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(undated by topic)

Hydrotherapy
HYDROTHERAPY

HISTORICAL.

Water is without doubt the most ancient of all remedial agents for disease. This fact is evidenced by the frequent reference to its use in the most ancient medical literature and in the facts of the habits and customs of the most ancient peoples which have been revealed within recent years by the study of ancient Assyrian and Egyptian records. The reason for this is clearly to be found in the fact that water is an agent always found ready for use, and adapts itself to almost every imaginable pathological condition in a most remarkable manner, approaching more nearly to a panacea than any other known medical agent. No other agent is capable of producing so great a variety of physiological effects, none is so universally present and hence there is none so readily available for meeting the various exigencies and indications arising from accident and disease.

The ancient Egyptians, Hebrews, Greeks, Persians, and Hindus all made use of water as a remedy in disease, as do the representatives of those ancient people at the present time.

According to an ancient Chinese record, dating back several centuries before Christ, a physician prescribed for a woman of that country 100 affusions of ice-water, each followed by wrapping in a linen sheet, a principle of treatment in principle resembling the wet sheet pack.

Among the Spartans of ancient Greece, cold bathing was made obligatory by law.

Hippocrates gave many excellent directions for the use of cold water, which the experience of two thousand years has not improved upon. He had an excellent understanding of the physiological properties of water, both hot and cold, which he employed in the treatment of fevers, ulcers, hemorrhages,
and a variety of maladies both medical and surgical.

Hippocrates directed that cold baths should be of short duration and should be preceded and followed by friction, and he evidently understood the phenomena of reaction, since he records the observation that after a cold bath the body quickly recuperates its heat and remains warm, while a hot bath produces the opposite effect. Even the mythology of the Greeks recognised the bath in various forms, and hot and warm baths were almost universally dedicated to Hercules.

Under the Romans the bath attained a very high degree of development. Emperors vied with one another in erecting magnificent structures in which many thousands of persons might daily enjoy hot or cold water baths, hot air and vapor baths, &c. The ruins of these ancient structures are among the most notable relics to be found in Italy at the present time. In studying these interesting remains a few years ago at Rome and Pompeii, the author was astonished to find the perfection attained in every detail of the equipment of these ancient bathing establishments.

Asclepiades employed water in nearly every form, hot and cold baths, douches, compresses, etc. One of his disciples, Antonius Musa, attained great fame through the cure of the Emperor Augustus of a chronic catarrh by means of the cold bath, as a reward for which his statue was ordered to be erected in the temple of Esculapius. But a lack of discrimination in the use of this powerful agent led to his downfall. Being called upon to treat the emperor's nephew, Marcellus, a favorite, the measure which had resulted so admirably in the cure of the athletic old soldier proved too powerful for the effeminate youth, and he was prostrated to such a degree that he died soon after at Naples, where he had gone to receive treatment at the hot baths of Baia, by means of which he hoped to counteract the evil consequences of his cold-water-cure experience.
Paster Kneipp, the Bavarian empiric, a few years ago had a similar experience. Being called upon to visit the Pope, who was suffering from chronic rheumatism, he was received with great honors, but the first cold bath given the aged prelate, who was little accustomed to such rough usage, occasioned such an exacerbation of his sufferings, that the poor priest was promptly dismissed in disgrace. If the patient had been a young and sturdy German peasant instead of a feeble Italian priest, his prescription might have succeeded better. A similar lack of discrimination, whether the prescription be made by a charlatan or by a legally qualified practitioner, is always attended by disastrous results. The untoward effects thus produced should not, however, be attributed to scientific hydrotherapy, but must be charged to the stupid audacity of quackery, or to the lack of information or experience of the otherwise competent physician.

According to Pliny, the bath was almost the exclusive method of treatment employed in Rome during five centuries, according to tradition, and other Roman physicians highly extolled the bath in their works, and the former later made the bath one of the three essentials of what he called a perfect therapeutic system, termed "Apotheoraphia," the other essentials being exercise and friction. Modern science offers nothing superior.

During the middle ages, the Arabic physicians, the most learned men of their age, were most enthusiastic advocates of the bath, especially in fevers, and their directions for the treatment of smallpox and measles could scarcely be improved upon at the present time. Rhazes recommended a drink of ice-water to the extent of two or three pints within half an hour, as a means of reducing temperature in fever. Avicenna prescribed cold water for the relief of constipation. Lanzani, an Italian physician, wrote an elaborate thesis on the internal use of water for the treatment of fevers, in the early part of the last century. Fra Bernardino, about the same time, acquired the name of the "Cold Water Doctor" by the use of iced water in the treatment of indigestion, nervous disorders, hemorrhages, etc. He required
But during the Dark Ages, this most valuable of all
remedies, suffered the enormous fate of so many more of the precious
treasures won by ages of costly and
dearthful human effort—5, and within
the last two centuries appeared again
as a rediscovery.
his patients to drink from three to six gobleets of ice-water daily. He 
avoided sweating and aimed to stimulate the bowels and kidneys.

Floyer, who also lived in the early part of the last century, 
gave systematic rules for the use of cold water both internally and
externally.

We quote below a few interesting extracts from a small work
entitled, "Primitive Physick", by John Wesley, M.A., the founder of the
Methodist Church, published in 1747, which afford ample evidence of the exist-
tence at that period among the common people of a very considerable amount of
knowledge respecting the use of water in a variety of ailments, as well as
for the preservation of health. Since the remedies recommended in Wesley's
work were all such as we found in successful use among the people.

For Ague, Intermittent Fever.—"Go into the cold bath just before the
cold fit". (This method is still in use in Germany and France), or "Drink
a quart of cold water just before the cold fit, then go to bed and sweat."

For a tertian ague, it is recommended to "use light and sparing
diet on the day between," "Or use the cold bath (unless you are of an adv-
anced age and extremely weak); a wise precaution showing little experi-
ence);"

But when you use this, on any account whatever, it is proper to go in cool,
to immerge at once, but not head foremost; to stay in only two or three
minutes (or less at first); never to bathe on a full stomach; to bathe
twice or thrice a week at least, until you have bathed nine or ten times;
to sweat immediately after it (going to bed), in palsy, rickets," etc.

"Before the cold fit begins, go to bed, and continue a large sweat
by lemonade for six or eight hours. This usually cures in three or four
times. If it does not, use the cold bath between the fits." The writer
found this method in use among the farmers of the western part of the United
States more than a quarter of a century ago and with success in cases in
which quinine and other antiperiodics failed to effect a cure.
For apoplexy, "To prevent, use the cold bath, and drink only water."

For asthma, "Take a pint of cold water every morning, washing the head therein immediately after, and using the cold bath once a fortnight."
"For present relief, vomit with a quart of more of warm water; The more you drink of it the better."

For dry or convulsive asthma, "Use the cold bath thrice a week.
To prevent swelling from a bruise, immediately apply a cloth five or six times doubled, dipped in cold water, and new dip when it grows warm."
"To cure a swelling from a bruise, foment it half an hour morning and evening with cloths dipped in water as hot as you can bear."
"For a burn or scald, immediately plunge the part into cold water. Keep it in an hour or if not well before, perhaps four or five hours."
"To prevent the rickets, tenderness, and weakness (in children), dip them in cold water every morning, at least until they are eight or nine months old."

For whooping-cough, "use the cold bath daily."

For cholera morbus, "drink two to three quarts of cold water, if strong, or of warm water, if weak.

For a cold, "drink a pint of cold water, lying down in bed."
For colic, "drink a pint of cold water; or a quart of warm water, or (apply) hot water in a bladder, or steep the legs in hot water a quarter of an hour."

For hysterical colic, "use the cold bath. Using cold bath two and twenty times a month entirely cured hysterical colic, fits, and convulsive motions."

For chronic headache, "keep your feet in warm water a quarter of an hour before you go to bed, for two or three weeks."

For headache from heat, "apply to the forehead cloths dipped in cold water for an hour."
"For one seemingly killed with lightening, a damp or suffocated plunge him immediately into cold water."

For mania, "apply to the head, cloths dipped in cold water; or pour cold water on his head out of a teakettle; or let him eat nothing but apples for a month."

For rheumatism, "use the cold bath with rubbing and sweating."

For rickets, "wash the child ever morning in cold water."

For sciatica, "use cold bathing and sweat, together with flesh-brush twice a day; or drink half a pint of cold water daily in the morning, and at four in the afternoon."

For stone, to prevent its occurrence, "drink a pint of warm water daily just before dinner."

For swelling of the joints, "pour on the part daily a stream of warm water; or a stream of cold water one day, and warm water the next."

Wesley recommended cold bathing for the cure of nearly all the affections of childhood, all chronic diseases, and many surgical cases.

"It is also useful to use the hot bath a few days before you use the cold."

It is interesting to note the sagacity and wisdom displayed in many of these recommendations which in many instances could scarcely be improved upon at the present day. They evince extended and accurate observation of the effects of hydraulic applications of water.

It is very interesting to note how few of our modern methods of employing water are really new. The moist compress, used in so many ways by Priessnitz, was well known to the ancient Greeks under the name of "apithea."

According to Sir John Floyer, the wet sheet pack was employed in his time by sportsmen who wished to diminish the weight of their jockeys by sweating. The method is thus described:

"Dip the rider's shirt in cold water, and after it is put on very
wet, lay the person in warm blankets to sweat him violently, and he will lose a considerable weight, a pound or two."

This same method was used in the treatment of various maladies, particularly cases of rickets in children. The child, being prepared for bed with a gown and night-cap, was quickly immersed in cold water, then put to bed closely wrapped in warm blankets and left in this condition all night, sweating profusely, a portion of the clothing being removed toward morning so that the body might be gradually cooled. That this method was employed with great perseverance is shown by the following suggestion which the learned author makes: "If one year's dipping proves not essential, it is repeated the next year, which generally answers expectations."

Floyer also mentions that in Staffordshire and other portions of England, it was a custom with the people "to go into the water in their shirts, and when they came out, they dressed themselves in their wet linen, which they wore all day, and much commended that for closing the pores and keeping themselves cool; and that they did not commonly receive any injury or catch any cold thereby, I am fully convinced from the experiments I have seen made of it."

The leading features of the so-called "Kneippism" are simply a revival of these rude practices of ignorant English peasants a century and a half ago.

Sir John Sinclair in his "Code of Health and Longevity" gives an account of an English nobleman, born in the year 1700, who, for a great part of his life, was accustomed, immediately on arising in the morning, to wrap himself in a sheet just dipped in cold water.

In the 15th century Savonarola, an Italian physician, made a systematic use of the cold bath, and Bariszi employed the cold vaginal douche in uterine affections. Cold infusions and general douches were employed by Baccio in Italy, while leading Spanish and German physicians
recommended cold applications for insomnia.

Septula employed the cold douche for the relief of headache and sunstroke in the 17th century.

Herman, a Belgic physician, resorted to the use of cold water at the same period for the relief of constipation, migraine, paralysis, and mania.

In 1697, Floyer, published a history of cold bathing, in which he directed that the patient should be made to sweat before taking the cold bath, by wrapping him in a wet sheet with blankets, precisely the same method employed more than a century later by Priesanitz and now known as the wet-sheet pack. Floyer also erected a water-cure establishment at Litchfield, England, in the latter part of the 17th century, more than a hundred years before Priesanitz. Two rooms were provided: hot baths in one, and dry packs to produce sweating, cold baths in an adjoining room.

John Hancock published a work entitled "Water the Best Cure in Fevers", in 1772, more than a century ago before Currie and Jackson in which he demonstrated the value of water drinking as a means of treatment in scarlet fever, smallpox, and measles. He cured ague by sweating with cold water, that is, by having the patient drink quantities of cold water while wrapped in blankets.

Sir John Chardin, a celebrated English traveler of the last century had "bilious remittent fever" when in Persia. His companion, a French surgeon, thought his case hopeless. A native physician was called in who made him fast five days and drink large quantities of water previously cooled with snow, had him lie upon a mat wet with water, kept the skin being constantly wet with water. Water was also poured at intervals over the patient while two men supported him. In two days the fever disappeared. This native Persian physician evidently had a knowledge of the value of water drinking, the evaporating bath, the affusion as means of combating fever, invaluable information of which western physicians are scarcely yet making any considerable practical use.
The native physicians of Mohammedan countries still generally follow Galen and so make use of water in many maladies in a very effective and practical way.

In the latter part of the last century two English physicians, Currie and Jackson made a most intelligent and scientific study of the use of water in fevers and with results which for a time commanded much attention from the profession in England. For some reason, not easily understood, the work of these able pioneers of a scientific method of inestimable value in febrile disorders was lost sight of and it was not until the attention of the whole civilized world was attracted by the fame of uneducated and blundering, but still successful, cold-water empiric that the profession began to give this agent the serious attention due it.

The modern popularity of water as a remedy must be without doubt largely credited to the enterprise and ingenuity of a Silesian peasant, Vincent Priessnitz, born in the little village of Grafenburg, in eastern Silesia, in 1799.

When seventeen years of age, Priessnitz met with an accident whereby he received numerous bruises and other injuries, including fracture of two of his ribs. Local physicians gave him no hope of recovery; but having been accustomed to use water in the treatment of domestic animals for which he cared, it occurred to him to try the same remedy for himself. He covered the affected parts with cloths kept moist by cold water, and also drank freely of water, with the result that he was in a short time completely cured.

This incident made so profound an impression upon the mind of Priessnitz that although an unlearned peasant, he determined to make a thorough investigation of the merits of water, employed both internally and externally as a remedial agent. He seems even to have undertaken some experiments on animals, for, according to Fleury, he studied the
effects of hot and cold foods upon two pigs, one of which was fed
upon cold, the other upon hot foods, making, when the animals
were killed, a careful examination of the intestines. He asserted
that he found in the case of the animal fed upon cold foods the in-
testines well contracted, pale, and of firm resisting structure, while
in the case of the animal fed upon hot food the intestines were found
red, relaxed, and so easily torn that they could not be used for making
sausage.

The basis of the system of Priessnitz was perspiration, followed
by cold applications. His methods were exceedingly crude and were
administered with comparatively little discrimination—the natural result
of his total lack of medical knowledge. However, his native tact and
sagacity soon led him to recognize a difference in the ability of his
patients to "react" to cold applications and he accordingly made it a
uniform practice to observe in each case the effects of the first application,
the readiness with which the patient yielded to the means adopted to in-
duce perspiration, and the promptness with which reaction took place on the
application of cold water.

Priessnitz discovered little perhaps, but he succeeded in calling
general attention to the efficacy of various simple methods of applying
water as a remedial agent, which had previously been little appreciated. He
accomplished more than this. He succeeded in curing a vast number of chron-
ic invalids whose maladies were practically incurable by the remedial
measure in common use by the medical profession of his time, and
though at first denounced and opposed by scientific physicians because of
his empiricism, sagacious medical men, after a time became convinced of the
genuineness of the cures effected, and many visited him for the purpose
of studying his system, such as it was. Among these was the surgeon-general of France who was put to suffering by

The attention of scientific men, thus attracted, led to a careful
study of the physiological effects of water in its various modes of appli-
cation for the purpose of finding a scientific foundation for its therapeutic use. Among the first to undertake an experimental study of the effects of water upon the human body was Fleury, who published in 1852 the first extended scientific treatise upon hydrotherapy, under the title, "Traité pratique et raisonné d'hydrothérapie."

We must not, however, omit to note the fact that published in 1301, a very interesting dissertation (a copy of which the writer has in his collection of works on hydrotherapy), upon cold, neutral and hot baths, based upon experimental data. The observations made were highly creditable to the author and agree perfectly with those since made by so many different investigators. It is to be regretted that the interesting work begun at this early period in America was not carried to completion.

John son and Gully in England, Bell in American, and above all, Winternits of Vienna, supplementing the work of Fleury, have within the last three quarters of a century built up a scientific hydrotherapy, which is based upon definite and accurate data. Before Fleury, the use of water was for the most part empirical; at the present time, thanks to the labors of the eminent investigators whose names have been mentioned, supplemented by the important work of Jurgenson, Rosbach, Liebermeister, Delmas, Robin, Henocque, BeniBardi, D'Arsonval, and others it may be fairly said that there is no therapeutic agent the use of which rests upon a more thoroughly rational and scientific basis than water, and there are few if any therapeutic or hygienic agents the physiological effects of which have been so elaborately and comprehensively studied.

Thanks to the attention which it has received from scientific men through extended and laborious researches, water has been rescued from the hands of empirics and charlatans, and has come to be recognized by eminent medical men as one of the most potent of all remedial agents,
ANATOMY AND PHYSIOLOGY IN RELATION TO HYDROTHERAPY

There is no remedial agent the scientific use of which demands so thoroughgoing and practical a knowledge of physiology as does hydrotherapy. Used empirically, water is certainly less likely to lead to disastrous results than medicinal agents, the terrible consequences of the unscientific use of which are only too forcibly illustrated in the enormous damage resulting from the extensive use of patent medicines. Nevertheless, water is an agent, which, like powerful drugs, is a two-edged sword, and its unscientific use has not infrequently resulted in most untoward effects. Indeed, it may well be believed that the very general prejudice prevailing against the use of water among physicians as well as among the laity, is largely due to the injurious results which have followed the bungling and unsuccessful use of this invaluable agent by so-called "water-cure doctors," and well-meaning, but unfortunately not well informed enthusiasts, who, having themselves experienced good results from the use of this simple and versatile therapeutic agent, have with best intentions but not infrequently with only the saddest results undertaken to cure all their sick friends by means of the same prescription which gave them relief.

It is only by an exact knowledge of the human body, its normal functions, and the modifications of tissue and function resulting from disease, that water can be therapeutically employed with the universally satisfactory results which this agent is capable of rendering. Not all cases, of course, are curable, but even in incurable cases it is marvelous to note the wonderful degree to which pain and various other symptoms may be mitigated by accurately adapted hydrotherapeutic prescriptions.
To use water intelligently, one must be a thorough
physiologist, and must and must have an especially good understanding
of the anatomy and physiology of the skin and the nervous system. For
the convenience of the reader, and that he may have freshly in mind
these anatomical and physiological facts which are most essential
to an understanding of the general principles of hydrotherapy, this
chapter is devoted to a brief summary of the anatomy and physiology of
the skin and nervous system, so far as it is particularly concerned
in the phenomena accompanying hydrotherapy, and of the function of animal
heat.

THE SKIN AND ITS FUNCTIONS. As an understanding and appreciation of the skin
and its functions is necessary to a correct comprehension of the principles
of hydrotherapy, since in by far the greater share of the medical
uses of water, the skin is involved, we will devote a few paragraphs to
the review of the anatomy and physiology of this remarkable organ.

Anatomically, the skin is a structure about one-eighth of an
inch in thickness, consisting of white and yellow elastic fibers, in which
is suspended a countless number of glands, blood vessels, and nerves. The
whole is covered with cells joined by a cement substance. The area of the
skin is about seventeen square feet.

Scattered through the superficial layers of the skin, just
below the epidermis are cells containing pigment, which are especially
abundant in the dark races.

The deeper layers of the skin contain, in certain portions of the
body, especially on the extensor surfaces, an abundance of smooth muscular
fibers, which are capable of contractions, or puckering, the mm skin.

The nails and hairs are appendages of the skin growing from pouches
in this structure, and are simply modifications of the horny layer.
The Sweat.—The sweat glands are, in man, present almost everywhere in the skin, and are largest and most numerous in the skin covering the palm of the hand, sole of the foot, forehead, and axilla. There are very few sweat glands covering the back, and these glands are absent at the margin of the lips. Each sweat gland receives an artery and a number of nerve filaments, and has a duct through which its product is discharged upon the surface.

The total number of sweat glands is about two and one-half millions. The perspiratory ducts present a surface of nearly eleven thousand square feet. The amount of perspiration produced daily is about two pints, or 1/64th the weight of the body, and double the amount of water thrown off by the lungs.

The degree of activity of the sweat glands are recognizable: viz.

1. Ordinary, so-called insensible perspiration, in which the quantity is so small in amount that the water and volatile constituents of the sweat are evaporated as rapidly as formed; 2. Sensible perspiration; profuse perspiration, in which the amount of secretion produced is so abundant that it appears in drops, or minute streams coursing over the surface.

The function of perspiration presents in different animals some interesting variation. The horse sweats, as does man, over the whole surface. The same is true of the ox but to less extent. In the cat or hedgehog, sweating is confined to the soles of the feet. Apes sweat with the palms of their hands. In the pig it is the skin covering the snout which sweats. The goat, rabbit, rat, and mouse do not sweat.

Conditions which control the secretion of Sweat. The secretion of sweat is increased by the following agents and conditions:

1. Increased temperature of the surrounding medium as by contact of hot air, hot water, or other heated substances with the skin. Water is
122° or above arrests the action of the sweat glands.

2. A dilute condition of the blood, such as results from copious drinking of water, especially of warm water.

3. Increased action of the heart, with rise of blood pressure.

4. Increased temperature of the blood. The sweat centers are excited by a rise of temperature amounting to 7° F.

5. Exercise, which increases the activity of the skin, not only by increasing the activity of the heart, but by raising the temperature of the blood, and thereby stimulating the sweat centers. The temperature may be raised by violent exercise to 104° F.

6. Percussions and friction.

7. Certain drugs.

8. Stimulation of the secretory nerves by electricity, or other means. Physiological experimentation has shown that there are special sweat centers, and nerves. The sweat nerves of the hind leg of a cat lie in the sciatic nerve. Stimulation of this nerve has caused sweating in the sole of the foot of a cat forty-five minutes after death. Mustard held in one side of the mouth will cause perspiration of the skin of the face of the same side.

The centers of the sweat nerves for the palms lie in the brachial plexus. Sweat nerves of the head ascend in the cervical sympathetic. Stimulation of the cervical sympathetic of one side causes sweating of the face and arm of the corresponding side. Sweating is also produced by stimulation of the infraorbital nerve.

