Most of the time she is entirely free from pain; she has slight distress every now and then, but expresses the warmest gratitude for the help given.

Case II.—Dr. H—— asked me to give him lavage. He looked haggard, suffered from migraine; had worked in country practice on Long Island for years; vomited often, with headache; had tried everything, including rest for eight months, dieted very carefully, and had recently, under one of our most eminent consultants, who regarded him as suffering from gastric catarrh, confined himself to hot water and chopped beef without avail. He had section of the external rectus done on both eyes by an enthusiast on the subject. Thought he was astigmatic, which Dr. Carl Koller did not concur in. My diagnosis of nervous dyspepsia was confirmed by lavage, which showed perfect digestion of a full and varied meal taken five hours previously. A mixed diet consisting of meat, farinaceous food, excluding vegetables and pastry, was ordered, which was well borne, to the great surprise of the patient. A daily ablution, with gradually reduced water, accustomed the patient to the cold plunge (60°), followed by friction and out-door exercise. Having occasion to visit one of his patients in consultation a year later, I found the doctor much improved in flesh; his general health good, and maintained by continuing the daily hydrotherapy which I had prescribed for him and by visiting his patients on a bicycle in the

summer. He thinks he "would have died if he had continued his former professor's advice to live on meat and hot water."

One of the chief difficulties in these cases of nervous dyspepsia is the dread of infringement upon what they have been led to regard as good dietetic rules. The usual effect of a test lavage (one of our simplest hydriatric procedures) is marvellous in these cases, inasmuch as it enables us to build up the nutrition and thus improve the general health upon which the local disease seems to depend in most cases, as illustrated in those already cited. The doctor's case cited above demonstrates what may be accomplished at the patient's home. I will not here detail the methods of hydrotherapy indicated, save to say that ablutions with water at 75°, reduced one degree every day, the patient standing in a little warm water, is a good domestic measure, and may be followed advantageously by daily cold affusions thrown with good force. Afterward institution treatment, where the temperature, pressure, and duration may be applied with precision, would, if necessary, be more useful by reason of the previous hydriatic training of the patient. In addition to these general procedures I have obtained great advantage from the trunk compress (page 121), the *rationale* of which does not require repetition. Suffice it to reiterate that it is a continuous local stimulant, producing cutaneous tonic hyperæmia, and that at each renewal, three or four times daily, the gentle shock arising from its application adds to the tonic effect, by first contracting the cutaneous vessels and under the subsequent reaction dilating them.

In obstinate cases of dyspepsia referred to me by colleagues, after the trial of all known remedies, as illustrated by the cases cited, a judicious water treatment had rarely failed, especially if the patient was away from home and could be induced to submit to a systematic course of douches. Under the magic touch of this flagellation with a solid column of cold water or the more gentle stinging spray of the fan douche, these unhappy creatures bloom forth into health and contentment. Their moodiness, introspection and apprehensions of evil, their tendency to magnify slight ailments into serious maladies—all disappear like a mist before the rising sun, when the physician applies all the resources of hygiene, diet, and hydrotherapy with judgment and skill, and avoids slipshod routine.

The result aimed at must, however, be clearly before the physician. The peripheral stimulus must be so adapted to each case that its effect is conveyed to the central nervous system, with the result of enhancement of the innervation of the stomach in the general beneficent result. All excitation must be avoided; while the heart is driven to better, more thorough work, it must not be overstimulated. The result will be a removal of the plethoric condition of the abdominal

circulation, because the blood is put into active fluxion by its withdrawal from the interior to the large cutaneous vessels. Thus the stomach and liver are supplied with better aërated blood, their local circulatory condition is enhanced by the invigorated general circulation, and the nutritive conditions are improved. That this is not theoretical deduction is daily proved by clinical results.

It is not the writer's purpose to burden these pages with clinical histories of his own cases, except to illustrate the hydriatic methods adopted in their management, which may be useful as a guide to the reader in the practical application of water in disease. Individual observations may be fallacious; the enthusiastic espousal of a therapeutic agent or method may bias the observer. Therefore I propose to present in the interest of fairness the views of others whose large clinical material entitles their opinions to respectful consideration.

In an essay on "The Diagnosis and Hydrotherapy of Stomach Diseases," read before the Balneological Society of Berlin,* Dr. Alois Strasser, clinical assistant to the Allgemeine Poliklinik, in Vienna, discusses the present methods of diagnosis in stomach diseases in a careful, conscientious, and scientific manner, arriving at the same conclusion which I had expressed in a paper on "The Clinical Aspects of Dyspepsia," read before the South Carolina Medical Association April 25th, 1895, that "the number of clinical tests which have been proposed for the purpose of obtaining a reliable measure of the digestive capacity of the stomach is bewildering to the general practitioner. They often serve no useful purpose, when the treatment is to be studied out and practically applied." Dr. Strasser's review indicates a thorough mastery, not only of all the scientific chemical methods, but also of the practical aspect of the subject—the treatment. "Hydrotherapy may be utilized with some success in every form of stomach disease. This is proved by the results of all hydrotherapeutic institutions. For instance, the statistics of the institution at Kaltenleutgeben show, during the past twenty-five years, fourteen hundred and twenty-four stomach and intestinal cases (the former in large majority, the latter mostly united with the former). *Of these only four per cent left the institution without being cured.* It is true that a large proportion of stomach cases are of a nervous type, which may favorably influence the statistics; still we must remember that nervous gastric cases are not sent at once to institutions, but often only after the primary neurotic disease becomes converted into an anatomical one.

"Nervous dyspepsia becomes changed to a chronic gastric catarrh and the atony is transformed into a regular muscular insufficiency; secondly, the category of nervous cases contains many which, after

* Blätter für klinische Hydrotherapie, May, 1896.

having been treated in vain by various medicines, resort to hydrotherapy as a last refuge."

My personal observation has led me to the conclusion that flabby or anæmic dyspeptics, and those of the better nourished class, who present psychical manifestations or neurasthenic symptoms, are the most favorable subjects for hydrotherapy. The fact must not be lost sight of that the latter is not a specific in this malady; it is only a potent aid in the hygienic and dietetic management. Many cases which fail under the latter may improve if judicious hydrotherapy be added.

CHAPTER XXVII.

THE HYDRIATRIC PRESCRIPTION.

The reader who has carefully followed the description of hydriatric procedures and their *rationale* detailed in the foregoing pages may now appreciate the necessity for precision in the prescription of these procedures by the physician, and for exactness in their execution by the attendant. There are many conditions which are essential to the success of hydriatic treatment, and in which the well-informed physician need not be instructed if he has fully mastered the *rationale* of the procedure he desires to apply. There are some general rules, however, which need to be regarded with special care. Many, indeed most, procedures may be readily executed at the patient's home. Especially is this the case in acute disease in which ablutions, half and full baths, and hip baths are indicated. The fact should be ever present in the physician's mind that a reaction sufficient to fulfil the therapeutic indications, *i.e.*, adapted skilfully to the condition of the patient and his malady, should be produced. In chronic cases even greater care is necessary, and for this reason many cases do much better in hydriatric institutions, where experienced physicians and attendants are accessible. The constitutional peculiarities—the age, sex, condition of blood-vessels, and nervous irritability—should be carefully ascertained. For instance, patients advanced in years, in whose vessels atheromatous changes have taken place, should not be subjected to prolonged procedures, which would throw too great a strain upon the inelastic and feeble vascular coats; patients who are anæmic or suffer from defective nutrition should not be subjected to procedures which abstract much heat. At the same time it should be borne in mind that *brief* applications of cold water, delivered under high pressure or accompanied by good mechanical irritation, are useful for anæmic cases, because they do not abstract heat and aim by their evanescent action to call forth a reaction which fills the cutaneous vessels and counteracts the anæmic condition.