The small blood vessels are usually dilated through excitement of the vaso-dilator nerves in conjunction with sweating; but sweating may occur with pale skin, the result of fear, pain, or the death agony.

Stimulation of the motor nerve causes sweating of the skin over the muscles supplied by the nerve, and of the same area of the opposite side of the body, and independent of any change in the circulation.

9. Mental excitement, as in hysteria and neurasthenia, often
gives rise to sweating, especially of the head and hands, sometimes of one side of the face only.

10. Profuse perspiration occurs as a symptom in certain diseases, as intermittent malarial fever, phthisis and acute rheumatism.

11. The appearance of sensible perspiration is encouraged by a moist warm atmosphere, in consequence of the lessened rapidity of evaporation.

Perspiration is decreased by:

1. Cold.

2. By a profuse water discharge from the kidneys or bowels. The skin and the kidneys seem to act reciprocally. When the secretion of one organ is increased, that of the other is decreased. In warm weather the volume of urine is usually diminished, in cold weather increased. The opposite is true of cutaneous secretion.

3. Certain drugs, as atropia.

4. Certain forms of disease, as in some cases of paralysis, diabetes, cancer, and many cases of chronic dyspepsia.

Perspiration is one of the most important methods by which the danger of excessive accumulation of heat within the body is averted. When the skin fails to perform this important function, as is not infrequently the case in fever, the bodily temperature often rises to a most dangerous degree.

Toxins of the Sweat. Not only uric acid, but more subtle and potent poisons are found in the sweat, as shown by the investigations of Souchard. Perhaps the most important of all these is a peculiar substance which manifests its properties by inducing a fall of temperature. The retention of this substance in the body may cause death, shown by the effects of varnish of the skin of an animal.

In diabetes, the sweat usually contains grape sugar. Sweat from bad-smelling feet contains leucin, tyrosin, and ammonia. The sweat of rheumatism may contain albumen, and that of puerperal fever lactic acid.
Bloody sweat occurs in yellow fever, and bile pigments are found in the sweat in cases of jaundice.

Chromogenic microbes may give rise to red, blue, and yellow coloring matters in the perspiration. Arsenious acid, mercuric chloride, and other toxic substances have been found in the sweat after internal administration.

The Sebaceous Glands. -- Fat-making glands are found in connection with both the coarse and fine hairs of the skin. They are absent only where hair is also absent, from the palms of the hands and soles of the feet, and are largest in the skin and the nose and the labia.

The purpose of these glands is to oil the hair and the skin. The layer of oil covering the skin protects it from excessive loss of heat. Covering the skin with oil hinders radiation, and is a method adopted by swimmers for protection. It is also much used by mountaineers in cold regions.

A minute band of involuntary muscular fibers is connected with each hair, one end being attached near the bottom of the hair pouch, the other to the skin in such a way as to form an acute angle with the hair. The sebaceous gland connected with each hair lies in the angle between this muscle and the hair. By contraction of the muscle, the hair is partially straightened and lifted up, slightly elevating the skin near the hair and compressing the gland and thus emptying it of its secretion.

Absorption of the Skin. -- The skin absorbs substances in watery solution only with difficulty on account of the oil on the epidermis and in the perspiratory ducts. Solutions administered in a fine spray, and substances dissolved in oil and rubbed in, are more readily absorbed. Absorption takes place readily when the oil of the skin is removed by ether, chloroform or alcohol. By means of a galvanic current, absorption of watery solutions of iodide of potash, strychnia, and other drugs may
be affected — cataphresis.

Cutaneous Respiration. — Respiration by the skin in man varies in different individuals, from one-half to one per cent of the total amount of oxygen received by the body. A somewhat less proportion of CO₂ is eliminated through this channel. In frogs, and some other closely related animals, the skin eliminates from two thirds to three fourths of the total amount of CO₂ excreted, and hence is a more important respiratory organ than the lungs. Dipping a frog in oil and thus suspending cutaneous respiration, kills it quicker than ligature of the trachea. Some creatures, as the earthworm, breathe wholly by the skin.

Respiration by the skin occurs through the thin walls of the per-spiratory tubules. Cutaneous respiration is most increased by rise of internal temperature, by increased cutaneous circulation, by circumstances which hinder lung respiration as asphyxia or dyspnea and during digestion.

Nervous Functions of the Skin. — The nerves of the skin are greater in variety and consequently in function, than those of any other portion of the body. The skin is without doubt the most important of all the sense organs. The several sets of nerves which supply it may be enumerated as follows:—

1. The two sets concerned in the tactile sense,—those which recognize respectively pressure and locality.
2. The two sets of nerves concerned in the temperature sense, which terminate in the skin in the so-called hot spots and cold spots.
3. Nerves which recognize pain.
4. Vaso-constrictor nerves.
5. Vaso-dilator nerves.

In all eight distinct sets of nerves which connect with corresponding nerve centers.

In making applications to the skin, the effects upon each one
of these several sets of nerves must be taken into consideration. It
is evident that those areas of the skin which possess the richest
nerve supply that must be most profoundly affected by hydrotherapeutic
applications and most capable of producing reflex through their connection
with the internal viscera by means of their centers of origin.

The Tactile Sense.-- The acuteness of the pressure sense in different
parts of the body is in the following order, beginning with the most
sensitive, -- the forehead, lips, cheeks, and temples, the back of the fingers
and forearm, anterior surface of the leg and thigh, the back of the feet,
the toes, the sole of the foot, and the posterior surface of the leg
and thigh. The extreme delicacy of the pressure sense is shown by the fact
that the vibrations may be felt when exceeding the Hz rate of 1500 per
second. This fact emphasizes the importance of giving careful attention
to the exact regulation of pressure as well as temperature in hydro-
therapeutic applications, a matter which has generally received less
consideration than is necessary for accurate and reliable results.

The nerves of touch are connected with the motor centers con-
trolling the muscles of the corresponding parts. Rumpf has shown that
increased sensibility of one part, whether produced by application of heat
or otherwise, is accompanied by a lessening of sensibility in the correspon-
ding region of the opposite side.

The Temperature Sense.-- This is one of the most interesting
of the functions of the skin, and the most one most directly involved
in hydrotherapy, as many of the most profound effects are the result
of the influence of thermic applications upon the temperature nerves
and through them upon the whole cerebro-spinal and sympathetic system.

The temperature sense is not uniformly distributed through the
skin, but is confined to certain spots, of which there are two kinds, --
hot spots and cold spots. These are arranged in curved lines or
chains, starting our from the hair roots, near which temperature spots are always to be found. (Fig.____)

Menthol excites the cold spots and so produces a sensation of cold. CO₂ excites the warm spots thus giving rise to a sensation of heat. Hot and cold spots are not sensitive to impressions of pain or pressure. A "leaping" limb recognizes heat only.

The acuteness of the thermal sense differs in different portions of the body, and in the following order the most sensitive being named first: tips of fingers, eyelids, cheeks, lips, neck, arm, back of hand, palm, thigh, leg, back, the back of the foot, the breast, and the palm of the hand have the same degree of acuteness. The more acute surfaces recognize a different of temperature of less than one tenth of a degree F. Regions situated in the median line, as the nose, are less sensitive.

The temperature is estimated higher when a large surface is exposed. Water at 85° feels warmer if the whole hand is immersed than water at 90° in which the finger is dipped. Whether produced by application of warm or cold water, a sudden immersion of the whole body in cold water produces a less unpleasant effect than when the body is introduced gradually.

Cold bodies feel heavier than warm ones. The pressure of a stream of water, as in the horizontal jet douche, feels greater when cold than when warm.

The skin is more sensitive to cold than to heat, impressions of cold being felt at once, while the sensation of heat develops gradually.

Thermic sensations are felt as warm or cold, according as the temperature of the object or medium brought in contact with the skin is greater or less than that of the skin itself; hence the temperature of the skin is the zero of the temperature sense. Objects of a higher temperature than
that of the skin are felt as warm or hot, those of a temperature below that of the skin, cool or cold.

Objects which are good conductors of heat feel warmer or cooler than poor conductors at the same temperature. It is for this reason that hot and cold water makes a stronger impression than air of the same temperature.

The temperature sense is most delicate at temperatures near or a little below that of the blood (80° to 90°). It is less delicate at temperatures below 80° and above the temperature of the body. Impressions of pain are made by a temperature of 130°F.

Temperature impressions are most intense when the difference between the object and the skin is greatest. The strongest impressions are made by alternation of heat and cold. Rapid variations of temperature produce more marked effects than gradual changes.

The sensibility of the temperature sense improves with practice and with diminution of blood supply. Venous congestion of the skin diminishes the temperature sense.

Fatigue of the temperature sense develops quickly.

The nerves of the temperature sense are associated with the heat-generating and heat-regulating centers of the brain and spinal cord.

Vasomotor and Secretory Nerves.— The blood-vessels are supplied with both constricting and dilating nerves, which arise from different centers, located at various levels in the spinal cord. It is through impressions made upon these nerves either singly or in succession that some of the most important effects in hydrotherapy are produced.

The relation of the principal vasomotor centers to the principal surface areas and to the viscera of the chest and abdomen, is briefly stated elsewhere in this work.

Each one of the several million sweat glands and sebaceous glands of the skin is supplied with a secretory nerve which is connected with the
great sympathetic centers and with centers in the spinal cord.

**General View of the Nervous System as Related to Hydrotherapy.** —

The skin, as has been very aptly remarked, is a harp of a thousand strings upon which one who is a master of the necessary means may play in such a manner as to produce almost any desired physiological or therapeutic effect. The skin is the keyboard and the nerves and nerve centers are the internal mechanism. An understanding of the relation of the skin to the nerves and nerve centers, and through them its relation to the internal viscera, is as essential to the physician who desires to employ hydrotherapy intelligently as in a knowledge of the rules of musical harmony and technique to the piano player. It is necessary to know the relation of the nerve endings in the skin with the nerve centers in the brain and spinal cord, and through them with the internal viscera supplied with nerves for the same or associated centers, and hence in special reflex relation.

Applications to the skin are sometimes made for the purpose of influencing the nervous system as a whole, and not infrequently it is desirable that the application should be limited in its effect to some single internal region.

There is no other class of therapeutic agents that require so profound a knowledge of physiology, especially the physiology of the nervous system, and such constant employment of this knowledge as do the various procedures included under the general term hydrotherapy. We have space to call attention briefly only to such physiological and anatomical data as are essential to a proper comprehension of the facts rehearsed in the chapters devoted to the physiological and therapeutic effects of water.

**Nerve Centers.** — While every nerve center in the body is more or less profoundly affected by general applications to the skin, there are four sets of centers which are especially involved, as follows:
1. Sensory centers, located in the brain.
2. Heat centers, located in the brain and spinal cord.
3. Vasomotor centers, located in the spinal cord.
4. Secretary centers, located in the spinal cord and the great sympathetic.

As most of the nerves connected with these ganglia pass into the spinal cord along with the spinal nerves, it is of importance to bear in mind a few facts respecting the relation of the several spinal centers to the spine itself or to the vertebra. These relations may be briefly stated as follows:

1. The eight cervical ganglia correspond to the seven cervical vertebra.

2. The twelve dorsal ganglia correspond in general to the several dorsal vertebra, ending however, with the eleventh.

3. The five lumbar ganglia are located at the level of the twelfth dorsal vertebra.

4. The ganglia of the five sacral and the coccygeal nerves are found at the level of the first and the second lumbar vertebra. In making applications to the spine, it is often essential that the above facts respecting the location of the spinal ganglia should be kept in mind.

The Superficial Reflexes.— As hydrotherapeutic applications are capable of exciting each and all the classes of reflexes which may be set up by stimulation of the cutaneous nerves, it is useful to bear in mind the location of the several reflex areas, and their relation to the special centers. These are as follows:

The scapular reflex area, between the shoulder blades, in relation with the sixth to eighth cervical and first dorsal centers.

The epigastric reflex area, epigastrium, in relation to the fifth to seventh dorsal ganglia.

The abdominal reflex area, the skin overlying the borders of the
recti muscles, in relation to the fifth to the twelfth dorsal centers.

The cremasteric reflex area, inner and upper portion of
the thigh, in relation with the first to third lumbar ganglia.

The gluteal reflex area, skin overlying the gluteal muscles,
in relation with the fourth and fifth lumbar ganglia.

Plantar reflex area, soles of the feet, in relation with the five
sacral and coccygeal ganglia.

In the application of the douche with Strong, the location of the
several reflex areas as described above must be kept clearly in mind.

Vasomotor Nerves.—For controlling vasomotor centers, both con-
stricting and dilating are located in the medulla. Subordinate vasomotor
centers are located in the spinal cord. The vaso-constricting centers
are found chiefly in the cervical and thoracic regions; the vaso-dilator cen-
ters are scattered throughout the cord.

Strong stimuli act on the vasomotor, more moderate on the vaso-
dilator fibers. The vaso-dilator fibers are more easily exhausted than the
vasomoters.

The veins and the lymph vessels are also supplied with vasomotor
nerves, of which at the present time nothing more than their existence
is known; but it is reasonable to suppose that these nerves obey the same
general laws as those connected with the small arteries.

The blood vessels of the head are controlled by vasomotor nerves
from the center in the medulla which pass to the head through the cer-
vical sympathetic.

The lungs receive vasomotor nerves from the second to the seventh
dorsal ganglia.

The intestines receive their vasomotor fibers through the three
splanchnics. The great splanchnic is the largest vasomotor nerve in the
body. Paralysis of the splanchnic causes death from accumulation of blood
in the portal circulation. The same result follows ligation of the portal
vein. This nerve is involved in surgical shock.
Vaso-dilators differ from vaso-constrictors in that they pass directly to the visceral ganglia of the bloodvessels without passing through the prevertebral ganglia.

The arms receive their vasmotor nerves from the middle dorsal region through the first thoracic ganglia of the sympathetic.

The skin of the trunk receives vasmotor fibers through the dorsal and lumbar nerves.

The vasmotor nerves of the lower extremities pass through the lumbar and sacral plexuses to the sympathetic, thence to the lower limbs.

The principal vasoconstrictor and vaso-dilator nerves of the kidney leave the spinal cord with the last three dorsal nerves.

The liver receives its vasmotor fibers from the solar plexus, which derives them from the great hypogastric plexus.

Most of the vasmotor nerves leave the spinal cord between the fifth cervical and first dorsal vertebrae. The most powerful vasmotor nerves are those of the palms, fingers, soles, toes, and ears.

The muscles receive their vaso-dilators through the trunks of the motor nerves.

The Visceral Motor Nerves.—The nerves which excite the peristaltic movements of the esophagus, stomach, and intestines leave the spinal cord in the upper part of the cervical region, reaching the intestines through the pneumogastrics.

The Sympathetic Nervous System.—The sympathetic nervous system consists of three distinct sets of ganglia, namely,—

1. The lateral, or vertebral ganglia, consisting of a series of ganglia arranged along on either side of the anterior surface of the vertebral column, distributed as follows.—three cervical, twelve dorsal, four lumbar, five sacral, one coccygeal. These two chains of ganglia form an ellipse, the ends being joined at the top and bottom in a single ganglion.
They are connected above longitudinally and transversely by intercommunicating fibers.

2. The prevertebral, or gangliated plexuses, consisting of the cardiac, solar, and hypogastric plexuses, or the thoracic, abdominal, and pelvic prevertebral ganglia.

3. Still further removed from the vertebral chain of ganglia are the viseral, terminal, or automatic ganglia, which are found in the various viscera,—the liver, kidneys, spleen, pancreas, intestines, and blood-vessels. In the intestines there are two sets of these ganglia, one between the two muscular layers, Auerbach's plexus, another lying beneath the mucous membrane, Meissner's plexus. The latter controls both the glands and the involuntary muscular fibers of the villi.

**The Splanchnics.**—The vertebral ganglia are connected with the three sets of prevertebral ganglia by visceral or splanchnic nerves, which may be properly termed the thoracic, the abdominal, and the pelvic splanchnics. The thoracic splanchnics are in the chest known as the three cardiac nerves; in the abdomen great, lesser, and least splanchnic. Nerve branches connect the prevertebral ganglia with the automatic ganglia, following the blood-vessels.

**Functions of the Sympathetic.**—Every ganglion is a brain. The vertebral ganglia of the sympathetic seem to be the central ganglia of the system.

The prevertebral ganglia, or gangliated plexuses perhaps as reorganizing centers, receiving impulses from all parts of the body and sending them out again to other parts, thus maintaining a universal reaction to impressions received from without.

The distal, or automatic part ganglia presides over the minute details of vital work, each controlling its own little sphere of activity.

The sympathetic nervous system presides over the processes of secretion, glandular action, and circulation, and through these control
The Splanchnic Nerves. The sympathetic, with the exception of the upper four ganglia, are connected with the abdominal nerves by three pairs known as the great, lesser and least splanchnics. These are among the most important vasomotor nerves in the body. They regulate the size of the great bloodvessels of the abdomen and by this means control to a remarkable degree the distribution of blood in the body.
practically all the processes of nutrition and organic change, as well as of voluntary activity. Through the grasp of the sympathetic upon the circulation of the brain, cerebral activity, thought, consciousness and even judgement, are under the control of the sympathetic.

The automatic ganglia, the intestines of the heart, the blood and lymph-vessels, the fallopian tubes, and of the uterus are capable of independent activity and may perform their functions when cut off from all connection with other nerve centers, although they are under ordinary conditions influenced in the direction of either inhibition or excitation by nerves received from the central nervous system.

It is through the influence of thermic and percussive applications to the skin upon the great sympathetic that the most remarkable effects of hydrotherapy are obtained. Through the powerful impressions which may be made upon this portion of the nervous system by external and internal applications of water, every nutritive process, indeed, every vital process taking place within the body may be modified, being augmented, or retarded, as circumstances require.
ANIMAL HEAT.

Since hydrotherapy consists for the most part in procedures which have for their object the making of thermic impressions upon the skin, it is evident that a correct knowledge of the phenomena and mechanism of heat production and regulation in the human body is essential to a proper appreciation of the methods and principles of hydrotherapy. Recent advances have been made toward the solution of the numerous difficult problems involved in the subject of heat production and regulation which render this study especially important, interesting and profitable from a practical standpoint.

Source of Animal Heat.-- The heat of the body is wholly derived from food, which, as has been shown by careful calorimetric studies, produces, when completely oxidized within the body, practically the same amount of heat which would be generated by its combustion outside the body.

A study of the heat-producing properties of the various elements of food shows that an ounce of dried albumin produces in the body sufficient heat to raise nearly six hundred pounds of water one degree in temperature. An ounce of fat produces eighty per cent more heat, or sufficient to raise nine hundred pounds of water one degree, and an ounce of starch a little more than four fifths as much as a pound of albumin or sufficient to raise four hundred and eighty pounds of water one degree.

The combustion, or oxidation, of food is not direct in the body as in a furnace, but occurs as a process of disassimilation, under the influence of special ferments which operate under the central of nerves and nerve centers. Oxygen is assimilated, CO₂ is excreted. Heat is the result of the tearing down of complex molecules and the reappearance in the form of molecular vibration of the energy which was previously employed in holding the molecules together in the organized state. These changes take place in all the tissues, even as recently shown, in the blood.
The total amount of heat produced in the body each twenty-four hours is 2,500,000 calories, or sufficient to raise 10,000 pounds of water one degree F. in temperature, or to raise from the temperature of freezing to the normal bodily temperature the body of a man weighing 160 pounds. This amount of heat would be obtained by the complete oxidation within the body of twenty-one ounces of starch, or a little less than half that quantity of fat. The generation of this large amount of heat within the body is necessary to maintain its temperature in the midst of a much cooler medium.

Cold and Warm Blooded Animals. — Cold blooded animals take the temperature of the medium in which they exist, or maintain but a slight difference between the bodily temperature and the surrounding medium, the temperature rising and falling with that of the water or air. The frog in water of 68° or less, maintains a temperature from two or three degrees to a few tenths of a degree above the water. In water of a higher temperature, its temperature is a little below that of the water.

The temperature of mollusks and fish may be reduced to 33° F., or scarcely a degree above freezing point. Most mammals have a temperature about that of human beings, namely, 98.6°. The mouse has a normal temperature of 100°. Birds have a normal temperature of from 107 to 111°.

A young infant approaches somewhat the condition of a cold blooded animal in its susceptibility to the influence of external temperature. This fact must not be forgotten in the employment of hydrotherapeutic processes in infants and young children. The ability to react to cold and to adjust the body temperature to that of the environment increases with development during the early years of life.

Temperature of Man. — Different observers report varying results. The normal temperature of man is generally considered to be
approximately $98.6^\circ F$, the normal limit of variation being $97.2^\circ F$ to $99.5^\circ F$. The temperature in the mouth is about $0.5^\circ$ higher than in the axilla, and in the rectum and vagina a degree higher than in the mouth.

The temperature of the surface varies, as does also the temperature of the internal organs.

**External Temperatures.**--With the temperature of the room about $68^\circ$, Kunkel found the temperature of various parts of the surface to be as follows:— (see page 32)

**Internal Temperatures.**--Davy and other observers give the following as the temperatures found in various internal parts:

- **Brain** 104 $^\circ F$
- **Left Ventricle** 107 $^\circ F$
- **Right Ventricle** 106 $^\circ F$
- **Liver** 106.5 $^\circ F$
- **Rectum** 105 $^\circ F$

The temperature of the carotid is from one to four degrees higher than in the jugular vein; in the carotid artery one and a half or two degrees above that of the carotid vein. In the hepatic vein the temperature is three or four degrees higher than in the portal vein during digestion. The blood leaving a muscle is ordinarily about $4^\circ F$ higher than that supplied to it when the muscle is in a state of rest. When the muscle is active, the difference is three times as great, or about $1.3^\circ F$.