Some patients present idiosyncrasies which are as striking in hydrotherapy as they are in medicinal therapy. It is therefore wise *in all cases* to begin with the mildest procedures, and increase the duration and pressure, and diminish the temperature cautiously, until the patient's reactive capacity has been ascertained. A somewhat exten-

sive experience has convinced me that, although water is a simple remedy and so easily applied that any one seems justified in using it, I must insist, with full consciousness of the import of my words, that *no remedy in the entire materia medica demands as clear judgment and as much knowledge of the patient's condition as does the application of water.*

The complicated nature of hydrotherapy becomes evident when we regard the fact that, unlike other remedial agents, there are several distinct elements involved in its "dosage." Water is for this reason capable of more varied and changeable dosage than any other remedial agent: its capacity for being applied in the solid, fluid, or vaporized (steam) state; the various methods of technique to which it may be subjected facilitate its adaptation to the most varied conditions of disease.

Since the chief therapeutic effect of water is derived, as we have seen, from its thermic and mechanical action upon the cutaneous surface, we find three methods of "dosing" it—by changing the *temperature, mechanical impact,* and *duration* of the application.

1. *Temperature.*—That the effect of any water application at 40° F. differs from that of water applications at 110° (both being within safe limits) is well understood; but the fact is rarely grasped that this represents an enormous latitude for grading its effect upon the human organism.

2. *Mechanical Impact (Pressure).*—The difference in effect due to the method by which water is applied to the skin is not sufficiently recognized, and yet I need only refer to the fact that water applied by squeezing from a sponge or by submerging the patient in a tub of water (without any friction) produces quite a different effect, subjectively and objectively, from that produced by water applied with active friction, as in the Brand bath or delivered upon the body with thirty or forty pounds' pressure as in the douche.

In a lecture* which the author had the honor to deliver by invitation of several medical teachers, in the German Hospital of Philadelphia, which, by the way, is the only general hospital in the world equipped with a perfect douche apparatus, the effect of pressure was demonstrated as follows:

A patient whom the house physician Dr. Frese represented as being in an ordinary condition of health, except that he was syphilitic, was selected. A jet douche upon the back at a temperature of 80° F. for two minutes, under a pressure of thirty pounds to the square inch, was applied. Wherever the stream impinged upon the skin the latter assumed a bright red hue; the cutaneous arterioles were dilated. He

* International Clinics, vol. ii., seventh series, 1897.

did not complain much of cold, although, being unaccustomed to such treatment, he did not find it very agreeable.

When the pressure of the stream was reduced to ten pounds, as indicated by the gauge, the skin was scarcely reddened, while an increase of pressure to thirty pounds brought out a red line, marking distinctly its course of impact. This experiment explained that we have a latitude of twenty-five pounds in this hospital apparatus (others furnish more or less), by which we may grade the *force*, and consequently the stimulating effect of the stream upon the sensory cutaneous nerve endings and the cutaneous vessels.

When the same stream of water, which was applied to the fairly robust syphilitic, was directed upon an emaciated, phthisical patient, whom Dr. Frese had also placed at our disposal, and who had just emerged from a hot-air bath, which facilitates reaction, very little redness was evoked, because the circulation of the patient was feeble.

This illustrates that all water applications may be graded also according to the *condition of the individual.*

3. *Duration.*—Another important mode of grading or dosing water applications is by the *duration* of the procedure. If we dip one hand into a bucket of water at 40° F. for one second, remove it, and dry it, the skin will assume a ruddy hue, grow warm, and feel comfortable. If we dip the other hand into the same water for *five minutes*, considerable pain will be produced; the skin will become mottled, cyanotic, and, after it is dried, a considerable time will elapse ere warmth and comfort are restored. The effect of *duration* when the temperature and the subject are the same is made evident by this simple experiment. The duration of a water application offers, therefore, by judicious graduation, an excellent mode of "dosing" the remedial action of water.

It follows from this complicated nature of hydrotherapy that exact precision must be observed in prescribing it and in executing the prescription.

Errors Commonly Committed.—In order more earnestly to impress this necessity of correct technique, some of the errors often committed by otherwise well-informed men will be pointed out, and thus some useful, practical lessons for the guidance of the reader may be inculcated by example.

The history of the remedial use of water demonstrates that no other remedy in our entire therapeutic armamentarium has experienced so many changes in the estimation of physicians. At one time lauded to the skies, it appears at another period entirely neglected; so that, despite its antiquity, water has not obtained a firm footing in therapeutics; despite its marked clinical results, it still requires to be brought to the attention of practitioners; despite its espousal by the best

authorities in ancient and modern practice and literature, the average medical man is not familiar with its history, action, and merits.

Indifference to a definite technique in the application of water has been the chief obstacle to the recognition of its value, and has rendered its application in the hands of many unsuccessful and discouraging.

Failure is the sure result of inattention to details. As a physician must judge the value of a remedy by his experience, it follows that failure to achieve the results which the experience of others had led him to expect has brought this remedy into disrepute, the fact unhappily remaining unrecognized that *not the remedy but its application was at fault.*

Unfortunately our medical schools do not include hydrotherapy in their curriculum, the therapeutic use of water being cursorily mentioned in the lectures on materia medica.

Thus has it come about that not only is the average medical man poorly informed upon this subject, but even among the justly eminent men in our profession a deplorable indefiniteness exists upon the principles and practice of hydrotherapy, which is manifest in society discussions and in the lectures from which our young men expect to derive instruction. A few examples to illustrate the correctness of this statement may interest the reader and prove instructive by pointing out the faults most commonly committed.

In a recent discussion on "The Treatment of Pneumonia of Infancy and Childhood," * the following reference is made to hydrotherapy by a justly eminent teacher: "*The best antipyretic is cold.* Cold bathing was once eulogized immensely, and again abhorred and warm bathing placed in its stead. The *rationale* of cold bathing is the cooling of the surface (that is, of fourteen feet in the adult, proportionately in the young), with its immense surface circulation. As long as this continues active, new blood will come to the surface every moment and the whole body is thereby cooled. When it is no longer active, the heart is weak, the extremities are cold, cold bathing is dangerous. The rule I have prescribed many years ago was this: No cold bath when once after it the extremities remain cold or cool."

This lecturer refers to the fact that he had "preached and practised this theory almost a score of years previously," and had at that time said:† "If there be anything I should rely upon in pneumonia, especially lobar pneumonia, when the fever is very high, it is *cold-water treatment.*" He also refers in this article to the prejudice existing against cold water, a prejudice to which he attributes his expulsion from the staff of a hospital at that time. He prophesied at that time that "this prejudice would disappear, just as the prejudice against pure air has disappeared."

* Archives of Pediatrics, April, 1893. † Medical Record, p. 289, 1870.

That this prophecy, made ten years previously, has not been fulfilled is evident from the following extract from Hare's "American System of Therapeutics," page 605, vol. i., 1891: "It seems strange that American physicians who are usually so prompt in giving all therapeutic measures a thorough and complete trial, should have so largely neglected and even condemned without adequate experience these measures."

Why has the enthusiastic advocacy of an able teacher, who has deservedly been followed by the profession in other respects, fallen barren, so that to-day the prejudice against the water treatment is as great, especially in America, as ever it was?

The reason is not far to seek. Had this author given more definite directions *how* cold the water should be, the *duration* of his bath or pack, the *frequency* of bathing or packing, his teachings would, I opine, have taken root, and would to-day have borne golden fruit in the hands of others, as the practice has done in his own hands. The author was careful enough to give in the same essay *minute directions* as to what he means by large doses of digitalis, and how these and other medicinal agents are to be given. But in his references to bathing he is, like too many other able writers and teachers, content to leave the important minutiæ to his reader's judgment. Many of the latter would properly regard "cold water" as water to which nothing is added, or just as it is obtained from the source of supply. The danger of such indefiniteness is made evident by the fact that in New York City the temperature of the Croton water varies from 45° in December to 75° in August. It will be readily seen that to the sensitive organism of a child it cannot be a matter of indifference whether water at 45° or at 75° is applied. Indeed, to a child, a "bath" at 75°, and even "packs" in sheets wrung out of water below 60°, would be dangerous. *The lesson is evident that, in prescribing "cold-water treatment," or, more correctly, "water treatment," physicians, especially teachers, should be careful in giving as minute directions with regard to temperature, duration, and method as they are in the habit of doing when referring to medicinal agents.* The terms cold water, warm water, lukewarm water, hot water, indicate approximate temperatures upon which there is no consensus of opinion. Hence, it is far more scientific to abandon these terms, and always refer to water at definite degrees of temperature, at defined pressure, giving clearly defined methods, duration, and frequency of repetition. This has been my unvarying practice for many years. I have reiterated it upon every occasion, because, as I have shown, the value of these therapeutic procedures depends upon such precision, and their universal adoption can be expected only when their value can be demonstrated by comparing results of many *observations made under similar conditions.*

In contrast to the above faulty teaching may be cited that of A. Baginsky,* who reports on thirty cases of croupous pneumonia in children, giving the most minute details of the hydriatric procedures, their exact temperature, duration, etc.

Another illustration of the damage inflicted upon patients and upon the progress and acceptance of hydrotherapy, may be drawn from the following incident:

In February, 1889, I presented before the New York Medical Society the first plea for the Brand method of bathing in typhoid fever, which had never before been discussed in any English-speaking society. That it was received not only without approbation but with decided condemnation did not surprise me, for on the day preceding this meeting a now eminent teacher of medicine had informed me that he never intended to use so heroic a remedy, because he had seen the able visiting physician of the hospital in which he had served as an interne "kill a patient" by this treatment. Inquiry into the cause of his antipathy elicited the fact that this so-called Brand bath consisted in *wrapping the patient in a sheet*, placing her on a Kibbee cot, *and sprinkling her with ice-water* until the mouth temperature showed marked lowering. A brilliant young man, a teacher and hospital attendant, was thus bitterly prejudiced against a method of bathing, of which, as the sequel proved, neither he nor his justly eminent teacher really knew anything. Both regarded the lowering of temperature as the chief aim of the cold bath, and looked upon any mode of applying cold water as a Brand bath, losing sight of the difference in effect arising from a difference in technique. To wrap the patient in a sheet and sprinkle him with ice water, as was done in the case cited above, is a deviation from the correct technique of the typhoid-fever bath. Such a procedure does not fulfil the main object of arousing the nervous system. After the first shock has passed no opportunity is given for reaction, because the sprinkling of ice water continues; the cutaneous vessels and the elastic tissue of the true skin contract, as evidenced by cutis anserina; the extreme cold imparted by the wet sheet without remission maintains the contraction of the cutaneous vessels, benumbs the sensory nerves, and thus impedes the transmission of the shock and subsequent stimulus, even if the latter has ensued in an exceptionally strong individual. The absence of friction in this faulty technique (which in the Brand bath stimulates to reaction, and by widening the blood area of the skin cools a large quantity of blood and relieves the laboring heart) frustrates completely the true aim of the cold bath.

The surface temperature is indeed reduced by this improper method, but the blood is driven to the interior, congestions are favored, the

* Archiv für Kinderheilkunde, p. 13, 1891.

organs are overloaded, and the patient emerges from such a bath (save the mark!) a shivering, cyanosed weakling.

Even such a sheet bath as was used by the distinguished hospital attendant referred to could, by proper understanding of the *rationale*, be made to serve a useful purpose. Nerve stimulus rather than temperature reduction should be the object. If the sprinkling were done rapidly with water at not less than 60°, if each part sprinkled were thoroughly rubbed with the flat hand of an attendant until warm, and thus every part of the body sprinkled, rubbed, slapped, and warmed up until it no longer responded by warming up, the dangerous contraction of the cutaneous vessels would be obviated, the vasodilators would be stimulated, a reaction would take place whose transmission to the brain would be salutary.

That the false procedure above quoted proved fatal is due to an error in technique, based upon a misconception of the *rationale* of the cold bath in typhoid fever.

The incident is referred to in detail, for the purpose of "pointing a moral" and impressing thereby a useful lesson.

I am happy to state that both preceptor and pupil* are now practising the Brand method with success. They have mastered the technique and follow it closely with rare exceptions.

That the best judgment must be applied to the technique of this treatment becomes apparent very soon to the observant practitioner. The ideal results obtained by Brand and others in twelve hundred cases without mortality can be realized only by following the exact technique of Brand. V. Ziemssen testifies that whenever he deviated from the strict Brand method he had cause to regret it, and my own observation corroborates his experience.

These incidents may suffice to show that even eminent clinical teachers have failed to obtain ideal results, because they deviated from the ideal technique, each one modifying it to suit his own fancy, without actual experience with the better methods. That physicians must blindly follow the dictum of Brand or of any other is not demanded, but the Brand method, which is definite in its technique, must not be charged with failures attending its modification, any more than Berg-

* This gentleman said in a letter to the author, dated December 9th, 1895: "When I commenced my service at the hospital the 1st of last August, I had had no experience with the Brand bath in typhoid fever, and I am free to confess that I was prejudiced against it. Since that time I have had fifty-two cases of typhoid fever under my care in the hospital. Eight-tenths of these cases at least I have given Brand treatment. I am now a believer in it. I believe the temperature of the first bath should be higher than ordinarily given, say 70° or 80°, and lower in each subsequent bath, until, say, after a half-dozen, they will stand a temperature of 60° or 65°."

mann's aseptic surgical technique should be charged with failures attending the neglect of any one of its exacting demands. For instance, the physician who does not begin bathing before the diagnosis is positively confirmed by the roseola cannot expect that freedom from lethal complications which early bathing surely brings, though he bathe exactly according to Brand throughout the case. He will surely have a smaller mortality than another who begins regularly in the second or third week, or one who uses higher body temperatures as indications for the bath, or one who adopts higher temperatures to please the patient or his friends.

The best results can be obtained only by minute attention to *all* the details of the method.

I have availed myself of this illustration of the subject, because extensive observation and careful inquiry among practitioners in Germany and in this country have convinced me that the lack of appreciation of the therapeutic value of this method of bathing and its consequent feeble recognition by the profession may be ascribed to losing sight of the true principles of the Brand baths, and consequent too liberal deviation from its correct technique.

Physicians always insist upon exact dosage of medicinal agents, the exact time and mode of their administration, frequency of repetition, and even their exact preparation. I plead for the adoption of similar care and attention in the prescription of water as a remedy as the only means of preventing the future desuetude of hydrotherapy.

Precision in technique is quite as important in the treatment of *chronic diseases* as in the acute. That the medical profession has not yet accepted this idea is illustrated by the prescription blanks of a certain hydrotherapeutic establishment, which read, "Give the bearer a douche, wet pack, sulphur bath, etc. The physician may strike out the bath not wanted." One may as well write a prescription reading, "Give the patient a dose of quinine, morphine, or sulphonal," without specifying exact dose and mode of administration. Such a prescription would be regarded as incomplete, indeed as absurd. That a prescription for a bath or other hydriatric procedure *without exact statement* of temperature, duration, mechanical impact, and method is equally incomplete, needs but to be pointed out.