The average temperature of the blood is about $102^\circ F$. The temperature of venous blood is nearly two degrees lower than that of arterial blood. The coolest blood in the body is that coming from the nose and ears.

The temperature of the infant or child is normally about one degree higher than of the adult. After the age of thirty, the temperature falls about one degree below the average adult standard, rising a degree above normal, or to the standard of infancy, in very advanced age.
A young infant approaches somewhat the condition of a cold blooded animal in its susceptibility to the influence of external temperature. This fact must not be forgotten in the employment of hydrotherapeutic processes in infants and young children. The ability to react to cold and to adjust the body temperature to that of the environment increases with development during the early years of life.
Heat Production.—Heat production in the body is the result of vital work, hence every living cell participates in the work of generating animal heat. The higher the degree of activity, the greater the rate of production of heat. Those organs which are the most active functionally produce the greatest amount of heat.

The body of the average man produces each minute sufficient heat to raise seven pounds of water one degree in temperature. In the horse and the dog, the rate of heat production is about the same. In a child weighing fifteen pounds, the heat production is twice as great, in the guinea pig, five times as great. In the mouse the rate of heat production is twelve times greater, and in the sparrow twenty-four times greater than in man. The rate of heat production in an animal appears to vary with the extent of its superficial or radiating surface.

Heat production is more active in strong and robust than in weak persons. The production of heat is more active in young persons or young animals than in adult persons or full grown animals, because of the larger proportion of radiating surface and the consequent necessity for greater heat production to remain a normal temperature.

Conditions which increase heat production and tendency to temperature rise are:

1. Glendular Activity.—Freshly secreted saliva is found to have a temperature of 2.7° above the blood of the carotid artery. The blood of the renal vein is warmer than that of the renal artery. Blood in the hepatic vein during digestion may have a temperature three or four degrees higher than that of the portal vein, though at other times the difference is but one degree or less.

2. Muscular Activity.—The blood leaving a muscle is a degree and a half higher during exercise than at rest. The temperature of an oarsman was found to be 104° after rowing one and a fourth miles in a race.

3. Mental Activity.—Mental activity has less effect on temperature
than muscular activity or glandular activity, but a temperature of half a degree F. has been observed as the result of vigorous mental effort.

4. Digestive Activity.—Longley proved that heat production is increased 35 per cent to 40 per cent during digestion. The body temperature rises as the result half a degree or more. The contents of the stomach may have a somewhat lower temperature during digestion owing to the fact that heat is rendered latent by the changes taking place in the food.

5. Cold applications increase heat production.

6. A Low External Temperature—(40°F. and below) causes increased heat production when the body is so exposed as to cause shivering or goose flesh appearance. If these symptoms due to muscular action do not appear, heat production is not increased, and may even be diminished.

7. A High External Temperature—Causes increased heat production through the increased tissue activity induced. The rate of heat production begins to rise slowly at 60°F. and although temperatures between 60°F. and 70°F. may be regarded as practically neutral in their effects, Vort fixed the exact neutral point in man at 58°F. Page found the neutral point in dogs to be 77°F. At a temperature of 104°F. the rate of heat production was three and a half times the normal.

The influence of external temperature upon heat production is a matter of great practical importance in dealing with many classes of morbid conditions, especially fevers.

Circumstances which decrease heat production are:

1. Fasting.—Abstinence from food causes a decided influence upon temperature. At first the temperature falls one or two degrees, then marked emaciation is developed, and shortly before death the temperature declines rapidly. Fasting and badly nourished patients have little heat-making power, and bear cold applications badly.
2. Sleep.—The temperature falls half a degree or more during sleep. It is for this reason that the temperature is usually higher at night than in the morning. The morning temperature is higher in a person who works at night and sleeps during the day. In hibernation, the maximum heat production is diminished to such an extent that the absorption of oxygen is less than one forty-fourth as much as during normal activity, and the elimination of CO\textsuperscript{2} only one-seventy-fifth the normal amount. This fact suggests the importance of at least a short period of exercise before the morning cold bath.

3. Moderate applications of heat lessen heat production while increasing heat elimination and thus cause a decline in bodily temperature.

Heat Regulation.—Modern researches upon this subject apparently demonstrate that the heat-producing and regulating mechanism of the body consists of three elements: thermogenic centers, thermogenic nerves, and thermogenic tissues. Of the thermogenic centers there are three classes:

1. The automatic centers, located in the spinal cord, which have immediate charge of the process of heat production, and under the control of which heat production is carried on.

2. The regulating centers, located in the brain, of two classes, one of which accelerates heat production by stimulating the automatic centers, of the cord, while the other exercising a controlling influence of inhibiting the automatic centers.

The automatic centers appear to be entirely uninfluenced by the various forms of stimuli which influence bodily temperature, while the regulating centers in the brain are extremely sensitive to such stimuli.

Heat applied to the skin and an elevated blood temperature acting directly upon the nerve cells excite the inhibitory center; while cold applied to the skin, and a lowered temperature of the blood, excite the accelerator
center. These centers in turn diminish or increase the activity of the automatic centers of the cord, as may be required to maintain the temperature which the system itself seems to establish as the standard to be maintained under given conditions or circumstances.

The inhibitory thermogenic center of the brain appears to rule in a remarkable manner a group of important functions which are utilized in heat dissipation when there is necessity to combat a tendency to temperature rise. These are:

1. Increased activity of the heart.
2. Dilatation of the surface vessels.
3. Increase of cutaneous secretion; perspiration.
4. Increased rate of breathing.

The blood is a circulating medium which is used not only to convey nutrient material from the stomach to the tissues, and excrementitious matter from the tissues to the excretory glands, but for the purpose of equalizing the temperature, conveying the surplus heat of the interior of the body to the surface, where it may be dissipated by conduction, radiation, and evaporation. Nearly nine-tenths of the daily heat loss occurs from the skin of which one seventh is due to evaporation. By the increased rate of heart beat, the exchange of blood between the center and the surface periphery takes place more rapidly.

By dilatation of the surface vessels a larger surface is exposed to the cooling influence which act upon the skin. The extent of surface over which the blood is spread is not wholly represented by the seventeen square feet of skin surface, but rather by the eleven thousand square feet of surface over which the capillaries are spread in the walls of the perspiratory tubules, nearly six times the capillary surface presented by the lungs.

The evaporation of the increased amount of sweat enormously increases heat loss. Each ounce of water evaporated from the skin absorbing heat sufficient to raise the temperature of sixty pounds of water one
degree Fahr. By various means the amount of perspiration may be increased to three or four pounds an hour.

The increase of respiratory activity increases heat loss, not only by the increased amount of the air which is warmed, but by the evaporation of water from the two thousand square feet of surface presented by the pulmonary mucous membrane.

In like manner the thermogenic centers control a number of mechanisms by which heat production is increased and heat loss is lessened.

When cold is applied to the surface, or when the temperature of the blood is lowered, the skeletal thermogenic center is excited and as the result:

1. The heart's action is slowed.
2. The surface vessels contract.
3. Perspiration is checked.
4. The erector pili and other involuntary muscles of the skin contract, hardening of the skin.
5. The respiratory movements are slowed.
6. The thermo-automatic centers of the spinal cord are excited.

The decreased activity of the heart lessens the rate at which the blood is sent to the surface; the contractile vessels of the skin diminish the area of blood exposed to cooling influences, lessens evaporation and loss of heat thereby; the contraction of the erector pili, by increasing the firmness of the skin, decreases its conductivity; the diminished respiratory movement lessens the amount of air heated by the lungs, through which more than ten percent of the total loss of heat occurs. Thus by the combined action of these various mechanisms, loss of heat is diminished while its production is increased.

Heat Production and Heat Dissipation Associated.—It is interesting to note that the functions of heat production and heat dissipation are reciprocal. If heat dissipation is suddenly increased by a
reflex influence acting upon the heat regulating center, heat production is also at once increased and measures are set in operation to conserve the bodily heat; while, on the other hand, if heat production is unduly increased, heat dissipation is immediately increased.

Every agent which tends to increase heat dissipation at the same time reflexly excites heat production, and whatever diminished heat dissipation, likewise by reflex action diminishes heat production. This action of the thermogenic centers whereby heat production is increased or diminished occurs independent of any effect upon the circulation.

Special thermogenic tissues: are found in the muscles, in which heat production is constantly taking place through the connection of these tissues with the automatic centers of the spine by means of the thermogenic nerves. Heat is constantly produced in the muscles even when at rest. When the muscle is active, four fifths of the energy consumed appears as heat, only one fifth as muscular movement. The muscles are the chief source of heat production in the body. They store up glycogen for heat production as well as muscle work.

A Sample Calorimeter: In the clinical study of the phenomena of animal heat there has long been a need for a calorimeter which could be used at the bedside. Some seven or eight years ago, while engaged in teaching a class of medical students in hydrotherapy, the writer devised a method of using a common bathtub for this purpose. The method is as follows:

In a room, the temperature of which varies little, and is about 70°F, fill a common bathtub with water at any desired temperature. Place in the tub two sensitive thermometers graduated to tenths of a degree and allow to remain undisturbed for fifteen or twenty minutes. Make a careful record of the temperature indicated by each thermometer. Every two minutes for ten minutes stirring the water constantly. By this means the average water, regardless of the temperature may be obtained, the average of the
At each reading, the average is the reading of the two thermometers being taken for the actual temperature of the water. Now put the patient in the bath and continue stirring the water and taking the temperature every two minutes as before. At the end of the experiment, add the amount indicated by the rate at which the water is known to be cooling. Multiply the number of degrees by the number of pounds of British thermal units lost by the body during the bath and absorbed by the water. The following is the record of an actual experiment made by this simple method, which the water has been kept for more than twenty years:

FEVER.

Fever is due to disturbance of the heat-regulating centers under the influence of toxic substances or nervous impressions, probably in most cases the former. Fever is no longer, as formerly, regarded as an unmitigated evil, to be combated irrespective of other symptoms, as it has been clearly shown that a rise of temperature is at least curative in its tendency. It is the result of the resistance of the body against the morbid elements which constitute the cause of disease.

The temperature has been known to rise as much as fifteen degrees above normal in pathological conditions, and a higher temperature, even, has been noted just before death. Recovery rarely occurs when the temperature exceeds 107°F.

In fever the functions of the heat-regulating centers are so greatly disturbed that influences which under ordinary conditions would not effect the bodily temperature, may occasion a rise of temperature of several degrees. In other words, there is in fever a disabolishment of the heat regulating centers of which character that the generation and elimination of heat are not properly controlled and
there is a marked less of resistance to the causes of thermic
disturbance but those which tend to produce depression of temperature
and those which produce temperature elevation.

Exposure to a heated air during the state

A warm atmosphere of febrile conditions tends far more in health
to cause rise of temperature both by decreasing heat elimination and by
increasing heat production. Atmospheric, as elsewhere remarked ( )
A temperature above 60° F. tends to increase heat production and at a
temperature of 104° F. heat production is increased to more than three times
the normal amount, hence the importance of proper regulation of the tempera-
ture of the air surrounding the patient in fever cases. A cold atmos-
phere increases heat production in fever but to a less degree than in
health. Exercise, either muscular or mental, even so slight as sitting up
in bed or conversing with a visitor, may cause a relapse when a patient is
just convalescing from a febrile attack.

Although the body is at rest in bed, there is, in fever, great
activity in the thermogenic tissues connected with the muscles. The pre-
dominating feature in fever is increased heat production. For each
degree centigrade (1.8°F) elevation of the body temperature, there is an
excess increase of heat production of six per cent, according to Lissauer (or 3.3%).
The following table represents the percentage
increase for each degree Max Fahrenheit within the ordinary range of fever
temperature.

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Percentage and Increase of Heat Production above normal</th>
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<tr>
<td>98.6° F</td>
<td>0</td>
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<tr>
<td>100.</td>
<td>4.6</td>
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<td>101</td>
<td>8.0</td>
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<td>11.3</td>
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<td>24.7</td>
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<td>107</td>
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</tbody>
</table>
HYDROTHERAPY.

HISTORICAL.

Water is without doubt the most ancient of all remedial agents for disease. This fact is evidenced by the frequent reference to its use in the most ancient medical literature and in the faces of the habits and customs of the most ancient peoples which have been revealed within recent years by the study of ancient Assyrian and Egyptian records. The reason for this is clearly to be found in the fact that water is an agent always found ready at hand for use, and adapts itself to almost every imaginable pathological condition in a most remarkable manner, approaching more nearly to a panacea than any other known remedial agent.

Elsewhere remarked, no other agent is capable of producing so great a variety of physiological effects, none so universally present, and hence none so readily available for meeting the various exigencies and indications arising from accident and disease.

Ancient Egyptians, Hebrews, Greeks, Persians, and Hindus all made use of water as a remedy in disease, as do the representatives of those ancient people at the present time.

According to ancient Chinese record, dating back several centuries before Christ, a physician prescribed for a woman of that country 100 applications of ice-water, each followed by wrapping in a linen sheet.

Among the Spartans of ancient Greece, cold bathing was made obligatory by law. As early as 692 B.C. gave many excellent directions for the use of cold water which the experience of two thousand years has not improved upon. He had an excellent understanding of the physiological properties of water, both hot and cold, which he employed in the treatment of fevers, ulcers, hemorrhages, and a variety of maladies both medical and surgical.
preceded and followed by friction, and he evidently understood the phenomena of reaction, since he records the observation that after a cold bath the body quickly recuperates its heat and remains warm, while a hot bath produces the opposite effect. Even the mythology of the Greeks recognized the bath in various forms, and hot and warm baths were almost universally dedicated to Hercules.

Under the Romans the bath attained a very high degree of development. Emperors vied with one another in erecting magnificent structures in which many thousands of persons might daily enjoy hot or cold water baths, hot air and steam baths, at will. The ruins of these ancient structures are among the most interesting relics to be found in Italy at the present time. In studying these interesting remains a few years ago at Rome and Pompeii, the author was astonished to find the perfection attained in every detail of the equipment of these ancient bathing establishments.

Asclepiades employed water in nearly every form, hot and cold, baths, douches, compresses, etc. One of his disciples, Antonius Musa, attained great fame by the cure of Emperor Augustus of a chronic catarrh by means of the cold bath, as a reward for which his statue was ordered to be erected in the temple of Asclepius (Esculapius). But a lack of discrimination in the use of this powerful agent led to his downfall. Being called upon to treat the emperor’s nephew, Marcellus, a popular favorite, the measures which had resulted so admirably in the case of the athletic old soldier proved too powerful for the effeminate youth, and he was prostrated to such a degree that he died soon after at Naples, where he had gone to receive treatment at the hot baths of Baiae, by means of which he hoped to counteract the evil consequences of his cold-water-cure experience.

Pastor Kneipp, the Bavarian empiric, a few years ago had a similar experience. Being called upon to visit the Pope, who was suffering from
chronic rheumatism. He was received with great honors, but the first
cold bath of the aged prelate, little accustomed to such rough usage,
so violent and shock and occasioned such an exacerbation of his suffer-
ings, that the poor priest was peremptorily dismissed in disgrace.

According to Pliny, the bath was almost the exclusive method of
treatment employed in Rome during five centuries. (Wish to verify this
in Natural History Vol. 2)

Celsius, and other Roman physicians, highly extolled
the bath in their work, and the later made the bath one of the three
essentials of what he called a perfect therapeutic system, termed
"Apothephia," the other essentials being exercise and friction.

During the middle ages, the Arabic physicians were the chief suppor-
ters of the bath as a remedial agent. Other physicians, the most learned
men of the age, were most enthusiastic advocates of the efficiency of the bath, especially in
fevers, and their directions for the treatment of smallpox and measles
could scarcely be improved upon at the present time.

Razes recommended a drink of ice-water to the extent of two or
three pints within half an hour, as a means of reducing temperature in
fever.

Avicenna recommended cold water for the relief of constipation.

Lanzani, an Italian physician, wrote an elaborate thesis on the
internal use of water for the treatment of fevers, in an early part of
the last century.

Fra Bernardino, about the same time, acquired the name of the "Cold
Water Doctor" by the use of iced water in the treatment of indigestion,
nervous disorders, hemorrhages, etc. He required his patients to drink
from three to six goblets of ice-water daily. He avoided sweating,
amended to stimulate the bowels and kidneys.

Floyer, who also lived in the early part of the last century, gave
If the patient had been a young and sturdy German instead of a feeble Italian priest, this prescription might have succeeded better. A similar lack of discrimination, whether the prescription be made by a charlatan or a legally qualified practitioner, is always attended by disastrous results. The outward effects produced must be attributed to the stupidity, ignorance, and audacity of quackery, or to the lack of information or experience of the otherwise qualified and efficient physician.
systematic rules for the use of cold water both internally and externally.

There seems to have been at this period a very general knowledge of the value of water for the treatment of numerous ailments. Since John Wesley, the founder of Methodism, wrote a treatise on "Domestic Medicine" and often mentions water, both externally and internally, as a remedy of great value. The following are a few of the suggestions which we find in Mr. Wesley's book, and which are valuable from the fact that the book was wholly composed of remedies which the author found in successful use among the laity with whom he associated:

(Make quotation from Wesley's book)

It is very interesting to note how few of our modern methods of employing water are really new. The moist compress, used in so many ways by Priestnitz, was well known to the ancient Greeks, and known by them as "Epithem" or "aphthum".

According to Sir John Hoffer, the wet-sheets pack was employed in his time by sportsmen who wished to diminish the weight of their jockeys by sweating. The method is thus described:

"Dip the rider's shirt in cold water; and after it is put on very wet, lay the person in warm blankets to sweat him violently, and he will after lose a considerable weight, a pound or two."

This same method was used in the treatment of various maladies, particularly cases of rickets in children. The child being prepared for bed with a gown and night-cap, was quickly immersed in cold water, then put to bed closely wrapped in warm blankets and left in this condition all night, sweating profusely, a portion of the clothing being removed toward morning so that the body might be gradually cooled. That this method was employed with great perseverance is evidenced by the following suggestion which the learned author makes: "If one year's dipping proves
Hydrotherapy.

The following interesting extracts from a small work entitled, "Primitive Physick," by John Wesley, M. A., the founder of the Methodist church, published in 1747, afford ample evidence of the existence among the common people of a very considerable amount of knowledge respecting the use of water in a variety of ailments, as well as for the preservation of health.

For Ague, Intermittent Fever.—"Go into the cold bath just before the cold fit." (This method is still in use in Germany and France.)

Or, "Drink a quart of cold water just before the cold fit, and then go to bed and sweat."

For a tertian ague, it is recommended to "use light and sparing diet on the day between," or use the cold bath (unless you are of advanced age or extremely weak). But when you use this, on any account whatever, it is proper to go in cool; to immerse at once, but not head foremost; to stay in only two or three minutes (or less at first); never to bathe on a full stomach; to bathe twice a week at least, until you have bathed nine or ten times; to sweat immediately after it (going to bed), in palsy, rickets, etc.

"Before the cold fit begins, go to bed, and continue a large sweat by drinking lemonade for six or eight hours. This usually cures in three or four times. If it does not, use the cold bath between fits."

For apoplexy, to prevent, use the cold bath, and drink only water.

For asthma, "Take a pint of cold water every morning, wash the head therein immediately after, and use the cold bath once a fortnight."

"For present relief, vomit with a quart or more of warm water. The more you drink of it the better."

For dry or convulsive asthma, "Use the cold bath thrice a week.

"To prevent swelling from a bruise, immediately apply a cloth five
or six times doubled, dipped in cold water, and new-dip when it grows warm.

"To cure a swelling from a bruise, foment it half an hour morning and evening, with cloths dipped in water hot has you can bear."

For a burn or scald, "immediately plunge the part into cold water. Keep it in an hour; if not well before, perhaps four or five hours."

"To prevent rickets, tenderness, and weakness [in children], dip them in cold water every morning, at least until they are eight or nine months old."

For whooping-cough, "use the cold bath daily."

For cholera morbus, "drink two to three quarts of cold water, if strong; or of warm water, if weak."

For a cold, "drink a pint of cold water, lying down in bed."

For colic, "drink a pint of cold water; or a quart of warm water; or hot water in a bladder; or steep the legs in hot water, a quarter of an hour."

For hysterical colic, "use the cold bath. Use cold bath two and twenty times a month has entirely cured hysterical colic, fits, and convulsive motions."

"For nervous colic, use the cold bath daily for three or four weeks."

For convulsions, "use the cold bath."  

To prevent corns, "wash the feet in cold water."

For a cough, "drink a pint of cold water lying down in bed, or use the cold bath, or wash the head in cold water every morning.

Blindness "is often cured by cold bathing."

For weak eyes, "wash the head daily with cold water."

For a slow fever, "use the cold bath for two or three weeks daily."

For hectic fever, "drink only thin water gruel or boiled milk and water."

For intermittent fever, "drink warm lemonade in the beginning of}
every fit. It cures in a few days.

**Sitz Bath for Fistula.**—"Have the vessel so contrived that he may sit with the part in cold water a quarter of an hour every morning."

For flux, drink two or three quarts of warm water.

For bloody flux.—A person was cured in one day by feeding on rice milk and sitting a quarter of an hour in a shallow tub having in it warm water three inches deep. Drink water largely; take nothing else until the flux stops.

At six in the evening,

**Leg Bath.**—Wrap yourself in blankets, then put your legs in water up to the knees, as hot as you can bear it. As it cools, let the water cool, so as to keep you in a sound sweat until ten, then go into a bed well warmed, and sweat until morning. I have known this cure an inveterate gout in a person above sixty."

For the gravel, drink largely of warm water.

For chronic headache, keep your feet in warm water a quarter of an hour before you go to bed, "or two or three weeks."

For headache from heat, apply to the forehead cloths dipped in cold water, for an hour."

For heart burn, drink a pint of cold water.

For the hiccough, swallow a mouthful of water, stopping the mouth and ears.

For hoarseness, take a pint of cold water, lying down.

For hypochondria use cold-bathing.

For violent colic, with fatal vomiting, immerse up to the breast in a warm bath.

For leprosy, use the cold bath or wash in the sea often and long.

"For one seemingly killed by lightning or suffocation, "plunge him immediately into cold water."

For mania, apply cloths dipped in cold water; (to the head) or pour cold water on head from a teakettle; or let the patient eat nothing but
apples for a month."

For the measles, drink only thin water gruel, or milk and water, the more the better, or toast in water.

For the palsy, use the cold bath, one to fifty, rubbing and sweating after it.

For palsy of the hands, wash them often in a decoction of sage, as hot as you can bear.

For palsy from working with white lead, use warm baths and milk diet.

For palpitation or beating of the heart, drink a pint of cold water.

To prevent piles, wash the parts often with cold water.

For the plague, cold water alone, drank largely, has cured it.

An easy purge. — Drink a pint of warmish water, fasting, walking after it.

For rheumatism, use the cold bath, rubbing, and sweating.

For rickets, wash the child in the morning with cold water.

For rupture, foment the part for half an hour with cloths four times doubled, steeped in cold water, gently touching it with the fingers.

Afterwards keep on it, many times doubled, a cloth shaped like a triangle, wet in cold water.

For sciatica, use the cold bath and sweat, together with flesh-brush twice a day; or drink half a pint early in the morning and in the afternoon.

For small pox, drink largely of toast in water.

For sore throat, take a pint of cold water, lying down in bed.

For stone, to prevent its occurrence, drink a pint of warm water daily just before dinner.

To stop profuse sweating, drink largely of cold water.

For swelling of the joints, pour on the part daily a stream of warm water; or a stream of cold water one day, and warm water the next.
For the toothache, keep the feet in cold water and rub with bran just before bedtime.

For numbness of the limbs, use the cold bath for rubbing and sweating.

For "swimming in the head" use the cold bath for a month.

For sleeplessness, try the forehead two hours with clothes doubled and dipped in cold water.

For ulcer, foment morning, and soak evening with a decoction of warm tea leaves.

Varicose ulcer of the legs cured by constant cold bathing.

Weakness of the ankles, cold water poured on morning and evening.

For wounds, keep the part in cold water for an hour.

Wesley recommended cold bathing for the cure of nearly all the affections of childhood, all chronic diseases, and many surgical cases.

It is also useful to use the hot bath a few days before you use the cold.

Rain or soft water was recommended as best for use, and water drinking was recommended as a means of preventing apoplexy, asthma, convulsions, gout, hysteria, palsies, and strong trembling.

It is interesting to note the sagacity and wisdom displayed in many of these recommendations which in modern instances could scarcely be suspected up to at the present day. They evince an extended and adequate observation of the effects of hydriatic applications.
not successful, it is repeated the next year, which generally answers expectation."

Floyer also mentions that in Staffordshire and other portions of England, it was the custom with the people to go into the water in their shirts, and when they came out, they dress themselves in their wet linen, which they wear all day, and much commend that for closing the pores and keeping themselves cool; and that they do not commonly receive any injury or catch any cold thereby, I am fully convinced from the experiments I have seen made of it.

It is interesting to note the fact that many of the features of the so-called "Enipission" are simply a revival of these rude practices of ignorant English peasants a century and a half ago.

Sir John Sinclair in his "Code of Health and Longevity" (1801) gives an account of an English nobleman, born in the year 1700, who, for a great part of his life, was accustomed, immediately on arising in the morning, to wrap himself in a sheet just dipped in cold water.

In the 15th century Savonarola, an Italian physician, made a systematic use of the cold bath, and Barizzi employed the cold vaginal douche in uterine affections.

Cold effusions and douches were employed by Baccio in Italy, while leading Spanish and German physicians recommended employing cold applications for insomnia.

Septula employed the cold douche for the relief of headache and stroke in the 17th century.

Berman, a Belgrade physician, resorted to the use of cold water at the same period for the relief of constipation, migraine, paralysis, and mania.

Floyer. In 1697, published a history of cold bathing, in which he directed that the patient should be made to sweat before taking the cold bath, by wrapping him in a wet sheet with blankets, precisely the same
method employed more than a century later by Priessnitz, now known as the wet-sheet pack.

John Hancoch published a work entitled "Water the Best Cure in More Than a Century Before Currie and Jackson, Fevers" in 1772, in which he demonstrated the value of water drinking as a means of treatment in scarlet fever, smallpox, and measles. He cured men ague by sweating with cold water, that is, by having the patient drink quantities of cold water while wrapped in blankets.

Sir John Chardin, a celebrated English traveler, had bilious remittent fever when in Persia. His companion, a French surgeon, thought his case hopeless and sent for a native physician, who made him fast five days, had him drink large quantities of water, cooled with snow; had him lie upon a mat wet with water, and his skin kept wet with water. Water was poured over the patient while two men supported him. In two days the fever disappeared.

Illustration of the evaporating bath.

Native physicians of Mohammedan countries generally follow Galen.

Add to the history resume of Curry's work.

The modern popularity of water as a remedy must be largely credited to the enterprise and ingenuity of a Silesian peasant, Vincent Priessnitz, born in the little village of Grafenburg, in eastern Silesia, in 1799.

When seventeen years of age, Priessnitz met with an accident whereby he received numerous bruises and other injuries, including fracture of two of his ribs. Local physicians gave him no hope of recovery; but having been accustomed to use water — the treatment of domestic animals
and to make use of water in many maladies in a very effective and practical way.
This native Persian physician evidently had a knowledge of the value of water drinking, the evaporating bath, the affusion as means of combating fever, invaluable information of which Western physicians are scarcely yet making any considerable practical use.
In the midst of the last century, English, French, and Jacksonian doctors, in a most careless and scientific study of the disease, in fever, had each received attention from cannaveralse. In England, for the profession early under some remarkable and able scientists, methodical and practical, was lost, and it was not until the middle of the world as whole could be attracted and blinding, but still that the few water could give the sense before the sense.
In the latter part of the last century, two English physicians, Currie and Jackson, made a most intelligent and scientific study of the living water in fevers, and with remedies which for a time commanded much attention from the profession in England. For some reason, not easily understood, the work of these able therapists, pioneers of a scientific method of indubitable value in febrile disorders was lost sight of, and it was not until the attention of the whole civilized world was attracted by the fame of an uneducated and blundering, but still successful, cold-water enthusiastic, that the importance of the principle began to receive recognition. The importance of the principle is now recognized.
for which he cared, it occurred to him to try the same remedy for himself. He covered the affected parts with cloths kept moist by cold water, and also drank freely of cold water, with the result that he was in a short time completely cured. This incident made so profound an impression upon the mind of Priessnitz that although an unlearned peasant, he determined to make a thorough investigation of the merits of water as a remedial agent. He employed both internally and externally. He seems even to have undertaken some experiments on animals; for, according to Fleury, he studied the effects of hot and cold foods upon two pigs, one of which was fed upon cold, the other upon hot foods, making, when the animals were killed, a careful examination of the intestines. He asserted that he found in the case of the ox animal fed upon cold foods the intestines well contracted, pale, and of firm resisting structure, while in the case of the animal fed upon hot food the intestines were found red, relaxed, and so easily torn that they could not be used for making sausage.

The basis of the system of Priessnitz was perspiration, followed by cold applications. His methods were exceedingly crude and administered with comparatively little discrimination—the natural result of his total lack of medical knowledge. However, his native tact and sagacity soon led him to recognize a difference in the ability of his patients to react to the treatment, and he accordingly made it a uniform practice to observe in each case the effects of the first application, the readiness with which the patient yielded to the means adopted to induce perspiration, and the promptness with which reaction took place on the application of cold water.

Priessnitz perhaps discovered little, but he succeeded in calling the attention of the whole civilized world to the efficacy of various simple methods of applying water as a remedial agent, which had previously been little known. He accomplished more than this. He succeeded in curing a vast number of chronic invalids whose maladies were practically
incurred by the remedial measures in common use by the medical profession of his time, and though at first denounced and opposed by scientific physicians because of his empiricism, sagacious medical men, after a time became convinced of the genuineness of the cures effected, and many visited him for the purpose of studying his system, such as it was. The attention of scientific men thus attracted led to a careful study of the physiological effects of water in its various modes of application for the purpose of finding a scientific foundation for its therapeutic use. Among the first to undertake an experimental study of the effects of water upon the human body was Fleury, who published in 1852 the first scientific treatise upon hydrotherapy, under the title, "Traité pratique et raisonné d'hydrothérapie."

Johnson and Gully in England, Bell in America, and above all, Winternitz of Vienna, supplementing the work of Fleury, have within the last half century built up a scientific hydrotherapy, which is based upon definite and accurate data. Before Fleury the use of water was empirical; at the present time, thanks to the labors of eminent investigators whose names have been mentioned, supplemented by the important work of Jürgensen, Rosbach, Liebermeister, Delmas, Robin, Henocqué, and Panin-Bardi, it may be fairly said that there is no therapeutic agent the use of which rests upon a more thoroughly rational and scientific basis than water, and there are few if any therapeutic or hygienic agents the physiological effects of which have been so elaborately and comprehensively studied.

Thanks to the attention which it has received from scientific men through extended and laborious researches, it has been rescued from the hands of empirics and charlatans, and has come to be recognized by some eminent medical men as one of the most potent of all remedial agents, and one which takes precedence over all others in the variety of morbid conditions to which it is applicable.
Grades

The extent of knowledge and
unfamiliar with the work of
different experiments. The author
and not further advanced.

Experimental data. The observer
published in 1901 as a collaboration between
Euler, Minkowski, and

THE SKIN AND ITS FUNCTIONS.

An understanding and appreciation of the skin and its functions is necessary to a correct comprehension of the principles of hydrotherapy, since in by far the greater share of the medical uses of water, the skin is involved, but we shall devote a few paragraphs to an analysis of the interplay and physiology of this remarkable organ in health.

Anatomically, the skin is a structure about one eighth of an inch in thickness, consisting of an intricate meshwork of white and yellow elastic fibers, which constitute a framework, in which is suspended a countless number of glands, blood vessels, and nerves. The whole is covered with cells joined by a cement substance.

Scattered through the superficial layers of the skin, just below the epidermis are found cells containing pigment, which are especially abundant in the dark races. The deeper layers of the skin contain, in certain portions of the body, especially on the extensor surfaces, an abundance of smooth muscular fibers, which are capable of contracting, or puckering, the skin.

The nails and hairs are appendages of the skin growing from pouches in this structure, and are simply modifications of the horny layer.

The area of the skin is about seventeen square feet.

The Sweat. -- The sweat glands (Hig. . . . . . . . . ) are, in man, present almost everywhere in the skin, and are largest and most numerous in the skin covering the palm of the hand, sole of the foot, forehead, and axilla. There are very few in the skin covering the back, and are absent at the margin of the lips. Each sweat gland receives an artery, and a number of nerve filaments, and has a duct through which its secretion is discharged upon the surface.

The total number of sweat glands is about two and one-half million, presenting a secreting surface of nearly eleven thousand square feet.

The amount of perspiration produced daily is about two pints, or 1/64th the weight of the body, and double the amount of water secreted by the lungs.
ANATOMY AND PHYSIOLOGY IN RELATION TO HYDROTHERAPY. -- There is no remedial agent the scientific use of which demands thorough-going and practical knowledge of physiology as does hydrotherapy. Used empirically, water is certainly less likely to lead to disastrous results than medicinal agents, the terrible consequences of the unscientific use of which are only too forcibly illustrated in the enormous damage resulting from the extensive use of patent medicines. Nevertheless, water is an agent which, like powerful drugs, is a two-edged sword, and its unscientific use has not infrequently resulted in most untoward effects. Indeed, it may well be believed that the very general prejudice prevailing against the use of water among physicians as well as the laity, is largely due to the injurious results which have followed the bungling and unsuccessful use of this invaluable agent by so-called water-cure doctors, and well-meaning, but unfortunately not well-informed enthusiasts, who, having themselves experienced good results from the use of this simple and versatile therapeutic agent, have with best intentions, but not infrequently with only the saddest results, undertaken to cure all their sick friends by means of the same prescription through which they have themselves found relief.

It is only by an exact knowledge of the human body, its normal functions, and the modifications of tissue and function resulting from disease, that water can be therapeutically employed with the universally satisfactory results which this agent is capable of rendering. Not all cases, of course, are curable, but even in incurable cases marvelous to note the wonderful degree to which pain and various other symptoms may be mitigated by accurately adapted hydrotherapeutic prescriptions.

To use water intelligently, one must a thorough physiologist, and must especially have a good understanding of the anatomy and physiology of the skin and the nervous system. For the convenience of the
feader, and that he may have freshly in mind those anatomical and physiological facts which are most essential to an understanding of the general principles of hydrotherapy, this chapter is devoted to a brief summary of the anatomy and physiology of the skin and the nervous system, so far as it is particularly concerned in the phenomena accompanying the hydrotherapy and functions of animal heat.
Ordinarily, three degrees of activity of the sweat glands are recognizable:

1. Ordinary, so-called insensible perspiration, in which the quantity is so small in amount that the water and volatile constituents of the sweat are evaporated as rapidly as formed.

2. Sensible perspiration, in which the activity is so great as to produce slight moisture of the skin; and

3. Profuse perspiration, in which the amount of secretion produced is so abundant that it appears in drops, or minute streams coursing over the surface.

The function of perspiration presents different interesting variations in different animals. A horse sweats, as does man, over the whole surface. The same is true of the ox, to a less extent. In the cat and hedgehog, sweating is confined to the soles of the feet. Apes sweat with the palms of their hands; in the pig it is the skin covering the sweat which sweats; the goat, rabbit, rat, and mouse do not sweat.

The secretion of sweat is increased by the following conditions:

1. Increased temperature, as by contact of hot air, or hot water, or other heated substances with the skin. Water at 122° (look up) or above arrests the action of the sweat glands.

2. A dilute condition of the blood, such as results from copious drinking of water, especially warm water.

3. Increased action of the heart, with rise of blood pressure.

4. The sweat centers are excited by a rise of temperature above normal 1° F.

5. Exercise, which increases the activity of the skin, not only by increasing the activity of the heart, but by raising the temperature of the blood, and thereby stimulating the sweat glands. The body temperature may be increased to 104° by violent exercise.

6. Percussion and friction.

7. Certain drugs.

8. Stimulation of the secretory nerves by electricity, or other
CONDITIONS WHICH CONTROL THE SECRETS OF

CRANE'S

1897

ALL LINEN
Physiological experimentation has shown that there are not only special sweat centers, but special nerves from these centers. Those of the hind leg of a cat lie in the sciatic nerve. Stimulation of this nerve has caused sweating in the sole of the foot of a cat forty-five minutes after death. Mustard held in one side of the mouth will cause perspiration of the skin of the face of the same side. The centers of the sweat nerves for the palms lie in the brachial plexus. Sweat nerves of the head ascend in the cervical sympathetic. Stimulation of the cervical sympathetic of one side causes sweating of the face and arm of the corresponding side. Sweating is also produced by stimulation of the infraorbital nerve.

The small blood vessels are usually dilated through excitement of the vasodilator nerves in conjunction with sweating; sweating may occur with pale skin, the result of fear, pain, or the death agony.

Stimulation of the motor nerve causes sweating of the skin over the muscles supplied by the nerve, and of the same area of the opposite side of the body, and independent of the circulation.

9. Mental excitement, as in hysteria, neurasthenia, often gives rise to sweating, especially of the head and hands, sometimes one side of the face only.

10. Profuse perspiration occurs as a symptom in certain diseases, as and intermittent malarial fever, phthisis, acute rheumatism.

11. The appearance of sensible perspiration is encouraged by a moist warm atmosphere, in consequence of the lessened rapidity of evaporation.

Perspiration is decreased by:

1. Cold.

2. By a profuse watery discharge from the kidneys or bowels. The skin and the kidneys seem to act reciprocally. When the secretion of one organ is increased, that of the other is decreased. In warm weather the volume of urine is usually diminished; in cold weather increased. The opposite being true of cutaneous secretion.
3. Certain drugs, antihypertotics, as atropia.
4. Certain forms of disease, as in some cases of paralysis, diabetes, cancer, and many cases of chronic dyspepsia.

Perspiration is one of the most important methods by which the danger of excessive accumulation of heat within the body is averted. When the skin fails to perform this important function, as is not infrequently the case in fever, the bodily temperature often rises to a most dangerous degree.

Toxins of the Sweat. — Not only uric acid, but more subtle and potent poisons are found in the sweat, as shown by the investigations of Bouchard. Perhaps the most important of all these is a peculiar substance which manifests its properties by inducing a fall of temperature. The retention of this substance in the body may cause death, as shown by varnishning of the skin.

In diabetes, the sweat usually contains grape sugar. Sweat from bad-smelling feet contains leucin — tyrosin and ammonia. The sweat of rheumatism contains albumin and that of puerperal fever lactic acid. Bloody sweat occurs in yellow fever, and bile pigments are found in sweat in cases of jaundice.

Chromogenic microbes may give rise to red, blue, and yellow colorimats in the perspiration. Arsenic acid, mercuric chloride, and other toxic substances have been found in the sweat after internal administration.

The Sebaceous Glands. — Fat-making glands are found in connection with both the coarse and fine hairs and the skin. They are absent only from the palms of the hands and soles of the feet, are largest in the skin of the nose and the labia.

The purpose of these glands is to oil the hair and the skin. The oily layer protects the skin from excessive loss of heat.

A minute band of involuntary muscular fibers is connected with each
hair, one end being attached near the bottom of the hair obliquely, the
tail to the skin in such a way as to form an acute angle with the hair.
The sebaceous gland connected with each hair lies in the angle between
this muscle and the hair. By contraction of the muscle, the hair is
partially
the hair and compressing the gland, and thus emptying it of its secre-
tion. Covering the skin with oil hinders radiation, and is a method
adopted by swimmers for protection. It is also much used by mountaineers in cold regions.

Absorption by the Skin. — The skin absorbs substances in watery
solution only with difficulty, on account of the oil on the epidermis and
in the pores of the skin. Solutions administered in a fine spray, and
substances dissolved in oil and rubbed in, are more readily absorbed. Absorption takes place readily when the oil of
the skin is removed by ether, chloroform or alcohol. Application by
means of a galvanic current, absorption of watery solutions of iodide of
potash, strychnia, and other drugs may be effected. Catalepsia.

Cutaneous Respiration. — Respiration by the skin in man varies in
different individuals, from one-half to one per cent. of the total amount
of oxygen received by the body. A somewhat less amount of CO₂ is
eliminated through this canal.

In frogs, and some other closely related animals, the skin elim-
ates two-thirds or three-fourths of the total amount of CO₂ excreted,
and hence is a more important respiratory organ than the lungs. Dipping
a frog into oil, thus suspending cutaneous respiration, kills it quicker
than ligature of the trachea. Some creatures, as the earthworm, breathe
wholly by the skin.

Respiration by the skin occurs through the thin walls of the per-
spiratory tubules. Cutaneous respiration is increased most by rise of
internal temperature, by increased cutaneous circulation, by circumstan-

...
ces which hinder lung respiration, and during digestion.

Nervous Functions of the Skin. -- The nerve supply of the skin is greater in variety of kind and region, and consequently in function, than those of any other portion of the body. The skin is without doubt the most important of all the sense organs. The several sets of nerves which supply it may be enumerated as follows:

1. The two sets concerned in the tactile sense, those which recognize respectively pressure and locality.

2. The two sets of nerves concerned in the temperature sense, which terminate in the skin in the so-called hot spots and cold spots.

3. Nerves which recognize pain.

4. Vaso-constrictor nerves.

5. Vaso-dilator nerves.


In all, eight distinct sets of nerves, which are all connected with their respective nerve centers. In making applications to the skin, the effects upon each one of these several sets of nerves must be taken into consideration. It is evident that those areas of the skin which possess the richest nerve supply must be most profoundly affected by hydrotherapeutic applications, most capable of producing reflex effects through their connection with the internal viscera by means of their centers of origin.

The Tactile Sense.

The acuteness of the pressure sense in different parts of the body is in the following order, beginning with the most sensitive, -- the forehead, lips, cheeks, and temples, the back of the fingers and forehead, anterior surface of the leg and thigh, the back of the foot, the toes, the sole of the foot, and the posterior surface of the leg and thigh.

The Temperature Sense. -- This is one of the most interesting of the functions of the skin, and one most easily and directly involved in hydrotherapy, for many of the most profound effects in hydrotherapy are...
This fact emphasizes the importance of giving careful attention to the exact regulation of pressure as well as temperature in hydrotherapeutic applications, a matter which has generally received less consideration than is necessary for accurate and reliable results.
the result of the influence of the thermic applications upon the tempera-
ture sense and through them upon the whole cere-
bral and sympathetic systems.

The temperature sense is not uniformly distributed through the skin, but is confined to temperature spots, of which there are two kinds, — hot spots and cold spots (Figs. 169 and 173, Landols and Sterling). These are arranged in curved lines or chains, starting out from the hair roots, near which temperature spots are always to be found. (Fig. 169, Landols and Sterling.)

The temperature sense varies in acuteness in different portions of the body. The acuteness of the thermal sense differs in different portions of the body, and in the following order, in the regions named: tip of finger; eyelids, cheeks, lips, neck, arm, back of hand, palm, thigh, leg, back of the foot, and the breast have the same degree of acuteness as the palm of the hand. The more acute surfaces recognize a different degree of temperature of less than one-tenth of a degree Fahrenheit. Regions situated in the median line, as the nose, are less sensitive.