The import of temperature and duration and mechanical impact of every hydriatric procedure requires to be impressed with emphasis. Every physician realizes the difference of effect arising from different temperatures, and yet we commonly read directions for cold baths, tepid baths, hot baths. By a cold bath is commonly understood a bath to which no hot water has been added. Such a bath in New York City, as has been shown, would be 45° F. in midwinter and 75° in midsum-

mer, as ascertained by exact observations in the Hydriatric Institute. That thirty degrees would produce an enormous difference in effect goes without saying. And yet the exact temperature of a bath is rarely designated. The difference of effect in the duration of a bath is also readily recognized, but that friction during the bath or a pressure of thirty pounds would produce an entirely different result from a pressure of five pounds needs to be practically* observed to be fully appreciated.

Just as the Brand bath has failed in the hands of those who modified or changed its technique, so has *hydrotherapy in chronic cases* failed because of inexact technique. It cannot be sufficiently reiterated that temperature, pressure, duration, and method should be prescribed and practised with as much exactness as the dose, prescription, and method of administration are stated in prescriptions of medicinal agents.

Phthisis may be offered as an illustration. The technique in this disease has been described (page 351). If this careful technique be not observed, if the patient be subjected to lower temperatures or higher pressures in the beginning, his reactive capacity would not be equal to the demand and the result would be serious and discouraging. A young hydrotherapist, recently returned from Germany, expressed great surprise that a case of phthisis which had been under hygienic treatment and diet, improving and gaining weight steadily, had begun to lose weight after douches had been used one week. To her question as to the probable cause of this result, I replied that there was "something wrong with the hydrotherapy used in the case." Upon asking her to detail the technique, she said that she had followed the plan adopted at the Montefiore Home—to dilate the cutaneous vessels by a hot-air bath before applying the douche. When she was asked how long the patient remained in the hot-air bath, the reply was "until she perspired freely." Here was the defect of the technique. The object of the hot-air bath in phthisis and other diseases manifesting defective nutrition and a tendency to emaciation is to dilate the cutaneous vessels for the purpose of enchancing reaction, but not to promote tissue change, which is evidenced by excessive rise of temperature and perspiration. As the latter method is adopted in treating obesity, its inappropriateness in phthisis is at once apparent. Bearing in mind the feeble circulation in phthisical patients, a gradual training of their reactive power, a daily neuro-vascular discipline as it were, is demanded, and not a reduction of flesh and vitality.

The following example of faulty hydrotherapy may also be instruc-

* See "The Practical Application of Hydrotherapy," a clinical lecture delivered at the German Hospital, Philadelphia, by Simon Baruch, M.D., p. 203, International Clinics, July, 1897.

tive. From a published lecture on neurasthenia, delivered by an eminent teacher, the following is quoted: "The cold-water treatment in the morning is apt to bring about a very beneficial change. I will suggest various methods of applying the treatment, which you can use in all cases, rich or poor, old or young. The top of the head and the nape of the neck are points of attack. Have the bathtub one-third full of lukewarm water so that the patient may stand in it without getting chilled; then if the bath has a douche attached, you may allow the shower to play on the top of the head and then down the nape of the neck; or you can slap the nape of the neck and the spine with towels wrung out of very cold water; or let him take a large sponge dipped in cold water, put it on the top of his head, and let the cold water run down his back. Nothing produces so good an effect on the nervous system as the trickling of cold water; it is not so good simply to wash with cold water; trickling out of a sponge is the proper way to apply cold water."

The indefiniteness of this technique is apparent, and may serve as a lesson of "how not to do it." According to the locality in which *cold* water is administered, its temperature may be 40° in midwinter or 80° in midsummer. And yet this lecturer says not a word about temperature. The trickling of cold water over the body needs but to be mentioned to provoke a feeling of chilliness; playing a douche of cold water over the head and spine of a neurasthenic of the excitable type would set him wild, while the same treatment may benefit the depressed neurasthenic if it be brief and daily and gradually lowered.

The recklessness of these suggested modes of applying cold water becomes more glaring when compared with the same lecturer's directions for the use of strychnine and phosphorus. He is quite explicit with regard to the preparation, dose, and combinations of these remedies. If he had followed the same course in describing the water treatment, by stating the temperature of cold water and of the *very* cold water; the pressure of the douche, which from the height of a few feet is a chilling drizzle, while from a height of fifty or sixty feet it stings and arouses the vasomotor nerves to an intense and pleasant activity; the duration of the treatment, which, if left to the patient, often bears unhappy consequences; he would not have failed to reach the proper method. I am glad to say that this teacher has recently published a valuable work, in which the directions for hydrotherapy are quite precise and well considered, and which testifies that the propaganda for scientific (*i.e.*, exact) hydrotherapy is bearing rich fruit.

Another eminent teacher advises neurasthenics to plunge into a tub of *warm* water (temperature not being stated), then allow *cold* water to run into the tub until the water surrounding the patient is cool; this

temperature again being left to the judgment or caprice of the patient. Here the very common error is committed to obviate shock. This is the baseless dread of inexperienced prescribers of cold water, who disregard the fact that the reaction following the shock is the aim of hydrotherapy when applied as a tonic or as a nerve stimulus, and that the reaction is exactly in proportion to the preceding shock.

It is unhappily a very prevalent error to regard the most agreeable bath as the most salutary. We do not so reason in the application of medicinal agents, of electricity, or of diet. And yet the application of water may be made agreeable by gradually accustoming the patient to lower temperatures, slowly reducing them every day or two, making the application brief at first and increasing or decreasing the duration and pressure day by day. The prime essential, however, should always be borne in mind that *reaction is our aim*, that this cannot be evoked without some shock, that the more intensely the latter can be borne the more effective the reaction; but the more brief it is, the less unpleasant.

If the physician bears in mind that his object in treating a case is an increase of the quantity of blood circulating in the cutaneous vessels, an enhancement of the nutrition, a stimulus to the entire nervous system, he will endeavor so to order the technique, provided he has mastered its details, as to evoke this salutary reaction without excessive shock.

For the attainment of satisfactory and definite results in hydrotherapy, a correct prescription is therefore paramount. This cannot be too often and too earnestly impressed upon the profession. Acute diseases, like typhoid fever and pneumonia, are under constant observation of the physician, who may at once note the result of an improper hydriatric technique and modify it, or, as is unfortunately more often done, relinquish it altogether. In chronic cases much damage may be done before the physician discovers it, if the treatment be not in the hands of trained and intelligent *attendants who are under medical supervision*. Too often the details are left to laymen because physicians have not received instruction in the *rationale* and technique. The result is as Dr. Vogl, medical director of the Bavarian army,* says: "*Physicians are themselves to blame if hydrotherapy is chiefly practised by laymen who know as little of the disease they are treating as they do of the effect of water, and thus damage not only the patients who confide in them, but also the cause of hydrotherapy.*"

During a visit to twenty-five institutions in Germany and France in which hydrotherapy is practised largely, I was astonished and chagrined to find only four which had a stationary thermometer to indicate the temperature of douches, and only two which had gauges in

* Münchener Medicinische Wochenschrift No. 27, 1896.

use to indicate the pressure applied. The technique cannot be controlled with any degree of certainty without these accurate aids. Nevertheless, yet good results are obtained, because in most of these institutions the treatment is administered under the eyes of experienced physicians.

To avoid injurious shock and gradually educate the patient's reactive capacity should be our guide in the hydriatric prescription. To enable me to accomplish this end with precision I have, without neglecting other hydriatic procedures, resorted to douches, with which I am able to grade the temperature, duration, and pressure, and thus adapt the shock and reaction to the patient's capacity and endurance, and to note the result definitely every day. Thus we may proceed with intelligence and judgment in meeting the indications of each case, by changing the procedure or by increasing or diminishing temperature, duration, and pressure accurately from day to day.