A "sleeping" limb recognizes heat only, and not cold. The temperature is estimated higher when a large surface is exposed. Water at 85° feels warmer if the whole hand is immersed than water at 90° in which the finger is dipped.

Cold weights feel heavier than warm weights. The pressure of a stream of water, as in the horizontal jet douche, feels greater when cold than when warm. But hot and cold spots are not sensitive to impressions of pain or pressure.

The skin is more sensitive to cold than to heat, impressions of cold being felt at once, while the sensation of heat develops gradually. Thermic sensations are felt as warm or cold, according as the temperature of the object or medium brought in contact with the skin is greater or less than that of the skin itself; hence the temperature of the skin is the zero of the temperature sense. Objects of a higher temperature than
+16

Measurant excites the cold spots and so produces a sensation of cold. CO₂ excites the hot warm spots and thus give rise to a sensation of heat.
that of the skin are felt as warm or hot, those of a temperature below that of the skin, cool or cold.

Objects which are good conductors of heat feel warmer or cooler than poor conductors at the same temperature. It is for this reason that hot and cold water makes a stronger impression than air of the same temperature. The temperature sense is most delicate at temperatures near or a little below that of the blood (80° to 90°). It is less delicate at temperatures below 80° and max above the temperature of the body. Impressions of pain are made by a temperature of 130°

Temperature impressions are most intense when the difference between the object and the skin is greatest. The strongest impressions are made by alternation of heat and cold. Sensibility of the temperature sense improves with practice and with diminution of blood supply. Rapid variations of intense temperature produce more marked effects than gradual changes. Venous congestion of the skin diminishes the temperature sense. Fatigue of the temperature sense develops quickly. Perception is more acute when large areas are exposed than small areas, but sudden immersion of the whole body in cold water produces a less unpleasant effect than when the body is introduced gradually. The nerves of the temperature sense are connected with the spinal cord with the so-called heat-generating and heat-regulating centers of the brain, and spinal cord.

The nerves of touch are connected with the motor centers controlling the muscles of the corresponding part. Rumpf has shown that increased sensibility of one part, whether produced by application of heat or otherwise, is accompanied by a lessening of sensibility in the corresponding region of the opposite side.

Vaso-motor and Secretry Nerves. -- The blood-vessels are supplied with both constricting and dilating nerves, which arise from different centers, located at various levels in the spinal cord. It is through
thermic impressions made upon these nerves either singly or in succession that some of the most important impressions and effects in hydrotherapy are produced.

The relation of the principal vasomotor centers to the principal surface areas and to the viscera of the chest and abdomen, is briefly stated elsewhere in this work.

Each one of the several million sweat glands and sebaceous glands of the skin is supplied with a secretory nerve which is connected with the great sympathetic centers and with spinal centers in the spinal cord.

General View of the Nervous System as Related to Hydrotherapy.

The skin, as has been very aptly remarked, is a harp of a thousand strings upon which one who is a master of the necessary means may play in such a manner as to produce almost any desired physiological or therapeutic effect. The skin is the keyboard and the nerves and nerve centers are the internal mechanism. An understanding of the relation of the skin to the nerves and nerve centers, and through them with the internal viscera, is as essential to the physician who desires to employ hydrotherapy intelligently as is a knowledge of the rules of musical harmony and technique to the piano player. It is necessary to know the relation of the nerve endings in the skin with the nerve centers in the brain and spinal cord, and through them with the internal viscera supplied with nerves from the same or associated centers, and hence in special relation.

Applications to the skin are sometimes made for the purpose of influencing the nervous system as a whole, and not infrequently it is desirable that the application should be limited in its effect to some single internal region.

There is no other class of therapeutic agents that require so profound a knowledge of physiology, especially the physiology of the nervous system, and such constant employment of this knowledge as do the various procedures included under the general term hydrotherapy. We have not
space here, however, for a lengthy dissertation upon the nervous system. We simply call attention briefly to a few important physiological and anatomical effects which are essential to a proper comprehension of the effects rehearsed in the chapters devoted to the physiological and therapeutic effects of water.

Nerve Centers. -- While every nerve center in the body is more or less profoundly affected by general thermal applications to the skin, there are four sets of centers which are especially involved, as follows:

1. Sensory centers, located in the brain.
2. Heat centers, likewise located in the brain and cord.
3. Vaso-motor centers, located in the spinal cord.
4. Secretory centers, located in the spinal cord and the great sympathetic.

As some of the nerves connected with these ganglia pass into the spinal cord along with the spinal nerves, it is of importance to bear in mind a few facts relating to the relation of the spinal centers to the spine itself and the vertebra.

1. The eight cervical ganglia correspond to the seven cervical vertebra.
2. The twelve dorsal ganglia correspond in general to the several dorsal vertebra; ending however, with the eleventh.
3. The five lumbar ganglia are located at the level of the twelfth dorsal vertebra.
4. The ganglia of the five sacral and the coccygeal nerves are found at the level of the first and second lumbar vertebra.

The Superficial Reflexes. -- As hydrotherapeutic applications are capable of exciting each and all the classes of reflexes which may be set up by stimulation of the cutaneous nerves, it is useful to bear in mind the location of the several reflex areas, and their relation to the
In making applications to the Spine, it is often essential that the above facts respecting the location of ganglia should be kept in mind.
special centers. These are as follows:—

The scapular reflex area, between the shoulder blades, in relation with the 6th to the 8th cervical and 1st dorsal centers.

The epigastric reflex area, epigastrium, in relation to the 5th to the 7th dorsal ganglia.

The abdominal reflex skin, overlying the borders of the recti muscles, in relation with the 5th to the 12th dorsal centers.

The cremasteric reflex area, inner and upper portion of the thigh, in relation with the 1st to the 3rd lumbar ganglia.

The gluteal reflex area, skin overlying the gluteal muscles, in relation with the 4th and 5th lumbar ganglia.

Plantar reflex area, soles of the feet, in relation with the five sacral and coccygeal ganglia.

Vasomotor Nerves.—The controlling vasomotor centers, both constricting and dilating centers, are located in the medulla. Subordinate vasomotor centers are located in the spinal cord. The vaso-constricting centers are found chiefly in the cervical and thoracic regions; vaso-dilator centers are scattered throughout the cord.

The blood vessels of the head are controlled by vasomotor nerves from the center in the medulla which pass to the head through the cervical sympathetic.

The lungs receive vasomotor nerves from the 3rd to the 7th dorsal ganglia. The intestines receive their vasomotor fibers through the three splanchnics. The great splanchnic is the largest vasomotor nerve in the body.

The arms receive their vasomotor nerves from the middle dorsal region through the first thoracic ganglia of the sympathetic. The skin of the trunk receives vasomotor fibers through the dorsal and lumbar nerves. The vasomotor nerves of the lower extremities pass through the lumbar and sacral plexuses to the sympathetic, thence to the lower limbs.
In the application of the douche with strong, the location of the several reflect areas as described above must be kept clearly in mind.
The principal vaso-constrictor nerves of the kidney leave the spinal cord with the last three dorsal nerves. The vaso-dilator fibers for the kidney accompany the vaso-constrictor fibers.

The liver receives its vaso-motor fibers from the solar plexus, which arises from the mesentery of the bowel.

Most of the vaso-motor nerves leave the spinal cord between the fifth cervical and first dorsal vertebrae. The most powerful vaso-motor nerves are those of the palms, fingers, soles, toes, and ears.

The blood vessels of the abdomen are supplied by the splanchnic nerves. Paralysis of the splanchnic causes death from accumulation of blood in the portal circulation. The same result follows ligature of the portal vein.

The muscles receive their vaso-dilators through the trunks of the motor nerves.

Strong stimuli act on the vaso-motor, more moderate on the vaso-dilator fibers. Vaso-dilator fibers are more easily exhausted than the vaso-motor.

The Visceral Motor Nerves. — The nerves which excite the peristaltic movements of esophagus, stomach, and intestines, leave the spinal cord in the upper part of the cervical region, reaching the intestines through the pneumogastrics.

The veins and the lymph vessels are also supplied with vaso-motor nerves, of which at the present time nothing more than their existence is known; but it might be reasonable to suppose that these nerves obey the same general laws as those connected with the small arteries.

The Sympathetic Nervous System. — The sympathetic nervous system consists of three distinct sets of ganglia, namely, —

1. The lateral, or vertebral ganglia, consisting of a series of ganglia arranged along on either side of the anterior surface of the vertebral column, distributed as follows, — three cervical, twelve dorsal,
four lumbar, five sacral, one coccygeal. (Verify) These two chains of ganglia form an ellipse, the two ends being joined at the top and bottom in a single ganglion. They are connected above longitudinally and transversely by inter-communicating fibers.

2. The prevertebral, or gangliated plexuses, consisting of the cardiac, solar, and hypogastric plexuses, or the thoracic, abdominal, and pelvic prevertebral ganglia.

3. Still further removed from the vertebral chain of ganglia are the visceral, terminal, or autonomic ganglia, which are found in the various viscera,—the liver, kidneys, spleen, pancreas, intestines, and blood vessels. There are two sets of these ganglia, one between the muscular layer of Auerbach's plexus, and lying beneath the mucous membrane, and plexus. The latter controls the glands chiefly, also controls the involuntary muscular fibers of the villi. (See recent paper in "Archives of Physiology."

The Splanchnics. — The vertebral ganglia are connected with the three sets of prevertebral ganglia by visceral or splanchnic nerves, which may be properly termed the thoracic, the abdominal, and the pelvic splanchnics. That is, three in number are in the chest known as the three cardiac nerves, in the abdomen great, lesser, and least splanchnic. Nerve branches connect the prevertebral ganglia with the autonomic ganglia, following the blood vessels. Vascular dilators differ from vaso-constrictors in that they pass directly to the ganglia of the blood vessels without passing through the prevertebral ganglia.

Functions of the Sympathetic. — Every ganglion is a brain. The vertebral ganglia of the sympathetic seem to be the central ganglia of the system. The prevertebral ganglia, or gangliated plexuses, act as reorganizing centers, receiving impulses from all parts of the body and sending them out again to other parts, thus maintaining a universal reaction to impressions received from without. The distal, or automatic
ganglia preside over the minute details of vital work, each controlling its own little sphere of activity.

The sympathetic nervous system presides over the processes of secretion, glandular action, and circulation, and through these control practically all the processes of nutrition and organic activity. Through the grasp of the sympathetic upon the circulation of the brain, cerebral activity, thought, consciousness, judgment, are under the control of the sympathetic.

The automatic ganglia of the heart, intestines, and the blood and lymph-vessels, the fallopian tubes, and of the utero-placental organs, are independent and capable of performing their functions when cut off from all connection with other nerve centers, although under ordinary conditions influenced in the direction of either inhibition or excitation by nerves received from the central nervous system.

It is through the influence of thermal applications to the skin upon the great sympathetic that the most remarkable effects of hydrotherapy are obtained. Through the powerful impression which may be made upon this portion of the nervous system by external and internal applications of water, every nutritive process, indeed, every vital process taking place within the body may be modified, augmented, or retarded, as circumstances require.
ANIMAL HEAT.

Since hydrotherapy, for the most part, consists in procedures which have for the most part the making of thermic impressions upon the skin, it is evident that an accurate knowledge of the phenomena and mechanism of heat production and regulation in the human body is essential to be in correct appreciation of the methods and principles of hydrotherapy. Recent advances have been made toward the solution of the numerous difficult problems involved in the subject of heat production and regulation which render this study especially important and interesting from a practical standpoint.

Source of Animal Heat.-- The heat of the body is wholly derived from food, which, as has been shown by careful calorimetric studies, produces, when completely oxidized within the body, practically the same amount of heat which would be generated by its combustion outside the body.

A study of the heat-producing properties of the various elements of food has shown that an ounce of dried albumin produces in the body sufficient heat to raise nearly 600 pounds of water one degree in temperature. An ounce of fat produces 30% more heat, or sufficient to raise 900 pounds of water one degree, and an ounce of starch a little more than four-fifths as much, or sufficient to raise 400 pounds of water one degree.

The combustion or oxidation of food is not direct in the body as in a furnace, but occurs as a process of disassimilation, under the influence of special ferments which operate under the influence of nerves and centers. Oxygen is assimilated, CO₂ is excreted. Heat is the result of tearing down of complex molecules and the reappearance in the form of molecular vibration of the energy which was previously employed in holding the molecules together in the state commonly known as organization. These changes take place in all the tissues, even, as recently shown, in the blood.
The total amount of heat produced in the body each twenty-four hours is 2,500,000 calories, or sufficient to raise 10,000 pounds of water one degree F. in temperature, or to raise from the temperature of freezing to the normal bodily temperature the body of a man weighing 160 pounds. This amount of heat would be obtained by the complete oxidation within the body of twenty-one ounces of starch, or a little less than half that quantity of fat. The generation of this large amount of heat within the body is necessary to maintain its temperature in the midst of a much cooler medium.

Cold and Warm Blooded Animals.—Cold blooded animals take the temperature of the medium in which they exist, or maintain but a slight difference between the bodily temperature and the surrounding medium, the temperature rising and falling with that of the water or air. The frog in water of 68° or less, maintains a temperature from one or three degrees to a few tenths of a degree above the water. In water of a higher temperature, its temperature is below that of the water.

The temperature of mollusks and fish is 38° F., or scarcely a degree above freezing point. Most mammals have a temperature about that of human beings, namely, 98.5°. The mouse has a normal temperature of 100°. Birds have a normal temperature of 107° to 111°.

Temperature in Man.—Different observers report varying results. The normal temperature of man is generally considered to be approximately 98.6°, the normal limit of variation being 97.2° to 99.8°. The temperature in the mouth is about .5° higher than in the axilla, in the rectum it is higher, and in the vesica, higher than in the axilla.

The temperature of the surface varies, as does also the temperature of the various internal organs.

External Temperatures.—With the temperature of the room about 68°, Munkel found the temperature of various parts of the surface to be as follows:
A young infant approaches somewhat to the condition of a cold-blooded animal inasmuch as its susceptibility to the influence of the external temperature of the environment must not be forgotten in the employment of hydrotherapeutic processes in infants and young children. The ability to react to cold, and so adjust the body temperature to that of the environment increases with development, until during the early years of life.
CRANE'S

1897

ALL LINEN
Internal Temperatures. -- Davy and other observers give the following as the temperatures found in various internal parts:

<table>
<thead>
<tr>
<th>Part</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brain</td>
<td>104°F</td>
</tr>
<tr>
<td>Left Ventricle</td>
<td>107°F</td>
</tr>
<tr>
<td>Right Ventricle</td>
<td>106°F</td>
</tr>
<tr>
<td>Liver</td>
<td>106.8°F</td>
</tr>
<tr>
<td>Rectum</td>
<td>105°F</td>
</tr>
</tbody>
</table>

The temperature of the carotid is one to four degrees higher than in the jugular vein; in the crural artery one and a half to two to that of the crural vein. In the hepatic vein the temperature is three to four degrees higher than in the portal vein during digestion. The blood leaving a muscle is ordinarily about 4°F higher than that supplied to it when the muscle is in a state of rest. When the muscle is active, the difference is three times as great, or about 1.3°F.

The average temperature of the blood is about 102°F. The temperature of the venous blood is nearly two degrees lower than that of arterial blood. The coolest blood in the body is that coming from the nose and ears.

The temperature of the infant or child is normally about one degree higher than that of the adult. After the age of thirty, the temperature falls about one degree below the adult standard, rising a degree above normal, or the standard of infancy, in very advanced age.

Heat Production. -- Heat production in the body is the result of vital work, hence every living cell participates in the work of generating animal heat. The higher the degree of activity, the greater the rate of heat production. Those organs which are the most active functionally produce the greatest amount of heat.
The body of the average man produces each minute sufficient heat to raise seven pounds of water one degree in temperature. In the horse and dog, the rate of heat production is about the same. In a child weighing fifteen pounds, the heat production is found to be twice as great; in the guinea pig, five times as great. In the mouse, heat production is found to be twelve times greater, and in the sparrow twenty-four times greater, than in man.

Heat production is more active in strong and robust than in weak persons. The production of heat is more active in young persons or young animals than in adult persons or full-grown animals, because of the larger proportion of radiating surface and the consequent necessity for greater activity to retain a normal temperature.

Conditions which increase heat production and tendency to temperature rise:

1. **Glandular Activity.** Freshly secreted saliva is found to have a temperature of 2.7° above the blood of the carotid artery. The blood of the renal vein is warmer than that of the renal artery. Blood in the hepatic vein during digestion may have a temperature three or four degrees higher than that of the portal vein, though at other times the difference is only one degree less. The contents of the stomach are somewhat lower during digestion, owing to the fact that heat is rendered latent by the chemical changes taking place in the food under ose digestion.

2. **Muscular Activity:** The blood leaving a muscle when at rest is 3 or .4 of a degree higher than that supplying it. The difference is a degree higher than at rest. Three or four times as great during exercise. The temperature of an oarsman was found to be 104° after rowing one and a fourth miles in a race.

3. **Mental Activity.** Mental activity has less effect on temperature than muscular activity or glandular activity, but a temperature of half a degree is not uncommon at the moment of the mental effort.
CRANE'S

1897

ALL LINEN
4. Digestive Activity. -- Langlois proved that heat production is increased 35% or 40% during digestion. The body temperature rises as the result half a degree or more.

5. Cold applications of cold increase heat production.

The rate of heat production in an animal appears to vary with the extent of its superficial surface.

Circumstances which decrease heat production:

1. Fasting. -- Abstinence from food causes a decided influence upon temperature. At first the temperature falls one or two degrees, then marked emaciation is developed, and shortly before death the temperature declines rapidly. Fasting and badly nourished patients have little heat-making tendency after cold applications typically.

2. Sleep. -- The temperature falls half a degree or more during sleep. It is for this reason that the temperature is usually higher at night than in the morning. The morning temperature is higher in a person who works at night and sleeps during the day. In hibernation, the heat production is diminished to such an extent that the absorption of oxygen is less than one-fortieth as much as during normal activity, and the elimination of CO only one-seventy-fifth the normal amount.

3. Moderate applications of heat lessen heat production and cause a decline in bodily temperature.

Heat Regulation. -- Modern researches upon this subject apparently demonstrate that the heat-producing and regulating mechanism of the body consists of three elements, -- thermogenic centers, thermogenic nerves, and thermogenic tissue.

Of the thermogenic centers there are three classes:

1. The automatic centers, located in the spinal cord, which have immediate charge of the process of heat production, and under the control of which the process of heat production is carried on.

2. The regulating centers, located in the brain, two classes, one of which accelerates heat production by stimulating the automatic centers,
6. A low external temperature (below 70°F and below) causes increased heat production when the body is so exposed as to cause shivering of the flesh and muscular action do not appear, heat production is not increased, and may even be diminished.

7. A high external temperature causes increased heat production through the increased tissue activity induced. The rate of heat production begins to rise above at 60°F, although temperatures between 60°F and 70°F may be regarded as practically neutral in their effects. But fixed the exact neutral point in man at 58°F, Page found the neutral point in dogs to be 77°F at a temperature.
If the rate of heat production was three and one half times the normal,
the influence of external temperature upon heat production is of great practical importance in dealing
with many classes of urban conditions and especially fever.
of the end.

the other exercising a controlling influence by inhibiting the automatic centers of the cord.

The automatic centers appear to be entirely uninfluenced by the various forms of stimuli which influence bodily temperature, while the regulating centers in the brain are extremely sensitive to such stimuli.

Heat applied to the skin acting directly upon the nerve cells stimulates the inhibitory center; while cold applied to the skin, or a lowered temperature of the blood, stimulates the accelerator center. These centers in turn inhibit or stimulate the activity of the automatic centers of the cord, as may be required to maintain the temperature which the system itself seems to establish as the standard to be maintained under given conditions or circumstances.

The inhibitory thermogenic center of the brain appears to rule in a remarkable manner a group of important functions which are utilized in heat dissipation when there is necessity for a lowering of the rate of heat production. These are:

1. Increased activity of the heart.
2. Dilatation of the surface vessels.
3. Increase of cutaneous secretion.
4. Increased rate of breathing.

The blood is a circulating medium which is used not only to convey nutrient material from the stomach to the tissues and excretaentitious matter from the tissues to the excretory glands, but for the purpose of equalizing the temperature, conveying surplus heat of the interior of the body to the surface, where it may be dissipated by conduction, radiation, and evaporation. Nearly nine tenths of the heat of the body is dissipated in this manner.

By the increased rate of heart beat, the exchange of blood between the center and the periphery takes place more rapidly. By dilatation of the surface vessels a larger surface is suddenly exposed to the cool-
ing influences which affect the skin. The extent of surface over which the blood is spread is not wholly represented by the seventeen square feet of skin surface, but rather by the eleven thousand square feet of surface over which the capillaries are spread in the walls of the perspiratory tubules, six times the capillary surface presented by the lungs.

The evaporation of the increased amount of sweat enormously increases heat loss, each ounce of water evaporated from the skin absorbing heat sufficient to raise the temperature of seventy pounds of water, one degree Fahrenheit. By various means the amount of perspiration may be increased to three or four pounds an hour.

The increase of respiratory activity increases heat loss, not only by the increased amount of the air which is warmed, but by the evaporation of water from the two thousand square feet of surface presented by the pulmonary mucous membrane.

In like manner the thermoregulatory centers control a number of mechanisms by which heat production is increased, or by direct operation of the centers in the cord heat is conserved, loss is lessened.

When cold is applied to the surface, or when the temperature of the blood is lowered, the accelerator thermoregulatory center is excited, and as the result:

1. The heart's action is slowed.
2. Surface vessels contract.
3. Perspiration is checked.
4. Rrrector pili and other involuntary muscles of the skin contract, thus hardening the skin.
5. The respiratory movements are slowed.
6. The thermo-automatic centers of the spinal cord are stimulated.

The decreased activity of the heart lessens the rate at which the blood is sent to the surface; the contracted vessels of the skin diminish the area exposed to cooling influence, lessens evaporation and loss of heat thereby; the contraction of the errector pili, by increasing the
firmness of the skin, decrease its conductivity, the diminished respiratory movement lessening the amount of air heated by the lungs, which loses amounts to more than 10% of the total loss, and thus by the combined action of these various mechanisms loss of heat is diminished while stimulation of the automatic centers increased its production. (Add about erection pilo and conductivity of the skin to explanation of heat dissipation.)

**Increased Heat Production and Heat Dissipation Associated.** It is interesting to note that the functions of heat production and heat dissipation are reciprocal. If heat dissipation is suddenly increased by a reflex influence acting upon the heat regulating center, heat production is at once increased and measures set in operation to conserve the bodily heat; while on the other hand if heat production is unduly increased, heat dissipation is immediately increased. Every agent which tends to increase heat dissipation at the same time reflexly stimulates heat production, and whatever diminished heat dissipation likewise by reflex action diminishes heat production. This reflex influence upon the thermogenic centers whereby heat production is increased or diminished occurs independent of any effect upon the circulation.

The special thermogenic tissues are found in the muscles, in which heat production is constantly taking place through the connection of these tissues with the automatic centers of the spine by the medium of the thermogenic nerves. Heat is constantly produced in the muscles even when at rest. When the muscle is active, four fifths of the energy consumed appears as heat, only one fifth in muscular movement.

**A Simple Calorimeter.** In the clinical study of the phenomena of animal heat there has long been a need for a calorimeter which could be used at the bedside. Some seven or eight years ago, while engaged in teaching a class of medical students in hydrotherapy, the writer devised
method of using a common bath-tub for this purpose. The method is as follows:

(Describe method. Also describe the Arsenic.)

FEVER.

Fever is due to the disturbance of the heat-regulating centers, under the influence of toxic substances or nervous impressions, probably in most cases the former. Fever is no longer regarded as formerly, in the light of an unmitigated evil, to be combated irrespective of the symptoms, as it has been clearly shown that a rise of temperature sometimes acts as a curative. It is the result of the resistance of the body against morbid elements which constitute the cause of disease.

The temperature in fever has been known to rise as much as fifteen degrees above the normal in pathological conditions, and a higher temperature has been noted just before death. Recovery rarely occurs when the temperature exceeds 107°F.

In fever the functions of the heat-regulating centers are greatly disturbed, so that influences which under ordinary conditions would not affect the bodily temperature may occasion a rise of temperature of several degrees."

A warm atmosphere in febrile conditions, raises temperature, but by decreasing heat elimination and by increasing heat production, also increases heat production, but to a less degree. Exercise either muscular or mental, even so slight as sitting up in bed or conversing with a visitor, may cause a relapse when the patient is just convalescing from a febrile attack.

Although the body is at rest in bed, there is in fever, great activity in the thermogenic tissues connected with the muscles, hence the predominating feature in fever is increased heat production. Heat dissipation may also be increased, but usually in less proportion than when the skin is freed and moist heat elimination is about three times the normal.
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follows:

Give description of method. Also describe Dr. Arsenyev's)

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The predominating feature in fever is increased heat production. Heat
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The dissipation of heat may also be increased, but usually in less proportion:

When the skin is red and moist heat elimination is more than three
times the normal.
In other words, there is in general a desire in the brain regulating centers of the generation and circulation of heat are not perfect, while disturbances of temperature which tend to produce depression of temperature, and those which produce temperature elevation.

As a result, there is a tendency to increase heat production and at a temperature of 104°F, heat production is increased to more than three times the normal amount, since the instability of proper regulation of the temperature of the air surrounding the
32 degrees Fahrenheit

Body temperature is an average of:

For each 1 degree increase in temperature:

1°C (1.8°F) increase in temperature:

There is an increase of heat loss detection of five percent, (or 2.5%) by thermocouples. The following table represents the percentage increase for each degree increase within the ordinary heat of body temperatures.

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Percentage Increase</th>
</tr>
</thead>
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The US Coast Guard Chief

stated that heat production in

the experiments with glycerol

for heat production as well as

muscle work.
The muscles are the chief source of heat production in the world. They store as glycogen for heat production as well as muscle work.
In a room the temperature of which varies little, and is about 70°F, fill a circular bath-tub with water, at any desired temperature, and allow it to remain undisturbed for fifteen or twenty minutes. Place in this tub two thermometers graduated for tenth of a degree, and make an accurate record of the temperature indicated by each thermometer every two minutes. By this means the average rate of loss of temperature may be obtained. The average of the readings of the two thermometers being taken for the actual temperature of the water, you first throw the patient into the bath, and continue stirring the water and taking the temperature every two minutes as before. At the end of the experiment add the amount indicated by the rate at which the water in question is cooling. The difference between the number of degrees by which the water is cooled and the number of degrees lost by the body during the period of exposure will indicate the amount of heat absorbed by the water. The following is the record of an experiment.
In certain febrile conditions, the rise of temperature is chiefly
due to diminished heat dissipation, a fact which must be kept in mind
in therapeutic applications for the reduction of temperature. The effect
of a warm atmosphere in increasing heat production in fever is the oppo-
site of what occurs in health. This fact seems to suggest that in a
febrile state the body approaches the condition of a cold-blooded animal,
in which heat production increases with rise of temperature in the
surrounding medium.

The temperature may be reduced in fever either by diminishing heat
production or increasing heat elimination, and therapeutic applications
may be made in such a manner as to effect either heat production or heat
dissipation. Both heat production and heat dissipation may be in-
fluenced by drugs of various sorts, which are known as antipyretics. The
effect thus produced, however, is purely toxic in character, and involves
not simply the heat-producing or heat-regulating centers, but all other
and centers as well, hence lessens the resistance of the body and the ac-
tivity of the reparative processes by which the curative forces of
the body seeks to effect a cure.

It is encouraging to note that the fever-controlling drugs of all
sorts are much less used by physicians at the present time than formerly,
and that their pernicious effects are being recognized, and the value of
physiological measures whereby the end sought may be safely and far more
efficiently obtained is recognized.

(Medical thermometry: describe my method)
PHYSIOLOGICAL EFFECTS OF COLD.

Cold is a vital depressant. Under all circumstances and in all modes of application this is its primary and its real effect. The discussion in relation to the physiological effects of cold which waxed warm and heavy a century ago grew out of the fact that those who maintained it to be a tonic or stimulant, failed to observe that its so-called tonic or stimulant effects were secondary results following a primary depression.

A low temperature, in whatever way produced, checks cell or protoplasmic activity. This may be readily seen by microscopic study of the amoeba or white blood-corpuscle, the movements of which are at once suspended when the temperature is lowered, but begin again with the application of heat. The life processes of warm-blooded animals are slowed when the bodily temperature falls a few degrees below the normal for the individual class or species of animals under investigation. This accounts for the phenomenon of hibernation. In a bear in the state of hibernation the temperature has been found as low as the point of the scale, and respiration... showing almost complete suspension of vital activity. In this state little waste of tissue takes place, so that the animal may pass several weeks without eating or drinking.

In fishes, the temperature of which is generally above the water in which they live, the temperature may be reduced so low that actual freezing takes place when there seems to be complete suspension of vital activity, but not actual death, and the animal may live in this condition for weeks and even months.

The depressing influence of cold upon vital activity is utilized in the preservation of food, the germs which produce putrefactive processes being unable to multiply and produce their peculiar ferments and toxins at a temperature of \(32^\circ\) F. It is through this depressing influence also that diphtheria and other localized maladies may, often, be effectually controlled by applications of ice to the affected parts. The activity
of the perspiratory glands is at once checked by the application of cold, as is also the secretion of gastric juice by the pepsic glands, as witnessed by Beaumont in his experiments upon Alexis St. Martin.

In the study of the physiological effects of water at different temperatures upon the various bodily structures and organs, we must keep in mind the fact that as employed in hydrotherapy, water is chiefly useful as a means of communicating or abstracting heat from the body. In its internal use, its caloric effects are supplemented by effects arising from its solvent and nutrient properties elsewhere discussed. In its external use, certain mechanical effects are added to its caloric effects in some forms of application, particularly the several varieties of the douche.

Heat and cold, as before remarked, are relative terms, objects being recognized as cold when they have a temperature less than the zero of the temperature sense, that is, the temperature of the skin, and the reverse. For convenience, however, in the study of the physiological effects of water, as well as in directing its therapeutic application, it is necessary to fix the meaning of certain terms indicative of the approximate temperature of the application. The terms which have been most commonly employed are the following: very cold, cold, cool, tepid, warm, hot, and very hot. The terms tepidate, nauseating, excessively hot, and excessively cold are used, especially by French hydrotherapeutists, but the utility of these terms is so limited that we have eliminated them.

As this classification is artificial and arbitrary, it is not easy to fix the exact limits of temperature to which each term should be applied, and this fact has given rise to considerable discussion and diversity of opinion. The writer believes, however, that the following table represents very nearly the consensus of intelligent opinion and the results of the largest experience upon this point.
The effects of applications at these various temperatures differ somewhat according to the part of the body to which the application is made, owing to the different temperatures of the different surfaces which vary considerably.

Whether or not the final effect of an application of cold is sedative or excitant depends much on the mode of application and the temperature employed, but chiefly on the length of the application.

When cold is applied to the body in any form, whether internally or externally, the first effect is, as stated, depression and a lessening of the activity of the living structures with which the cold medium comes in immediate contact. If the application is continued for a long time, this vital depression continues likewise, and is maintained after withdrawal of the application. The longer the application, the longer the depression which follows. Sooner or later, however, the parts return to their normal condition, and if the depression has not been so great as to vitally damage the parts, in the return of normal activity the pendulum swings, so to speak, beyond the normal line, so that for a time a higher degree of vital activity is maintained than before the application. This is what is termed "reaction."

When the cold application is a short one, the reaction follows quickly and is as much more intense as the application made is vigorous. In very low temperature and administered with much pressure, application of a low temperature made suddenly and for a brief period is as easily done as off a knife.
quickly followed by a violent reaction.

The application may be so managed that the primary effect or action, in other words the sedation, may be diminished, or the reverse; the secondary effect, the reaction or state of excitation or stimulation being diminished, may be increased.

Cold may be applied by means of ice, cold water, cold air, or by means of the evaporation of water or other volatile liquids from the surface of the body, which may be either spontaneous or increased by a current of air. In hydrotherapy, all these methods are employed. The same principles rule, however, whatever the mode of application.

All discussion respecting the mode of so-called action of cold must cease with the recognition of the fact that it really has no physiological action whatever, acting only as a physical agent to lower the temperature of those parts with which it comes in contact. The so-called physiological action is wholly due to the action of the body itself; first, in recognizing the presence of an agent which interferes with its functions and injuring the integrity of its tissues, and second, in rallying its forces to repel the invader, or to avert the danger arising from its presence. Keeping this principle in mind, the interpretation of the various phenomena developed by the application of cold to the body will be found to be relived of many difficulties.

A series of interesting experiments upon animals made reported by Wertheimer, in 1893, showed that the general effect of excitation of the sensory nerves of the skin by cold are in accord with the general law relating to the reflex influence of peripheral irritants of all sorts, chemical, electrical, etc.; namely, short and intense applications cause a brief preliminary contraction of the vessels of the internal viscera, which is quickly followed by a dilatation of the same; while a prolonged more moderate application of cold to the surface results in prolonged contraction of the small vessels in the internal regions of the body.
This contraction appears to be one of the methods by which nature seems to defend herself against injury from the loss of heat through the application of cold. By the slowing of the rate at which the blood passes through the internal organs, these organs will be deprived of less heat than though the circulation were continued at the usual rate. The vessels of the skin being contracted at the same time, it is apparent by this wise provision of nature the body is most efficiently protected against injury from cold.

Haümann operating upon frogs detached all portions of one of the hind legs with the exception of the sciatic nerve, and then applied cold and irritating substances to the skin of the separated leg, and observed with the microscope the effects upon the mesenteric circulation. He observed that if the water employed was of low temperature and the application brief, the mesenteric vessels were contracted, while if the application were much prolonged, or the water not very cold, the mesenteric vessels were dilated. This experiment shows that intense cold stimulates the vaso-constrictors, both internally and externally, but reaction takes place internally even during the application. Applications of higher temperature produce opposite effects.

It is interesting to note the fact that the dilatation of the vessels of the viscera after a short intense application of cold to the surface follows so quickly that it is distinctly recognized as its primary effect, although from a physiological standpoint it is the secondary rather than the primary effect of the application. The vasodilatation is a phenom enon of reaction which occurs more quickly in the viscera than the skin, because of the higher temperature of these organs and their complete protection from the cooling processes to which the skin is subjected.

Influence of Cold upon the Skin. -- The phenomena observed following an application of cold to the skin are the following:

1. Contraction of the small blood-vessels. A short application of
cold or very cold water at 32° to 65° degrees, produces pallor of the skin, due to contraction of the small vessels. This is the result of the reflex excitation of the vaso-constrictors.

When the application of cold is long continued, the surface becomes blue, due to the fact that the weaker muscles in the walls of the small veins become exhausted and relaxed, while the arterioles are still contracted. The veins being filled with blood, the hemoglobin of which has been reduced, the skin becomes blue or purplish in color. This is the primary effect of cold, or rather the vital action produced by it during the application.

When the application is withdrawn, the parts return to their normal condition, and if the application has not been too greatly prolonged, the pallor or blueness gives place to redness, the result of relaxation or dilatation of the small arteries and capillaries of the skin. This is the secondary effect of cold, or so-called reaction, one of the most interesting and important phenomena connected with the application of water to the body, the full discussion of which is left to a separate chapter.

Percussion, or slapping— the same effect on the small vessels as cold water, causing first stimulation of vaso-constrictors, and later the reverse.

2. Decrease of Suspension of Perspiration. — The almost instant suspension of the glandular action of the skin as the result of the action of cold is even more remarkable than the excitement of these glands by the application of heat. It is evidently a purely reflex phenomenon, as suspension of perspiration takes place before the application of cold has continued long enough to occasion a lowering of the temperature of the blood so that suspension of the action of the perspiratory glands may take place while the sweat centers are still experiencing the stimulating effect of a blood temperature sufficiently high to provoke intense action.
1897

Crane's
of the glands.

This sudden checking of perspiration as the result of application of cold is injurious or dangerous only when the body is in a state of fatigue, or when the perspiratory activity is the result on the part of the system to antagonize the febrile movement, as in the sweating stage of malarial fever, sweating sickness, etc.

5. Decreased Heat Elimination and Increased Heat Production. — Cold applications, by causing contracting of the small vessels, lessen the circulation in the skin, and in this way lessen the amount of blood circulating through the skin, thus tending to diminish heat elimination. At the same time, and the reflex effect upon the centers controlling heat production is such as to stimulate the development of animal heat in the body.

The reaction which occurs, however, directly after the first contact with the cold application, results in an increased circulation of blood through the skin, thus exposing a large area of blood to the cooling influences which act upon the surface of the body, so increasing heat elimination; and if the application of cold is long continued, the temperature of the muscles lying beneath the skin, as well as that of the skin itself, is lowered, thus checking the heat-producing processes which are most active in the muscles, in which about one-half of the heat within the body is produced.

6. Lessened Tactile Sensibility. — Applications of a temperature below 28° to 38° lessen the acuteness of the tactile sense. Even a brief application of ice or very cold water will abolish tactile sensibility, and the same effect is obtained by a prolonged application of cold water. This property of cold applications is taken advantage of by dentists, who freeze the gum by the application of ether, or quinine spray, as a means of obviating the pain of tooth extraction. Other simple operations are rendered painless in a similar manner.
It is also noteworthy that suspensions of the action of the mucous glands of the entire skin surface may be brought about by application of cold to a very small area as in cases the hands or feet in some cases the hands or other equally small surfaces.
5. Very Cold Applications or Prolonged Applications Excite Pain.--Applications below 32° do not excite the temperature sense, but give rise to pain. Even very cold applications are to most patients painful at first, producing shock. The cold impression is more painful if the application is made gradually; that is, if the cold application is gradually brought into contact with the body then if the application is brought to bear upon the whole surface at once, as in the plunge bath, the sensation in the latter being more generalized, whereas in the former it is concentrated upon the limited surface which is just coming in contact with the cold application. The fine spray feels cooler than a douche at the same temperature for the reason that the spray stuns the skin by its mechanical effect and thus lessens its sensibility. Immersion in cold water also for the same reason gives rise to more shock or pain than the douche, though at the same time less intense. A curious fact not infrequently noted is that more distress is experienced from the application of water at a temperature from 55° to 65° than by water from 45° to 55°. This is perhaps due to the more prompt reaction at the lower temperature.

The Influence of Cold Upon the Circulation.

Cold slows the circulation and diminishes the frequency of the heart beat. The slight shock occasioned by the first application of cold increases momentarily the activity of the heart, but the pulse rate quickly returns to normal and is soon perceptibly slowed, the effect depending upon the intensity and duration of the application. This effect is the result of the reflex influence of the stimulation of the skin upon the nervous mechanism of the heart. This phenomenon is due to the fact that the accelerator nerve of the heart is first excited, later the pneumogastric, whereby the heart's movements are slowed. It thus appears that
very short application of cold produces increased activity of the heart, whereas a more prolonged application slows the heart. The effect of cold, however, applied to the skin may be considered to be that of a depressing agent.

Local applications of cold produce varied effects, some of which may be regarded as reflex, others as due to the direct influence of cold upon the involuntary fibers of the small vessels and the sympathetic ganglia in the vessel walls. Some of the most interesting of the phenomena produced by local applications are the following:

Naumann showed that cold applications made to the limb of a frog completely separated from the body with the exception of the sciatic nerve, gave rise to contraction of the mesenteric vessels, if the degree of cold was moderate and the application short; while an application at a lower temperature or more prolonged, gave rise to dilatation of the vessels.

Edwards has shown that immersion of the hand in cold water gives rise to lowering of temperature in the other hand.

Tholozan and Brown-Séquard showed that the application of

Plethysmographic experiment made by Francq showed that a piece of ice held in one hand causes shrinking of the other hand within two or three seconds, with a return to the normal volume at the end of a minute.

Snow rubbed upon the inside of the arm at the bend of the elbow, or ice applied to the subclavian region, diminishes the height of the sphygmographic tracing obtained from the radial artery (Winternitz), showing a contraction of the distal portion of the artery.

A compensatory effect is sometimes observed. Winternitz has noted that placing the elbow in water at 50° for thirty minutes gives rise to an elevation of temperature in the axilla, showing an increase in the internal temperature corresponding to a lowering of the external.
Waller noted that the application of ice over the cubital nerve at the elbow produced a rise of temperature of \(7^\circ\) in the two last fingers, while the temperature of the other three fingers fell an equal number of degrees. The muscles of the hypothenar region were at the same time paralyzed.

The phenomena developed by this interesting experiment are closely akin to those observed by Bernard, following the division of the sympathetic nerve of the ear of a white rabbit, which occasioned reddening of the ear of the side operated upon, while the opposite ear became pale.

Cold applied across the trunk of an artery causes contraction in its distal portion. An ice-bag applied to the axilla lessens the circulation in the arm. An ice cravat, or ice-cold compress applied about the throat lessens the cerebral circulation through its influence upon the carotid and the vertebral arteries. The vertebral arteries alone may be influenced by an ice-bag applied to the back of the neck. An ice-bag over the femoral artery in like manner lessens the circulation in the leg. The circulation in the hand and foot may be controlled by the application of an ice-bag to the bend of the arm or the knee. An ice-bag applied over the heart slows its action and thus diminishes the rate of the circulation of blood in the entire body. It thus becomes a useful measure in fevers.

This sedative effect of cold applied over the heart is also found of great service as a means of relieving palpitation. The accompanying sphygmographic tracings (Nos. \(\ldots\) \(\ldots\) \(\ldots\)) illustrate the influence of a cold upon the heart.

Bothrig showed that short applications of cold to the skin have the effect to excite the heart, while very prolonged applications lessen the heart beats.

Winternitz showed that application of cold to a limited surface of the skin increased the heart beats for three minutes. The pulse then
The influence of cold upon the mucous membrane is essentially the same as that upon the skin, except that the mucous membrane is somewhat less sensitive to the influence of cold, having a smaller number of sensory nerve fibers. The mucous membrane is, however, richly supplied with vasomotor and sympathetic fibers, through which decided reflex effects are produced. A large quantity of cold water taken into the stomach produces even more marked effect than water applied to an equal area of the skin. The general temperature may be lowered by this means, and the heart's action lessened, and the activity of the general circulation diminished. Cold water drinking often lessens the pulse rate to 10 to 15 beats per minute.

Even more marked effects are produced by means of the cold enema, which, together with water drinking, is one of the most efficient means of combating fever.

In this depressing effect of cold water when taken into the stomach, we have the explanation of the results which sometimes occur in drinking cold water in a state of fatigue. The power of reaction being less, chill and resulting internal congections are produced which result in great injury. Cold water drinking is not contraindicated by active perspiration, but rather by fatigue, whether the skin is in a state of activity or not.
EFFECTS OF COLD UPON RESPIRATION.

The observations reported by Halle, Fleury, Richter, Johnson, and others seem to indicate no regularity in the effects of cold upon the respiratory movements. One reports no appreciable effect; another, quickening of the respiratory activity, with slowing of the heart; another, sometimes quickening, sometimes slowing, of respiration. This confusion seems to be the result of failure to note the difference in the effect produced by different modes of application. The effects noted by the writer have been found pretty uniformly the following:

When the cold application takes the form of the douche, the effect is to produce at first short gasping respiratory movements, this effect being more pronounced the lower the temperature, the more abrupt the application, and the more force employed. If, however, the patient is immersed in the full bath, respiratory movements after the first instant are slowed to a marked degree, and are decidedly fuller or deeper; that is, the amount of tidal air is increased.