Conclusion.—The reason that different results are obtained by different physicians from the application of water may be found in the technical errors committed on account of an erroneous conception of the *rationale* of hydrotherapy. To avoid this rock upon which many have split, the reader will do well carefully to study not only the technique, but the *rationale* of each procedure, and use a definite prescription for applying it.

CHAPTER XXVIII.

HISTORICAL EPITOME—THE LESSON—NECESSITY FOR INSTRUCTION IN HYDROTHERAPY.

The history of hydrotherapy forms the most interesting chapter of the history of medicine; it illustrates how prejudice may thwart progress and how enlightened physiology and pathology have tended to reinstate a valuable but neglected remedy.

What remedies have survived since the days of Hippocrates and Galen? The application of diet and the use of water are really the only remedies which have withstood the test of time. Blood-letting may be cited to illustrate the fate of a remedial agent which has no rational basis. This heroic measure has for centuries been advocated and defended by the leaders of medical thought and practised by the rank and file of the profession. Nevertheless, the last third of the present century has witnessed its complete downfall from a position which no other therapeutic agent has ever occupied. As soon as the progress of physiology and pathology gave the physician a clearer insight into the vital processes in health and disease, blood-letting lost its prestige beyond recovery. Water, whose origin as a remedy is coeval with blood-letting, but which has never attained such marvellous dominance over the medical mind, enjoys to-day greater confidence and is more genuinely appreciated than at any previous time. Despite professional and lay prejudice, it stands to-day secure against successful assault, by reason of its rational basis and favorable bedside results.*

A rapid glance over the history of hydrotherapy suffices to show that water is an orthodox remedy, having been first dilated upon in the works of Hippocrates, who correctly insisted that cold stimulates and warmth relaxes, and who applied it in many diseases with skill and judgment.

Among the noted men who warmly advocated water in disease may be mentioned Asclepiades, whose eminence is attested by his being the friend and physician of Cicero. He really foreshadowed "the cellular theory" by teaching that not the juices of the body but its elements and atoms are active in health, and that a disturbance of their activity

* "System of Practical Therapeutics," Hare, vol. i.

constitutes the essence of disease." He cast aside all spoliative medication and depended chiefly on diet, exercise, and baths. Celsus, Themison, Cœlius Aurelianus, and Antonius Musa were his disciples, all men who occupy high places in the history of medicine. Celsus was the physician of Ovid and Fabius Maximus. Musa restored the Emperor Augustus and the poet Horace to health by cold baths (Suetonius). The philosopher Seneca became an enthusiastic "psychrolutus," after he was cured by cold water prescribed by Charmis.

The greatest physician of the seventh and eighth centuries, Paulus Ægineta, was an active hydrotherapist; he applied cold affusions in sunstroke and anuria.

In the twelfth century Van der Heyden collated three hundred and sixty cases of malignant dysentery cured by water. Van Helmont regarded baths and affusions as superior to medicines.

In 1697 great propaganda for hydrotherapy was made by Floyer, a learned English physician, whose book was translated into German, and converted Prof. Friedrich Hoffmann. Being regarded as the most able physician in Germany, the latter diffused the knowledge thus obtained and elaborated by him over all parts of Europe.

The body physician of Frederick the Great, Theden, treated small-pox, malignant fevers, and rheumatism with water.

In 1743 Hahn taught its value in small-pox and other exanthemata. That justly great physician, Hufland, was so warm an advocate of hydrotherapy that he offered a prize for the best treatise on the action of cold water in fever, the prize being obtained by Professor Froehlich, physician to the Austrian emperor.

Despite the advocacy of these and other eminent men, water did not attain popularity until Priessnitz came upon the scene. This remarkable empiric was so successful that he treated in 1840 nearly sixteen hundred patients from all parts of the world. Many physicians from foreign lands visited this peasant water doctor, and became missionaries of hydrotherapy.

In Germany his followers were mostly laymen. Nevertheless, the impress of his life and work can be noticed to-day.*

Germany has been a fruitful field of research and practical demonstration in hydrotherapy, in recent times as well as in the past.

To Prof. Wilhelm Winternitz, who graces the chair of hydrotherapy in Vienna, medical science owes nearly all it has learned about the scientific uses of water in disease. He dedicated himself to the development of hydrotherapy in his graduation thesis, which concluded with the hope that "the knowledge of the uses of water in disease would become the common property of medical men." Before his time

* The "Priessnitz Umschlag" is a reminder of this influence.

there existed no physiological basis for hydrotherapy. He infused the true scientific spirit into its study and pursuit, and built upon this foundation the noble edifice upon which medical men now rely in the hour of direst need. The most important truth of hydrotherapy, its primary action upon the nervous system, was clearly brought out by Winternitz, who showed that even in fevers this effect is paramount and the antithermic effect is secondary. As a teacher, his genial manner and clear presentation have conveyed the knowledge of the value of water in disease to students from every land, who have become missionaries of his good work. To-day physicians and nurses are sent to him for instruction from the Bavarian and Austrian armies. Winternitz has published over two hundred monographs and works, which, having been translated into every language, serve everywhere as beacon lights to the searcher after truth. As a practitioner his wonderful success is illustrated by the institution at Kaltenleutgeben, which has increased from eighteen patients in 1862 to two thousand patients in 1896. He created the first hydrotherapeutic clinic (a part of the Allgemeine Universitäts Klinik in Vienna) at his own expense. When the introduction of antitoxic therapeusis threatened the disparagement of hydrotherapy, as of all other therapeusis, this grand man, fortified by physiological, pathological, and therapeutic learning, clearly set forth the scientific truth that, while water possessed no antitoxic virtues, it aided nature in its battle against the manifestations of toxæmia, by improving cardiac action, vivifying the nervous system, and furthering the oxidation and elimination of toxic products, thus establishing more firmly than hitherto the scientific basis of hydrotherapy. This doctrine he had taught years ago, but its acceptance was slow; it is now almost universally accepted.

The application of cold water became one of the methods in the modern expectant treatment of acute diseases. The greatest progress in this direction was initiated by Ernst Brand, who, in 1861, published his remarkable results from baths of 65° F. in typhoid fever. The methodical use of these baths has become classical, and will probably remain so until specific antitoxic methods are discovered. Jürgensen, Traube, Liebermeister, Fürbringer, Leyden, Ziemssen, Vogl, Senator, Gerhardt, of the present generation, favor active hydrotherapy in febrile diseases, and place it at the head of all remedial agents.

On its value in chronic diseases we have the testimony of many teachers, among whom is Prof. F. A. Hoffman, of Leipzig, who says:* "Cold water is a therapeutic agent by whose correct application we may most surely and without danger of reaction exercise and invigorate the nervous system, and herein I seek its fundamental signifi-

* "Allgemeine Therapie," Leipzig, 1892.

cance in the treatment of all possible internal diseases. *I am convinced that in time all chronic diseases of the organs will be drawn into the domain of the bath treatment.*"

In the Balneological Congress held in Munich in 1896, the chief of Professor Leyden's clinic, Dr. G. Klemperer, gave a *résumé* of the methods used in the clinic by advice and with the co-operation of Professor Leyden. He emphasized the fact that "the effects of hydrotherapy are derived from an extraordinary, quite incomparable excitation produced upon the nervous system, which is transmitted to various organs." In this address he dwelt upon its value in neurasthenia, asthma, functional and organic cardiac, gastric, and intestinal diseases, which have been referred to in the clinical portions of this work.