The effect of the douche or spray of increasing the rate of the respiratory movements is especially pronounced when it is applied to the chest or upper part of the body. Thus employed an unpleasant sensation of constriction in the throat is also produced, the very opposite of the effect following an application of warm water. This property of cold water must always be borne in mind in the treatment of rheumatic, it is doubtless reflex in character. The pulmonary vessels being made to contract suddenly by the powerful excitation of the vaso-constrictor centers of the cord, the area of blood presented for gaseous interchange in the pulmonary mucous membrane is very greatly diminished, while at the same time the demand for oxygen and for the elimination of CO₂ is increased, thus bringing about a painful sensation experienced in suffocation.

This sensation disappears at once when reaction occurs, and the quickened respiratory movements are succeeded by slower and fuller move-
CRANE'S

in whom a cold dry, the Bute chut will generally produce a paroxysm of asthmatic breathing, and sometimes a most distressing sense of suffocation.
ments accompanied by increased absorption of oxygen and increased elim-
ination of CO₂.

An examination of the expired air shows that a larger amount of
oxygen is absorbed and a larger amount of CO₂ is exhaled under the
influence of cold applications.

Oxidation of many organic waste substances takes place in the lungs.
(See American Textbook)

Liebig observed more than half a century ago that cold air, cold
water, and exercise, habitually employed, are the most powerful of all
means of stimulating tissue activity.

EFFECT OF COLD UPON THE MUSCLES.

Prolonged application of water at a low temperature decreases mus-
cular irritability and muscular energy. This is shown in the stiff, and
clumsy condition of the fingers as the result of exposure at low tem-
perature.

The muscular sense, or sense of weight, is likewise affected by
cold. Cold objects feel heavier than warm ones. The probable cause of
this is that the expenditure of nervous energy is larger when required to
lift a cold object than a hot object, owing to the lessened muscular
irritability. (Experiment upon this point to determine whether true.)

A short cold bath, as a douche or a spray, lasting for a few seconds
and due to a very remarkable degree. An exp-

The above results in delivering

A cold douche feels stronger than a warm
doche.
The cold bath, if very short and given with much pressure, and especially if preceded by a hot bath, is a powerful means of restoration after excessive muscular exertion resulting from severe muscular effort, but it must be immediately preceded by a hot bath and must be very short and vigorous, two to four minutes.

(Here add + 2 ½)
It is a curious and interesting fact that while cold lessens the irritability of involuntary muscles, it excites the activity of the smooth muscular fibers of the skin, thus giving rise to the appearance known as goose flesh. It also causes contraction of the smooth muscles in the small blood-vessels, and when applied to a large area of the skin or over special regions, as the feet or lower abdomen, may excite the involuntary muscles in the bowels and bladder, causing evacuation of these cavities.

Shivering is due to the involuntary action of the voluntary muscles, set up reflexly as a means of combating the influence of cold by producing an increased amount of animal heat.

The application of cold water to the feet, as by means of the spray or stepping into a cold bath, may produce a goose flesh appearance over the entire surface of the body, with shivering. The application of a cold spray or douche to one side of the body will produce a goose flesh appearance of the opposite side, which has not been moistened, together with the usual phenomena attending the application of cold to the entire surface of the body, thus demonstrating the powerful reflex character of the phenomena set up by cold applications are universal in their effect within the body.

The Influence of Cold upon the Nervous System.

Nearly all the phenomena arising from the application of cold are illustrations of the effect of cold upon the nervous system. In this section we shall call attention especially to those effects of cold which are chiefly confined to the nervous system itself.

The recent developments in the minute anatomy of the nervous system throw much light upon the method by which the nervous functions are influenced by cold as well as other agents. The discovery of the fact that each nerve cell, or neuron, is an independent entity, connected with
other cells or tissues by contact only and not by actual continuity of structure, and the further discovery that in its activities, the nerve cell actually executes movements whereby it undergoes distinct changes in form, retracting or protracting its dendrites and the delicate filaments containing the end-tuft of its neuraxon, has afforded a rational explanation for much that was before mere surmise or conjecture.

The neuron is by these discoveries found to be subject to precisely the same laws which govern protoplasmic activities elsewhere than the animal nervous system. A careful study of the influence of heat and cold upon the erythro and white blood-corpuscles teaches that the influence of heat is to cause increased activity of the cell with excitation of protoplasmic processes or arms, while cold diminishes activity, causing retraction of its processes. We may hence justly conclude that when cold applications are made in such a manner as to affect the nervous system, similar changes occur. We know, for example, that insensibility is due to the retraction of the dendrites, or protoplasmic processes of the neuron or nerve cell in that part of the brain in which the center of consciousness resides, thus cutting off connection with the rest of the nervous system by breaking contact at the points at which connection is necessary for maintenance of the state of consciousness. The same principle applies to all other nervous functions. Increased nervous activity of any particular sort means simply increased movement of the neurons, active protraction of their dendrites, and increased contacts with other neurons through their neuraxons with their collateral branches end-tufts and innumerable gemmules or contact globules. These interesting relationships will be easily understood by reference to the accompanying explanatory plate.

(Show cuts of nerve cells, Purkinje cells, neuraxons showing collaterals, and gemmules.)

With these facts in mind, it is not difficult to understand that
applications of cold to a nerve trunk may greatly diminish or even entirely
abolish its functions, by paralyzing the parts to which it is dis-
tributed, as in Waller's experiment, in which an application of ice to
the cubital nerve at the elbow caused paralysis of the hypothalamic region.

Helmholtz showed that the application of cold to a nerve may dimin-
ish the rate of transmission of nervous impulses over it to one-sixth the
normal rate. After such an application of cold to a nerve trunk and its
withdrawal, the nerve quickly recovers, and the part to which it is dis-
tributed becomes the seat of pain, which may be very intense, showing
that nervous sensibility is heightened in the reaction which follows the
numbing effect of a cold application.

If the application of cold is less intense in character and less
prolonged, the sedative effect may be so slight as to be unnoticed, so
that the effect observed may be simply that of excitement, which, how-
ever, as we have shown, is simply due to the rebound or reaction which
naturally follows vital depression, owing to awakened resistance.

In like manner, a short application of cold to the head results in
increased cerebral activity. The reaction—effect completely over-
shadows the brief depression first produced. A prolonged application of
intense cold to the head results, however, in a decided lessening of
cerebral activity, and may give rise not only to stupidity and drowsiness,
but absolute unconsciousness, a fact which has for centuries been made
use of in prisons as a means of subduing refractory offenders.

REFLEX EFFECTS OF COLD APPLICATIONS.

Interesting facts which have already been presented in relation to
the influence of cold upon the skin, both locally and distant parts, are
examples of reflex effects. The effects include not only dilatation
and constriction of blood-vessels, but also contraction of the smooth
muscles found in the bowels, bladder, and other hollow organs of the
body. The minute air-tubes, and the ligaments which support the visceras, the various secreting structures, the liver, kidneys, digestive glands, and other allied structures are also influenced reflexly by specific applications of cold in the distal parts which are in relation to the area operated upon.

A short, very cold (40° to 55° F.) application, at high pressure, produces vaso-dilatation.

A prolonged application of cold of less intensity and without percussion effect, produces vaso-constriction.

A prolonged cool or cold application (55° to 60°) produces vaso-constriction in the distal parts which are in relation to the area operated upon.

Application to Vascular Reflex Areas.

Reflex Effects upon the Muscles. — By keeping in mind the above facts, it is apparent that to produce reflex effects in the muscles we have but to make cold applications to those areas, stimulation of which is capable of developing muscular contraction. These areas, as elsewhere pointed out, are the intra-scapular (space between the shoulder blades).

The epigastric (the sides of the chest at about the level of the 4th rib).

The abdominal (the borders of the recti muscles).

The cremasteric (inner and upper surface of the thigh).

The plantar (sole of the foot).

By the stimulation of the skin of these several areas, a large part of the muscular groups may be brought into activity. This is particularly true of the plantar surface. Short, very cold applications, at high pressure, made upon these surfaces may be very serviceable in all cases in which it is desirable to stimulate the nutrition of the muscles, as general muscular weakness, parasis or paralysis, and progressive muscular atrophy, and other maladies in which there is wasting of the
A most useful effect is obtained from the contraction of the uterine muscle which is set up by cold applications to parts in reflex relation with it, as the hands, feet, breasts, and abdomen, whereby contraction of the uterine muscle is produced.

SPECIAL REFLEX AREAS IN RELATION WITH THE INTERNAL VISCERA.

Cold applications to the face and neck, short and intense, cause dilatation of the cerebral vessels.

A prolonged contraction of the cerebral vessels is produced if the application is greatly prolonged, and vertigo and even unconsciousness may result.

Short and intense applications of cold to the neck and chest produce an acceleration of the pulse and of the respiratory movements, followed by slowing of the heart and respiration.

Prolonged immersion of the hands in cold water causes contraction of the vessels of the brain and mucous membrane lining the nose. It is thus useful in combating cerebral hyperaemia and chronic nasal catarrh.

A prolonged cold foot-bath causes contraction of the vessels of the brain and mucous membrane of the nose, increases secretion of the kidneys, and stimulates the bladder and the bowels.

A short cold foot-bath causes contraction of the vessels of the uterus, and may thus be useful in combating hemorrhage.

Very cold applications to the breasts, abdomen, the hands, and the feet cause contraction of the involuntary muscles of the bladder, bowels, and uterus. It is more than probable that muscular structures in the liver, spleen, and other viscera are likewise influenced by cold applications to the parts named, as well as by applications made to the overlying areas of skin.

A short, very cold douche to the feet, with strong pressure, dilates the vessels of the uterus, and is hence useful in amenorrhea.
A prolonged cold application to the upper dorsal region relieves congestion of the nose, and is hence useful in nosebleed. The popular practice of applying cold metal to the spine to check nosebleed shows the relation of this surface to the nasal mucous membrane.

A prolonged cold application over upper dorsal and lower cervical region causes contraction of the pulmonary vessels; and is hence useful in pulmonary congestion and hemorrhage. Application to the lower dorsal region will often arrest vomiting.

Prolonged application of the ice-compress, or ice-bag, to the lumbar region produces dilatation of the vessels of the uterus and lower extremities.

A cold lumbar douche at moderate pressure, and continued for a quarter to three-fourths of a minute, produces contraction of the vessels of the uterus.

A very cold and very short douche (two to four seconds), with strong pressure to the lumbar region, produces dilatation of the uterine vessels. The last-named measure is accordingly useful in amenorrhea and certain forms of dysmenorrhea.

Prolonged cold applications to the breasts and the internal surface of the thighs produces contraction of the vessels of the uterus. Winternitz has shown that cold applications to the thighs also influences the pulmonary circulation, combating congestion.

A short cold douche applied to the lower portion of the sternum stimulates the kidneys, increasing the flow of urine.
Short cold douche, with strong pressure over the liver, stomach, spleen, bowels, produces dilatation of the blood-vessels, with increased activity in these organs.

Contraction of the small vessels may be produced in the liver, spleen, stomach, bowels, and other internal viscera by the application of cold of moderate intensity to the skin over these organs. This measure is of great service in the treatment of pathological conditions involving congestion of these organs.

Cold applications to a reflex area often give rise to a sense of
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constriction in the parts reflexly connected, as when a cold douche is applied to the feet, a strong sensation of constriction is felt in the lower abdomen.

SUMMARY OF METHODS FOR REFLExLY INFLUENCING THE INTERNAL VISCERA.

The vessels of the important viscera may be caused to either dilate or contract, according as the application is intense and short (dilatation), or moderate and long (contraction), by the following methods:--

The brain, by applications to the neck, the neck and face, the hands and the feet.

The heart, by applications to the neck and face, upper dorsal spine, and hands and feet.

The stomach, by applications to the lower dorsal spine and the epigastrium.

The kidneys, by applications to the lumbar region, the lower portion of the sternum and the feet.

The bowels, by applications to the feet and the abdomen.

The bladder, by applications to the feet and abdomen.

The liver, by applications over the lower right chest.

The spleen, by applications over the lower left chest.

The lungs, by applications over the chest and to the thighs (Winteritz), also the upper dorsal region.

The uterus, by applications to the lumbar region, the feet, and the abdomen, the breasts, and the uterus itself.
THE EFFECTS OF COLD UPON THE BLOOD.

In .................. (see Modern Medicine) Prof. Winternitz, of Vienna, called attention to the remarkable influence of cold applications in increasing the number of blood corpuscles, both red and white, and also the amount of hemoglobin. Thurneys had previously called attention to the same fact. Winternitz carried his experiments further, and also noted the fact that white blood corpuscles are increased in much greater proportion than red corpuscles. In one case reported by Winternitz the total increase of red corpuscles by one bath was from .......... to .........., and in the same case the increase of white corpuscles was from .......... to ..........

In a case observed by the writer the increase was from .......... to .......... The remarkable phenomenon is due, according to Winternitz, not to the sudden creation of new blood corpuscles, but to sudden contraction of the vessels of the viscera immediately following the application of cold to the surface, whereby great numbers of corpuscles, which show a disposition to collect in the vessels of the liver, kidneys, spleen, and other internal viscera, are driven into the circulation.

That this explanation is not entirely complete, however, is shown by the fact that local application of cold water are followed by an increase in the number of corpuscles and the hemoglobin at the seat of the application, though no such increase is observed elsewhere.

According to Henochque, both cold applications, as well as hot, increase the rate with which oxy-hemoglobin of the blood is reduced.

D’Arsonval and others have shown by the estimation of gas contained in the blood at different points of the body simultaneously that the interstitial combustions are increased by cold applications. These observations have been confirmed by Rickert, and others, who have shown that the gaseous exchanges are decidedly increased by cold applications, so that a greater amount of oxygen is passed through the body in a given amount of time.
THE INFLUENCE OF COLD UPON ABSORPTION.

By introducing belladona into the rectum and observing the length of time which elapses before dilatation of the pupil and other characteristic physiological effects appear, Fleury shows that absorption from the alimentary canal is very greatly increased by the cold douche. The writer has repeated these experiments with the following results:

'It is a fair inference that the absorption of food is likewise increased by the cold douche.'

These results show clearly that cold applications to the surface stimulate absorption from the mucous membrane of the alimentary canal, and consequently that such applications must favor nutrition by promoting alimentation.

THE INFLUENCE OF COLD UPON SECRETION.

A short, very cold douche, administered with much pressure over the stomach and liver, has the effect to increase the secretory activity of these organs by dilating their vessels, thus increasing the quantity of blood brought in contact with the secreting cells, and at the same time stimulating their activity.

Experiments made upon the rabbit and dog show that intense applications of cold give rise to increased production of sugar, sugar appearing in excessive quantity in the blood, and if the application is of sufficient intensity, in the urine also. As it is generally conceded that the glycogenic of the liver may be taken as an indicator of its activities in other directions, it is evident that cold applications may be made in such a manner as to produce greatly increased activity of the hepatic functions. Similar effects of very cold applications have been observed in man. It is hence apparent that all applications of water which favor destruction and elimination of tissue poisons and pathological toxines,
must be capable of rendering valuable service in the treatment of renal
disease, in which the elimination of these wastes becomes

The following experiments have been made by the author to prove that
the secretion of hydrochloric acid by the stomach glands may be stimula-
ted by suitable applications of cold water, as well as by hot applica-
tions, as before stated.

INFLUENCE OF COLD UPON EXCRETION.

Short applications of cold applied to the skin, being followed by
intense reaction, favor perspiration, while prolonged cold applications
had the opposite effect.

As a rule, an increase in the quantity of fluid eliminated through
the skin is accompanied by a decrease in the quantity of urine. This is
not universally the case, however, and it should be remembered likewise
that the quantity of urine is not the true measure of renal activity,
but rather the quantity of poisons removed from the system.

Applications of ice water to the skin of a dog causes temporarily a
decided decrease in size of the kidneys, due to contraction of vessels
and tissues. The reaction following a cold application
gives rise to dilatation of vessels and relaxation of tissues, and in-
creased functional activity.

The conflicting results reported by Popoff, Miller, and other in-
vestigators respecting the influence of cold applications upon the renal
function, led the writer to undertake a series of experiments for the
purpose of determining the effects of the cold bath upon renal activity,
with the following results:—
General cold applications, especially the cold douche, and increase the production of HCl, and hence improve the quality of the gastric juice. The alternate circle douche is perhaps of all means of promoting gastric secretion the most efficient.

Cold applications which give rise to increased heat production and a corresponding increase of CO₂, do not give rise to an increase in urea. The production of urea seems to be regulated by the body temperature. An increase in the body temperature is accompanied by an increase of urea, as in fever; with a depression of the body temperature, urea production and elimination is decreased.

Cold applications to the lower third of the thigh (the serial douche) excite sexual activity.
The Influence of Cold Applications Upon Animal Heat.

Curry first showed (quote "Effects of Water Cold," London, 1797) that applications of cold water to the surface are capable of lowering not only the surface temperature, but also the internal temperature of the body.

This was the beginning of scientific hydrotherapy. In an experiment related by Curry, a healthy man was put into a bath at 40°, his temperature at the time being 97.3°. His temperature, according to the observer's statement, quickly fell to 83.1°, but rose at the end of fifteen minutes to 91.3°, at which point it remained for nineteen minutes, when the temperature again rapidly descended, reaching in three minutes 84.9°, at which time the experiment was interrupted. The subject, who had been in the cold bath thirty-five minutes, was then placed in a hot full bath at 95°. As he continued to shiver vigorously, the temperature of the bath was raised to 103°. At the end of twenty-eight minutes the bodily temperature was found to be normal. The fact that other observers have frequently noted a remarkable lowering of bodily temperature as the result of administering a cold bath leaves no room to doubt the accuracy of the observations made.

Nevertheless, the uniform testimony of careful observers has been that general applications of cold to the surface of the body not only lower the surface temperature, but the internal temperature as well.

Fleury, who next took up scientific study of hydrotherapy, observed a lowering of seven degrees from the immersion of a man in a bath at 50° for twenty-five minutes.

Jürgensen observed a reduction of temperature 6.5° as the result of a cold bath.

Fleury was the first to note that the temperature did not begin to fall for some minutes after the subject was removed from the bath.

The majority of observers have not noted so great lowering of tem-
temperature from local applications as those named above. Draper obtained a fall of 1 1/2° from an hour's immersion in a bath of 73 1/2° to 75°. As a rule, the effect of the cold bath in lowering the temperature of the body is increased as the temperature of the bath is lowered and its duration prolonged.

It is important to bear in mind that cold applications to be effective in reducing temperature must as a rule be considerably prolonged. Exceptions to this rule, which it is highly important to understand, are given elsewhere. It should be noted, however, that the surface often continues cold for some time after it has become reddened by reaction.

The reduction of temperature in the cold bath is greatly facilitated by friction of the surface, as by this means surface excitation is maintained so that the cooling effect of the bath is greatly facilitated. The experiments of Winternitz showed that the rate of heat elimination from the skin in the cold bath may be increased as much as 30% by vigorous friction of the surface.

The necessity for the prolonged application of cold grows out of the fact that within a short time after the cold application the forces of the system rally themselves to resist it, heat production is increased, heat elimination diminished, and the result is a tendency to return to normal temperature. If the application is withdrawn before this tendency has been suppressed, the normal temperature will be quickly recovered and may be even exceeded. This, with the other phenomena of reaction, will be studied elsewhere.

When the cold application is considerably prolonged, the tendency to reaction is greatly suppressed by exhaustion of the nerve centers involved in reaction and a lessening of the sensibility of the sensory nerves involved in the reflex movement upon which reaction depends. Thus the system gradually loses its power to resist the depressing effect of cold and the anti-thermic effects of cold are developed.
If the application is continued for a sufficient length of time, not only the thermal, but all other vital activities of the body are slowed, and to such a degree that two or three times hours may elapse before the normal temperature is restored. Plienitz directed his patients to avoid the secondary chill, which he regarded as a fever. Bell 302.

An ice-cap applied to the head is an efficient means of lowering general temperature through exercising a depressing effect upon the thermogenic centers. An ice-bag applied over the heart lowers general temperature by slowing the circulation, thus diminishing vital activity. Copious cold water drinking and the large cold water enema, although local applications, exercise a very decided effect in lowering general temperature, especially in febrile conditions.

Effects of Local Cold Applications upon Bodily Temperature. — Applications of water at a temperature below that of the body always lower the temperature of the part to which the application is made.

Local applications of cold water, such as immersion of the hand or foot, reduce the temperature of the surface, but with no appreciable effect upon the internal temperature, unless a considerable amount of surface is involved, as in the employment of large cold compresses to the trunk, except in case of internal applications and applications to special regions, as noted above.

Edwards has shown that immersion of the hand in cold water gives rise to lowering of temperature in the other hand.

Tholozan and Brown-Squard showed that the application of heat to a foot or hand causes a rise of temperature in the opposite foot or hand. These local applications of heat and cold were found to be without influence upon the general temperature.

Winternitz showed that the application of snow to the forearm produces, first, a lowering of temperature in the hand to the extent of two degrees, and then an elevation of 1.5°F.
Ice held in the mouth caused a lowering of the temperature of the cheek of the corresponding side. Copious drinking of ice-water likewise produced a fall in the temperature of the skin of the epigastrium. This lowering of temperature is so marked in degree that it may be used as a method of locating the stomach, as demonstrated experimentally by one of my students in carrying out a series of laboratory experiments in hydrotherapy under my direction.