Vierordt, Erb, Nothnagel, Strümpell, Ziemssen, Kussmaul—indeed most German clinical professors—teach and prescribe the application of water in disease at the present time.

In Italy, where the eminent Savonarola had early established water as a remedy by his work, "Tractatus de Omnibus Italiæ Balneis," a priest damaged its reputation by senseless enthusiasm. Pater Bernardo, living in the island of Malta, was the precursor of Kneipp, of whom so much is heard to-day. He practised many of the same methods (walking upon wet grass and upon wet stones) and attracted all Europe with his "miraculous cures." He was followed by Todano and Sangez, in 1722. The former paraded as "Medicus per aquam," the latter as "Medicus per glaciem," both filling their credulous patients with ice water, and rubbing them with snow and ice, while they fed them on three or four yolks of eggs a day. This quackery again caused water to fall into disuse among physicians. Its value ceased to be recognized until Gianini, professor in Milan, published in 1805 his work, "Della Natura delle Febri e del Migliore Metodo di Curarle," in which he substituted baths of from five to fifteen minutes for Currie's affusions in fevers, gout, and rheumatism. Thus the empirics caused an indifference to the remedial value of water to result, which continued for eighty years.

Italy was rescued later from indifference to hydrotherapy by the teaching and writings of many eminent men—Borelli, Baglivi, Bellini, Valisneri, Cyrillo. These, with Michelotti and Cocchi, were the forerunners of men like Cantani, Semmola, and Vinaj, who have in more recent times illustrated the value of hydrotherapy clinically and physiologically. Some of the most notable investigations upon the effects of hydriatric procedures emanate from Vinaj and Maggiora. Semmola, professor of therapeutics in the Naples University, whose lectures (1890) were translated into German with a laudatory preface from Professor Nothnagel, taught that "hydrotherapy stimulates cutaneous

activity, and with it all functions of tissue change and organic purification, so that often real marvels of restoration in severe and desperate cases are accomplished. Unfortunately these remarkable results are more rare to-day than they were in the time of Priessnitz, of which I was myself a witness. The reason appears to lie in the fact that hydrotherapy has become the monopoly of the exclusively trade doctors, who treat the various maladies without strict selection of the hydriatic procedure in each case, etc. *Hydrotherapy presents a truly rational treatment, and therefore certain and unfailing effects*, unless the local processes have reached incurable limits (atheroma, visceral arteriosclerosis, etc.). In such cases, indeed, pharmacology alone is also powerless in its results."

France.—A general practitioner, Schedel, who studied hydrotherapy in Germany, was the first physician who demonstrated the value of cold-water applications in the building up of failing compensation in valvular diseases of the heart, and as a tonic in tuberculosis.

The great Magendie also increased our knowledge of the effects of water by physiological demonstrations.

Fleury founded a distinct school of hydrotherapy by the introduction of *douches* as the chief method, fortifying his clinical results by physiological and rational deductions. He claimed that cold douches are a reliable substitute for quinine in malarial diseases, and that they are of great value in tuberculosis and anæmia. By his indefatigable labors and physiological demonstrations, as far as the knowledge of the day enabled him, he gave an impetus to the systematic use of the douche, which is to-day recognized as the French method, and which has become famous through its advocacy and application by Charcot, Dujardin-Beaumetz, and others.

An incident occurring in 1839 furnished an interesting illustration of the status of hydrotherapy in France. Two regular practitioners, Engel and Wertheim, petitioned the French government for permission to open a hydropathic institution. The petition was referred to the French Academy of Medicine, which appointed a committee, consisting of Bouillieaud, Velpeau, and Roche. The last-named delivered such a tirade against hydrotherapy, characterizing it as "dangerous, unscientific, chimerical, and opposed to the simplest laws of physiology and pathology," that the sixty members present made an adverse report. Permission being denied, Wertheim demanded a bedside test. Gibert and Devergie applied hydrotherapy in the Hôpital St. Louis, and reported so favorably that permission was granted by the ministers. A few years later Scoutetten, who was sent to Germany by Marshal Soult to study hydrotherapy, reported that, "while it cannot be reckoned a universal remedy, the numerous permanent cures it has wrought in

intelligent persons commend it to popular attention. The interests of humanity and medical science demand that a demonstration of the technique and action of hydrotherapy should be made in Paris under the eyes of able physicians." This unbiassed and sensible report gave a great impetus to the development of hydrotherapy among French physicians, to whose honor it redounds to-day.

France has steadily advanced in the development and practical application of hydrotherapy. The great clinician Charcot applied it constantly in his practice, and doubtless owed much of his remarkable success to the judicious use of water. He was in the habit of referring his cases to Keller in Paris, and to the hydrotherapeutic establishments of Divon and other rural resorts. In acute diseases the missionary labors of Glénard, who learned the Brand method while a prisoner of war at Stettin, and of his fellow townsmen, Tripier and Bouveret, who have written an excellent treatise which has been translated into the German language by Pollak, are noteworthy. The scientific investigations of Roque, Weil, and A. Robin, on the effect of the cold bath upon urinary excretion in typhoid fever, have become classical. To-day France is the stronghold of the Brand method. Hutinel, Guinon, Rendu, Johel-Renoy, and others, have emphasized the value of bathing in pneumonia and the exanthemata.

The works of Dujardin-Beaumetz, Delmas, Duval, Beni-Barde, Glatz, and Charcot afford evidence of great activity on the part of modern French physicians in hydrotherapy for chronic diseases.

Water-cure establishments did not until recently multiply in France as they did in Germany after Priessnitz, because the laws against lay practice are more stringent in France. This fact has caused a marked difference in the development of water institutions in these two countries. Physicians of scientific attainment entered upon the investigation of hydrotherapy in France with zeal, while in Germany the natural prejudice entertained by the medical profession against the empiricism of Priessnitz and his followers for a long time prevented educated physicians from attaching themselves to water establishments. To-day the pendulum seems to have swung in the opposite direction, judging from the number of medical men who claim to be followers of the priestly water apostle, Kneipp.

In England hydrotherapy has not obtained a foothold among physicians, despite the fact that some of our best works on the subject emanated from English authors in the latter part of the eighteenth and early part of the nineteenth centuries.

That English physicians are not at the present time better acquainted with the methods of Floyer, Currie, and Wright in the treatment of fevers is a deplorable fact, illustrating their neglect of

medical history and inattention to the medical achievements of men whose labors were better appreciated in foreign lands.

Currie's work was translated into several foreign languages, and his practice was introduced into the Vienna hospitals by Joseph Frank. Currie introduced affusions in the treatment of fevers, and this really pointed the way to the Brand method. In gout and convulsions, paralysis and tetanus, and other diseases he also claims to have had good results.

A careful search for the cause of the desuetude into which the use of water has fallen in England, despite its advocacy by its most eminent medical men in the seventeenth century, develops the fact that Floyer's writings were so enthusiastic and convincing that many intelligent lay people espoused the methods advocated by him. Among these was a minister of the gospel, John Hancocke, who in 1723 wrote "Febrifugum Magnum, or Common Water the Best Cure for Fevers," which reached seven editions in one year. The enormous influence of this work upon the lay people is explained by the popularity of his book. With natural aversion, English physicians neglected a remedy which had thus been lauded into popularity. Even such influential men as Pitcairne, Cheyne, and Huxham, who appreciated and advocated its use, could not establish a permanent position for it. As a result this valuable remedy, especially in its application to chronic diseases, fell into the hands of irregulars, who erected hydropathy into a system of treatment and still more decidedly estranged regular practitioners from water as a remedy. The practice and writings of Drs. Wilson and Gull, of Malvern, in more recent times, may be cited to confirm this statement.

Many years of active and careful propaganda will be required to regain the ground that was lost through the bitter opposition aroused by the writings of John Hancocke and his ilk.

It is a sad commentary upon the indifference to the history of medicine to note the neglect of scientific hydrotherapy, even in acute diseases, which exists in England to-day. In the summer of 1896 the author visited one of the largeest and most modern hospitals in London. Making the rounds with the able and otherwise progressive physician, a case of typhoid was reached, which was receiving expectant treatment. When I asked if the Brand method or any positive water treatment was used besides sponging, the attendant exclaimed, "Do you approve of such heroic measures?"

In a discussion of the treatment of fevers in 1895 by the British Medical Society, a general condemnation was meted out to cold baths, because "they are heroic." Only one timid advocate was heard in their favor. But Prof. William Osler, of Baltimore, stated on that occasion

that " were the Brand method more heroic still he would use it, because it saves life." This incident occurred in the country which gave birth to, and in which lived and practised James Currie, whose writings had inspired Brand.

In America the application of water in disease has until recent times been vague, and its advocacy rather timid, probably because the earlier text-books on medicine were reproductions of works by English physicians, who, as I have shown above, have exhibited a singular indifference to hydrotherapy. The most earnest non-empirical advocates of water in disease in America are Drs. Abram Jacobi, of New York, and the late Hiram Corson, of Pennsylvania, who illustrated its value in a large *clientèle*, and to whose writings I owe my earliest inspiration and example.

During the past few years quite a change has been wrought in the attitude of American physicians toward hydrotherapy.

Dr. W. H. Draper, professor of clinical medicine, Columbia University, in an address* on hydrotherapy before the New York Academy of Medicine, said: " In persons whose nutrition has been enfeebled by chronic disease, and in neurasthenia, hysteria, and hypochondriasis, its good effects are very striking. It seems to be more effective than any treatment by medicine in stimulating the nerve centres, in restoring the equilibrium of the circulation, and in reviving the activity of the organic functions."

In February, 1889, I presented before the New York State Medical Society the first plea made in this country for the cold (Brand) bath in typhoid fever. It received only condemnation in the discussion which followed. In commenting upon this paper, the *Medical Record* of February 16th, 1889, said editorially: " It will be difficult to persuade the profession to adopt the heroic method of cold bathing." Nine years later the same journal commented editorially in its review of " Typhoid Fever Treatment" (May 7th, 1898), as follows: " Advocates of the bath treatment seem to be increasing in number; it is generally conceded that excellent results are to be obtained by judicious cold-water treatment, and the closer the Brand method has been followed the better the reports seem to be." The Brand method is now taught and practised by the most eminent clinicians of America, and an excellent chapter upon it appears in Prof. H. C. Wood's exhaustive " Text-Book on Therapeutics." Hydrotherapy is now regularly practised in many of our metropolitan hospitals in acute diseases. The author introduced its systematic application for chronic diseases in the Montefiore Home for Chronic Invalids in 1887. Many other institutions have since that time had douche apparatuses constructed, and are applying

* Medical Record, April 22d, 1898.

water successfully in chronic diseases. Among these are the German Hospital of Philadelphia, the Elizabeth (United States Government) Hospital at Washington, the Massachusetts State Hospital at Danvers, the Rhode Island Asylum at Providence, besides private institutions in Louisville, Ky.; Sing Sing, N. Y.; Fond du Lac, Wis.; and other places.

Many American health resorts and sanatoria practise hydrotherapy in the old-fashioned hydropathic manner. Recently the German practice of attaching hydrotherapeutic establishments to good hotels at health resorts has been initiated in this country. The Lakewood Hotel (winter) in New Jersey and the Montvert at Middletown Springs, Vt. (a summer resort), have obtained complete hydrotherapeutic equipments, which are superior in efficiency for the correct application of temperature, duration, and pressure, to those which the writer has seen in Germany or France, and which are under the direction of educated physicians.

The author has established a hydriatric department in the Riverside Baths, to which many physicians and several dispensaries send obstinate cases for treatment. Bellevue Hospital has also followed this initiative. The Park Avenue Hydriatric Institute of this city, which was inaugurated in 1892, for the purpose of promoting the use of hydrotherapy in chronic diseases, has administered over forty-five thousand treatments to patients referred by over one hundred physicians. It is to be hoped that such institutions may multiply in our cities, and that they may always be under the direction of educated physicians, and not be "run" by masseurs and bath nurses, who have so often brought hydrotherapy into disrepute among physicians (see Vogl, page 414).

These evidences of growing appreciation of the merits of hydrotherapy *among American physicians* offer to the author a gratifying *finale* to this brief historical *résumé* of the subject.

Conclusion.—An unbiassed study of the entire history of hydrotherapy develops the fact that the great clinical teachers of the present day reaffirm their faith in a method of treatment which has received the highest sanction from Hippocrates, Asclepiades, Celsus, Hufeland, and Currie. For a long period the medical profession had received its chief information on water from men who, though honestly striving for the propaganda of water as a remedy, were regarded as enthusiasts whose views were probably tinged by prejudice in favor of their methods of practice. Some faint shadows of the bitter but just prejudice which Priessnitz and Hancocke and their ignorant and blatant followers had aroused in the minds of medical men still seem to fall upon those who attempt to secure attention to hydrotherapy. *To remove this fallacious and mischievous idea is one of the aims of this work.*

The testimony of clinical observers, *not* connected with hydrotherapy

as a specialty, has therefore been cited to define clearly its status at the present time, as evidenced in the clinical portions of this work.

History has repeated itself here as in other departments. The *opinions of the most judicious, philosophical, and successful physicians of past ages have been sustained by the judgment of this enlightened era.*

The student of the history of hydrotherapy must observe that it has passed through many cycles in the estimation of physicians. It would be profitable to ascertain the causes of these fluctuations in order to avoid their adverse influence in the future.

Just as among the ancients we find among the most renowned physicians the most active advocates of water as a remedy, so does its history in modern times develop the same fact. The simplicity of this remedy, however, antagonized the pedantic and self-important members of the profession. When laymen, who must have learned its value from observing its effects in the hands of physicians, espoused it, the latter became entirely estranged. Thus did it come about that Priessnitz created a sect, the hydropaths, whose influence for the popularization of the treatment was in inverse ratio to its adoption by the profession. And *this blighting effect of the empirical espousal of water as a remedy is to-day mainly responsible for the aversion which many physicians feel to its adoption.* This aversion is least pronounced in France, because that country has not been so extensively invaded by the water quack, and its hydrotherapeutic institutions are under the care of educated physicians. In Germany, too, where Ziemssen, Brand, Jürgensen, Winternitz, and others have labored to prepare a scientific basis for hydrotherapy, prejudice is rapidly disappearing among the rank and file of the medical profession. This is also the case in Italy.

In England and America, however, much agitation will be required to induce physicians to wrest this valuable therapeutic agent from the hands of the empirics, to whom their indifference appears to have delegated it.

Are we, as medical men, just to ourselves or to those who intrust their lives and health into our keeping, in maintaining an indifferent attitude? Calm reflection must bring us to realize the fact that the application of water in disease is the most orthodox therapeutic measure in medicine, having (as I have shown) been fully treated by Hippocrates, and taught by the most eminent and judicious men who have illuminated medical history, and that therefore hydrotherapy deserves to be liberated from the absurd and undeserved stigma of relationship with empiricism.

The excessive medication, combined with blood-letting, which, as referred to above, characterized the practice of medicine in the early

part of this century, gave way to what was termed therapeutic conservatism. The writings of Bigelow and Flint in this country, and of Dietl, Wunderlich, and others in Europe, developed the expectant method of treatment, which aided the system in its battle against disease instead of fighting the latter at the expense of the former. The therapeutic nihilism resulting from the abandonment of excessive medication causes many physicians, especially in Germany, to shrug their shoulders when discussing treatment, while they glow with enthusiasm when the bacteriological or pathological aspect of the case is considered. As a result of this indifference to therapeutics, a sect of "nature doctors" (Naturärzte) has appeared, who propagate their therapeutic ideas by lectures, books, and periodicals, and thus succeed in driving the physician from the field. The empirics like Priessnitz, Hancocke, Oertel, Pater Bernardo, and their ilk are to-day represented by the followers of Kneipp, who used cold water in the most crude methods, and combined it with herbs and teas, but chiefly depended upon abstemiousness in diet and mode of life. The water procedures of Kneipp are based upon the idea that the body must be forced to produce its own reaction, a correct principle if not indiscriminately applied to patients whose reactive capacity needs gradual training. To neglect of the latter may be ascribed the numerous sad failures reported by reliable observers, but never published by the Kneipp enthusiasts. In this country there are several "Kneipp cures" which eke out an existence. One large company organized last summer has failed to materialize. It would seem therefore that the practical American mind may by proper instruction be held aloof from this fad.

The Lesson.

The study and judicious application of hydrotherapy in regular practice will accomplish more for the protection of the people against the quacks than prosecutions through legal channels. It is not wise, however, to treat the doings of these people with contempt and to shrug our shoulders when their "cures" are brought to our attention. The patient cares little how he is healed; he certainly prefers to be cured by the empiric to being kept in continuous pilgrimage to the scientific doctor's office. A correct diagnosis does not interest a sick man so intensely as correct treatment.

Necessity for Instruction in Hydrotherapy.

The author hopes to bring the medical profession to a realization of the danger which by reason of their indifference threatens them and their *clientèle*, by presenting the above brief *résumé* of the history of

water as a remedy. He would urge most earnestly a careful, conscientious, and thorough investigation of its physiological and clinical claims, and the introduction of means for better instruction of medical students in the theory and practice of hydrotherapy. Happily some of the most earnest teachers in Germany are now making an effort in this direction.

The addition of hydrotherapy to the clinical curriculum has recently been agitated in the German Parliament.

The medical director of the Bavarian army, Dr. A. Vogl, has recently* recommended the instruction of medical officers of the army in hydrotherapy, and has induced his government to send a number of army surgeons to the Hydrotherapeutic Clinic of Professor Winternitz, in Vienna, for this purpose.

Vogl regards "the insufficient education of medical men in physical therapeutics, especially in hydrotherapy, as a serious defect, which injures physicians in their earlier practice, and for which it is difficult to compensate later." He justly holds that "hydrotherapy should be taught in its entirety, as Winternitz has done, upon a physiological basis. By lectures and clinical demonstrations it should be brought before the student just as other therapeutic agents and methods are offered to him—as obligatory branches of study. When this is done, hydrotherapy will become the general property of all physicians, and not be practised as a special and distinct method."

Professor Kussmaul writes in a recent brochure:† "It cannot be denied that the faith in prescriptions is waning among educated people and that confidence in dietetic remedial methods and in the curative power of water is in the ascendant."

"Even the lower strata begin to realize how much may be accomplished with air, water, and proper regulation of habits of life without the use of medicine. A distrust against even the most powerful and indispensable medicinal agents is becoming more pronounced in large circles. Water is the chief agent, which has won steadily growing confidence as a remedy, because, unlike every other, it may be utilized in varied and changing temperatures and forms of application, for the most varied therapeutic purposes. According to the correct and skilful selection of the procedure, it regulates the circulation and distribution of blood, the production of heat and tissue change, and influences the respiration and the nerves.

"The treatment by water has passed its childhood days, when it still staggered upon feeble limbs, and not infrequently did as much damage

* Münchener medicinische Wochenschrift, No. 27, 1896.

† "Ueber den commissarischen Entwurf zur Revision der deutschen medizinischen Prüfungsordnung," 1896.

as is done by improper medication. Ripened experience and physiological knowledge have fortified the treatment and rendered it safe. *Hydrotherapy, combined with diet, may undoubtedly bring about, or aid in the cure of numberless acute and chronic diseases.*

"Of hydrotherapy the young physician knows almost nothing when he leaves the university. Unfortunately he sooner or later may encounter discomfiture when an uneducated water doctor steps in and cures the patient after he has failed. Deeply chagrined and disappointed in his confidence in scientific therapeutics, he may pass into the camp of crude empiricism.

"Here lies a great gap in the education of our physicians; here lies the real cause of weakness in the contest for the favor of the public which sooner or later must be encountered by the physician with the layman who may have gotten experience in water treatment or be naturally adapted for it. A revision of our course of study must be made, above all things.

"The teacher of clinical medicine has now so many duties to perform in his work of instruction that no time is at his disposal for familiarizing his students with hydrotherapy. In order to instruct them more than superficially, distinct chairs and clinical divisions are required, in which appropriate cases may be treated by hydrotherapeutic procedures. These lectures could be combined with others on balneology and purely dietetic treatment, but, for Heaven's sake, let not this professorship be connected with that on pharmacology!"

In this connection the views of Professor Vierordt, of the Heidelberg University, are of great interest, as showing that the seed which Winternitz many years ago sowed is now about to reach fruition in his own country. Vierordt says: "All signs indicate that hydrotherapy will succeed in obtaining a distinct and clear position in medical science, and that it will correspondingly reach the consideration in medical instruction to which it is entitled. Hydrotherapy can be taught only practically, because it must be applied more individually than any other therapeutic agent."

Professor Vierordt* has established an arrangement for baths, douches, massage, etc., in connection with his polyclinic, where trained attendants apply them under strict medical supervision with regard to temperature, duration, and force. One of his assistants resides near the institution and watches over its work. "All expectations have been amply fulfilled. It is utilized for instruction of small groups of students in the polyclinic, who thus learn practically, under the personal supervision of the professor and his assistants, the indications for and application of the more simple and useful hydriatric methods. Experi-

* Deutsche medicinische Wochenschrift, 1897.

ence gathered in this small institution warrants the recommendation that facilities for ambulant hydriatic treatment should be connected with every medical polyclinic, for the benefit of patients and students alike. *Hydrotherapy should be included in medical instruction,* not as a specialty; it should be brought completely into the domain of our scientific curative agencies by the careful selection of procedures and of cases to which it is adapted."

Professor Credé* also insists upon the necessity of applying hydrotherapy and other physical remedies in the hospitals, and pleads for instruction in these branches in the universities. He claims with justice that "if physicians were better versed in these branches, the field of operation of many quacks would be greatly curtailed."

In America also a plea for instruction in hydrotherapy has been published. Dr. Frederick Peterson, chief of the Neurological Clinic in the College of Physicians and Surgeons, Columbia University, writes:† "Many of the scientific principles of hydrotherapy have already been established, but it would be well worth while to carry out at a few of our clinics and in the physiological laboratories some of the elaborate experiments with water which are frequently resorted to for the purpose of demonstrating the uses of new drugs. It would be well if some of our large schools would initiate a course of lectures on this subject."

It is unnecessary to add anything to the pleadings of these recognized teachers, with whose views the author is in entire accord. My personal intercourse with many physicians affords daily illustration of the truth of their statements and the correctness of their views. I would most earnestly commend to the consideration of the faculties of our progressive medical schools the example of the Universities of Vienna and Heidelberg.

* Berliner klinische Wochenschrift, 26, 1895.

† American Journal of the Medical Sciences, February, 1893.

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