The application of cold water to the soles of the feet, especially if in the form of a spray, gives rise to a lowering of temperature.

Effects of Cold upon Thermo-Electrical Currents of the Tissues.

Cantrellet has made the interesting suggestion that by means of a cold application to the surface the difference of temperature thus created between the exterior and the interior of the body must directly augment the intensity of the organic thermo-electric currents which are constantly playing within the body, thereby modifying, in an important way, various nutritive processes, and perhaps especially those concerned in the storing and discharge of nervous energy. This is a subject which deserves careful investigation.
THE PHENOMENA AND NATURE OF REACTION.

reaction, using the term as it is employed in hydrotherapy, is one of the most complex and interesting of physiological phenomena. The term is perhaps somewhat misleading, as it suggests the idea of a single process, whereas instead of being one reaction, there are really a series of actions and reactions. The most important of these are two, which may be distinguished as the circulatory action and reaction, and the thermal action and reaction.

Ordinarily, we speak of the reaction as that of most common extent.

These reactions come into play in most of the processes of hydrotherapy, but especially in those processes which are employed for general effects.

Applications designed exclusively for local effects are usually managed in such a way as to repress reaction, either partially or wholly; as for example, when it is desired to restrain local inflammatory processes, pain, congestive headache, or hemorrhage, reaction is suppressed as much as possible by continuous application of cold of the necessary degree of intensity. On the other hand, employment of the cold or cool shampoos to the scalp for baldness, the cold douche to stimulate perspiration, or the heated compress to a rheumatic joint, reaction is encouraged by means of friction, strong percussion or high pressure or protection from evaporation. In some general applications, reaction is suppressed as much as possible, as in the employment of the tepid bath for the reduction of temperature, whereas, in other applications, it is encouraged, as in the cold full bath, with friction, for reduction of temperature, and the short, cold spray or douche administered for tonic effects.

Definition of Reaction: Reaction consists of a series of vital processes which follow the application of either hot or cold applications to the skin or the mucous membrane. The vital activities produced by cold applications are much more pronounced than those produced by heat.
and differ in character; nevertheless, the vital reactions produced by
applications of heat are clearly defined and constant in character, and
may be most advantageously utilized in hydrotherapy, though strange to
view of these facts, it is絕然異乎常道 that
say, the reaction of heat has been almost absolutely ignored by writers
wholly disregarded
upon hydrotherapy, being mentioned only incidentally when not absolutely
ignored.

The reaction effects of either heat or cold to the skin are much
more pronounced than those applied to the mucous membrane though the
stomach and the colon.

The phenomena resulting from a very cold application to the skin,
with strong pressure and short and moderate duration, (3 to 10 sec.)
as already noted, may be divided into two classes:

1. The immediate effects, which accompany the application, which
may be called its primary effect or ACTION, and

2. A class of secondary effects, which constitute the phenomena of
REACTION.

The most important of these phenomena are summed up in the following
tables:

<table>
<thead>
<tr>
<th>ACTION</th>
<th>REACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Contraction of the small blood-vessels of the skin.</td>
<td>1. Dilatation of the small blood-vessels of the surface.</td>
</tr>
<tr>
<td>2. Pallor of the skin.</td>
<td>2. Redness of the skin.</td>
</tr>
<tr>
<td>3. Goose flesh appearance and roughness of the skin.</td>
<td>3. Return of skin to soft, smooth and supple condition.</td>
</tr>
<tr>
<td>4. Sensation of chilliness.</td>
<td>4. Sensation of warmth, even while the temperature of the skin may be several degrees below normal.</td>
</tr>
<tr>
<td>5. Trembling, shivering, chattering of the teeth, in some cases decidedly painful and distressing sensations.</td>
<td>5. A sensation of comfort and well-being.</td>
</tr>
<tr>
<td>6. Quickening of the pulse, marked rise of blood pressure, as shown by the sphygmograph and the sphygmonodynamometer.</td>
<td>6. Slowing of the pulse (from 15 beats, increased fullness.</td>
</tr>
</tbody>
</table>
t. These might be added the remote effects, that is the final result of the application in series of applications in modifying normal or pathological nutritive processes; but these effects are too varied and numerous to be presented in tabulated form, and as will be studied in detail in later chapters.
ACTION.

7. First checked, then quick, deep, gasping respiration.


9. In most cases slight increase of the internal temperature.


REACTION.

7. Respiration slower and deeper.


9. Fall of internal temperature.

10. Increase of sensible perspiration.

The initial symptoms following an application of cold water are evidence of a protective effort on the part of the system to prevent the undue loss of heat by closing the blood channels of the skin, by decreasing its conductivity, and by increasing heat production by general and vigorous muscular action in shivering.

If the cold application is with low temperature at high pressure and of short duration, the phenomena of reaction begin immediately when the application ceases.

If the patient has exercised vigorously just before the bath, or if vigorous friction of the skin, or hot bath has been administered, and not infrequently in very vigorous persons without the preparation referred to, the phenomena of reaction begin even before the termination of the application, as shown by reddening of the skin, disappearance of goose flesh, and other unpleasant symptoms.

If after reaction has set in, a renewed application of cold is made, a second reaction will occur in most cases, but the vital movement will be much less prompt and pronounced, and if the subject is feeble or fatigued, the secondary reaction may not occur. In some very vigorous subjects, even a third or fourth reaction may be produced, but each time with diminished vigor; and sooner or later, a point will be reached at which no reaction will occur, or only after a very long delay.

If instead of a short cold application, as by means of douche or
the patient is placed in the cold bath, essentially the same thing occurs. After the first contact with cold water, the tendency to reaction appears, amounting in some cases to actual reddening of the skin, especially if the patient is rubbed. The continued contact of the water with the surface, however, prevents the complete development of reaction, and sooner or later a second chill occurs, reaction from which may be entirely suppressed.

When a person when reaction does not occur are exceedingly unpleasant. The most prominent are prolonged chilliness, a disposition to nausea or faintness, giddiness, weakness, and great depression. The surface remains pale and cold, and the internal temperature may also be below normal, as the chill indicates the beginning of a decline of temperature below the normal level. The symptoms indicate that the energies of the body, by which it is able to combat the disturbance created by the application of cold to the surface, are unable to respond to the demand made upon them under existing conditions.

Conditions which favor reaction. The phenomena of reaction will seldom fail if the application of cold is made in a proper manner. There are various conditions which may be controlled by which aid the energies of the body in developing prompt and vigorous reaction. By the employment of these measures in connection with proper adaptation of the modes of applying cold to the surface, it is possible to modify at will the degree of intensity of the reaction; effects obtained in any given case, which may be classified as follows:

1. Those applicable before the bath.

2. Those which influence the condition of the patient during the bath.

3. Those which may be employed after the bath.

These several conditions and applications may be enumerated as follows:
1. To be employed before the bath, (1) rest, warm clothing, exposure to the air of a warm room, a hot bath of some sort, and drinking hot water, or some other hot beverage.

2. Exercise more or less vigorous in character, according to the strength of the patient, to be taken just before the bath, but never carried to the degree of even commencing fatigue.

3. Friction of the skin until well reddened.

4. A state of general health and vigor.

2. Conditions pertaining to the bath itself, or acting in conjunction with it.

1. A very low temperature; the lower the temperature the more prompt the reaction. Ware and tepid baths do not cause contraction of the surface vessels and hence their employment is not followed by reaction.

2. Short and sudden application.

3. Application of the spray or douche, with considerable degree of pressure. The douche or spray is on this account better than the full bath, sitz bath, or plunge bath.

4. Friction either in the full bath, the massage douche, and the rubbing wet sheet.

5. Alternating or revulsive spray or douche, the difference in temperature employed being as great as possible.

3. Measures which encourage reaction after the bath.

1. Heat in the form of hot dry air, warm clothing, or hot water drinking. It is even possible to induce reaction in frozen parts by the alternate employment of hot and cold water, or rubbing with snow or ice in a warm room. The lumberman in the north woods of Michigan warms his feet by taking off his shoes and stockings and rubbing his bare feet with snow, then at once dressing them again.

2. Exercise should be as vigorous as the strength of the patient
A warm, slightly moist skin

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will allow.

(3) Friction of the surface with the hand, rough towel, or flesh brush, practiced by the subject, or the attendant, or by both.

Conditions which discourage reaction: Omitting any of the specific conditions of disease which hinder reaction and which contraindicate cold applications to the skin, the following may be enumerated as among the most important conditions which hinder reaction and must be taken into consideration in the employment of general cold applications:

1). Old Age. It is well to bear in mind the adage formulated by an eminent French writer "A man is as old as his arteries." Subjects in whom arterio-sclerosis has begun, react with difficulty and require special care. Very cold baths must be avoided altogether unless the area involved is very small.


3). Exhaustion, either temporary exhaustion from excessive exercise, or loss of sleep, or extreme nervous exhaustion, owing to the weak condition of the nerve centers, upon which prompt reaction depends.

4). Obey:swelling to relative anaemia of the skin.

5). Rheumatic diathesis: inability of the body to readily adjust itself to change of temperature is very marked.

6). Unhealthy or inactive skin.

7). Profuse perspiration especially when accompanied by fatigue.

8). Extreme nervous irritability.

9). Very low temperature of the skin.

10). An immediately preceding or impending chill.

Thermic reaction: As the above observations relate chiefly to that portion of the phenomena of reaction designated as circulatory reaction, it may be profitable to consider briefly by itself the interesting series of vital activities which constitute thermic reactions.

Thermic reaction to cold may be defined as the effort of the body to
replace the heat which has been lost by exposure to cold and to restore the equilibrium of the bodily temperature.

All cold applications of whatever sort, whether applied to the skin or mucous membrane, lower both the temperature of the surface to which they are applied, and the internal or general temperature of the body. This has been abundantly proven by Latham, and others. At a considerable proportion of the cases, however, the ultimate lowering of the internal temperature is preceded by a slight rise of temperature, which begins simultaneously with the cold application and continues for ten to twelve minutes afterwards. After the initial rise and subsequent lowering of temperature, there is a gradual return to the normal temperature. This vital movement is very well shown in the following diagram, modified by Battey, from Augusti. (Copy diagram marked “1”, page 64.)

The above diagram represents the effect obtained from a short, very cold douche or spray applied to the skin with high pressure. Battey observed that vigorous exercises, or hot bath before the cold application favored the initial rise of temperature.

Exercises taken just before a cold bath increases the initial rise of temperature which is doubtless due to the fact that muscular activity increases heat production to a marked degree so that the cold application finds the thermogenic processes in full play, at least in the muscles, which manufacture one-half of the heat produced in the body, and hence more able to produce a strong thermic reaction.

Warm or tepid baths (90 to 93°) do not produce the initial rise of temperature. The following diagram represents the thermic reaction accompanying and following a tepid bath.
In the employment of the rapid bath, lowering of the bodily temperature occurs purely in a physical and mechanical manner, independent of any reflex action. The surface blood vessels remaining relaxed, the blood is cooled as it comes in contact with the water at a temperature a few degrees below the bodily temperature, and by the circulation of the blood current the internal temperature is gently lowered.

Not infrequently the rise of bodily temperature produced by thermic reaction does not cease at the normal point, but rises slightly above it.

The cause of the initial rise of temperature produced by short, intense cold application to the skin is evidently the slowing of the blood current. The blood is heated in the internal viscera and cooled at the surface of the body. A complete circuit of the blood through the heart is effected with every 27 to 30 heart beats, or in little less than half a minute. It is evident that the more rapidly the blood is passed through the skin the more heat will be given up to the skin and the air, and hence the greater will be the cooling of the whole mass of blood and the lower will be the internal temperature, the rapid current tending to equalize the temperature of the body, warning the surface and cooling the interior.

It is equally evident that the slowing of the circulation must have exactly the opposite effect, the blood remaining in the skin loses more of its heat and the skin is accordingly cooled to a great extent, whereas the blood which traverses the viscera, in which thermogenic processes are least active, will remove a smaller amount of heat thus occasioning a rise of temperature in the interior of the body, and so in a small degree reversing the difference between the internal and external temperature. The intense application of cold to the surface causes contraction of the small arteries in every part of the body, in the viscera as well as in the skin. (H. Wernham). The contraction of the vessels of the viscera is much more frequent in duration than in the skin, but is long enough
to check the movement of the blood current, thus momentarily encouraging
the fall of temperature in the skin and the rise of temperature of the
internal parts, as above explained.

Simultaneously with the development of the internal rise of tempera-
ture by the means above explained, there occurs an increase of heat pro-
duction as the result of reflex action through the sympathetic nervous
system, accompanied, as shown by Leibnitz, with increased production
of CO₂ through increased cellular metabolism.

Curiously enough, these influences which give rise to an increase
of internal heat are antagonized by a reflex action exerted through the
sympathetic, or vaso-motor system, which tends to cool the body either
by inhibiting the thermo-genic centres, as suggested by Fredericq, or
through the intervention of a special refrigerating centre.

The initial rise of temperature in the interior of the body is very
brief in duration for the reason that the circulatory reaction which di-
lates the surface vessels, heat elimination is greatly increased, both
by the enlargement of the area of blood exposed to the cooling influences
acting upon the skin, also by increased rapidity of the blood current,
so that the skin is rapidly warmed and the interior cooled. When the
minimum temperature is reached, which may be either a few tenths of a
degree or three or four degrees below the normal a rise in temperature
takes place and continues until the normal point is reached, or even
surpassed, as is shown in the following diagram.

The thermic phenomena following an intense application of cold to
the surface may be briefly epitomized as follows:

(1) Cooling of the skin by conduction and evaporation;

(2) Cooling of the skin and of the viscera by reflex refrigerating
influences due to the sympathetic.

(3) Elevation of the internal temperature in consequence of the
slowing of the blood current following contraction of the arterioles with
(4) General increase of temperature internally and externally through reflex stimulation of the thermogenic centres.

Went to make a new device, and see it out in terms of degrees, indicating the time in seconds and minutes. Make some experiments to determine the actual time and record experiments in this direction.

The thermic reaction is a useful indicator of the extent to which the bodily functions may be modified by hot or cold applications to the surface, and of individual susceptibility. The writer has found the following a useful means of testing the reactive power of an individual.

A vessel of sufficient size to receive the arm immersed to the elbow is provided with water at a temperature of 30°F. The patient immerses the bared hand and arm to the elbow for two minutes. Note is taken of the surface temperature of the arm before immersion and even after five minutes after removal until the original temperature is restored.

The appearance or non-appearance of goose flesh and length of the continuance of this phenomena is also noted. In normal individuals, as the writer has shown by experiments upon one hundred healthy persons, the original temperature is restored in minutes; the goose flesh phenomena appears at the end of minutes, and disappears at the end of minutes.
THE PHYSIOLOGICAL EFFECTS OF HEAT UPON THE BODY.

Heat may be applied to the body experimentally or for therapeutic purposes in a variety of ways, as by means of hot water, steam, hot air, and by radiation from an incandescent body, as the electric light bath.

Illustrations of these several modes of application are to be found in the full bath, the fomentation, or poultice, the Russian or vapor bath, hot air or Turkish bath, and the electric light bath.

The effects produced in the application of heat to the body depend upon both the mode and the intensity of the application. They depend (1) upon the mode of application, and (2) upon the intensity of temperature of the application.

Water is recognized as hot when above the temperature of the surface of the body, or between 90 and 104 degrees, and is termed very hot when above 104 degrees. At a temperature of 120, a full bath becomes unendurable, although small areas, as in the hand or foot bath, or in the application of a fomentation, may be gradually trained to endure a temperature ten or fifteen degrees higher. The mucous membrane readily tolerates a temperature ten or fifteen degrees higher than the skin. A full bath of 120 degrees cannot be prolonged beyond two or three minutes without danger to life. For some persons it would be hazardous for even a few seconds.

In the vapor or Russian bath a temperature of 112 to 120 is not uncomfortable, and 130 to 145 degrees can be tolerated for a short time.

The ordinary temperature of the Turkish bath is 140 to 160 degrees. The hot room often has a temperature of 220 to 230 degrees, and the writer has occasionally experienced a temperature of 300 degrees without ill effects. Temperatures much higher than this have been endured for a short time in dry air by specially trained persons.

Both in the employment of the electric light or radiant heat, it is not easy to determine the temperature to which the body is subjected.
thermometer exposed upon the surface of the body, in an electric light bath, or radiant heat bath, has been seen by the writer to register a temperature of ... although the temperature of the air at the same time, as measured by a thermometer protected from the direct rays of the incandescent lights, was but. 

The body expands under the influence of heat in this respect behaving like most other bodies. The rate of expansion is very nearly the same as that of water. The body of a man weighing 152 lbs. expands each degree centigrade. Each degree Fahrenheit of the sum 2.1 c. c. for 1° or 0.5 c. c. for 5°. White fibrous tissue expands under the influence of heat, although, with elastic tissue, like rubber, contracts. The ligaments of joints are composed of white fibrous tissue, hence they are relaxed by the application of heat.

Heat is without doubt one of the most powerful of all vital stimulants. The heat of the sun is the direct source of all animal and vegetable life. Heat stimulates protoplasmic activity as is easily shown by many laboratory experiments. A clinical illustration of the same fact is found in the increase of pigmentation of the skin under the influence of the prolonged use of fomentations or poultices.

In the following pages we shall consider the effects of heat and cold as applied to the body by means of water in its ordinary or liquid state, except when otherwise stated.

THE EFFECTS OF HEAT UPON THE SKIN.

The effects of heat applied to the skin differ somewhat according to the intensity and mode of application, but the effects in general may be stated to be as follows:

1. Dilatation of the capillary vessels: The effect of moderate heat, that is, hot water or water applied at a temperature of 100 to 104 degrees & to produce reddening of the surface, more or less intense, according to the thickness of natural complexion of the skin, and the temperament of the subject. This reddening of the skin is due to the
influence of heat upon the vasomotor nerves, paralyzing the vaso-constrictors, and stimulating the vaso-dilators, while cold produces the opposite effect, viz.; pallor of the skin due to paralysis of the vaso-dilator nerves, and stimulation of the vaso-constrictors. At the same time, the surface is roughened, presenting a greenish appearance, due to contraction of the involuntary muscle fibers connected with the hair bulbs. Slight shivering may also be produced, as from application of cold, showing that the phenomena of shivering is not due directly exclusively to the influence of cold, but is connected with the excitation of the vaso-constrictor nerves from whatever cause.

Pallor and other phenomena due to excitation of the vaso-constrictors from very hot applications, are of but short duration, pallor giving place to redness and the other appearances which follow, not application of more moderate degree. If the application is made to increase gradually in temperature from moderate heat, as 100 to 104 degrees, a final temperature of 130° or even higher may be reached without excitation of the vaso-constrictors, the surface remaining reddened.

Some time after such an application, however, if continued for fifteen to thirty minutes, vaso-constrictor phenomena again intervene.

The effects of heat upon the circulation are the same in the case of the mucous membrane, as of the skin, except somewhat higher temperature is required to produce parallel effects.

The stimulating effect of a high temperature upon the vaso-constrictors renders it invaluable as a means of checking hemorrhage from small vessels, as ecchymosis, in uterine hemorrhage, and capillary ooze from surgical wounds. It must be remembered, however, that, when applied for such purposes, the water should be at a temperature of 130 to 140 degrees. Some allowance must be made for lowering of temperature during the application.
It is useful also to remember that hot applications to the skin produce not merely a dilatation of the blood vessels, but increased activity of the blood current, and a like increase of the flow of lymph in the lymph channels.

3. Increase of cutaneous secretion and respiration. A general hot bath or even the application of heat to a comparatively small area of the surface has the effect to produce a general increase of activity of the glands of the skin, both perspiratory and sebaceous. Perspiration may be induced either to the degree of producing slight moisture of the skin, or profuse sweating, according to the length or intensity of the application made. The ordinary rate at which moisture is thrown off by the skin is about per hour. But by the application of heat in the form of a very hot bath at a temperature of 110 to 115 degrees, this may be increased to or at five times per hour, or times the ordinary amount, still greater effects may be produced by the electric light bath, as shown by the following experiment:

The above facts emphasize sufficiently the importance of administering copious draughts of water in connection with applications of heat. It must be remembered that a loss of fluid from the blood has a depressing effect upon the heart similar to bleeding, though somewhat less marked; hence the vital necessity for making good the amount removed through water drinking, or, if necessary, by means of rectal injections.

Prolonged and repeated perspiration induced by artificial means weakens the skin and lessens its power to react against and to resist cold impressions.

It is interesting to note in this connection that while the absorp-
A blast of highly heated air has been successfully used as a means of cleansing hemorrhage, also a jet of steam. For several years the author has made use of a metallic instrument that at nearly a full thousand degrees centigrade, through which a stream of hot water is forced, at a temperature of 1070°, the small vessels are sealed up and their hemorrhage is checked.
tion of oxygen and the elimination of CO₂ by the lungs is diminished as
the result of hot applications to the surface, the opposite effect is
produced upon the skin. Ordinarily the skin performs about 6% per cent
of the total amount of respiratory work done by the body. Under the in-
fluence of heat, this proportion may be doubled. (Find out how much).
This is evidently due to dilatation of the blood vessels of the skin,
and the moistening of the horny layer, whereby the interchange of gases
between the skin and the air is facilitated.

3. Increased Loss of Heat by the Skin. The application of heat
to the surface increases the loss of heat by the skin in four ways—

(1) By dilating the surface vessels, thus increasing the area of
blood exposed to the cooling influences operating upon the surface of
the body.

(2) By increasing the rate of the blood current in the skin through
the stimulation of the vaso-dilators and thus increased activity of
the heart. (--------)

(3) By increase in the amount of evaporation from the surface by
increased activity of the sweat glands and increased heating of the skin.

(4) By increase of the conductivity of the skin, thereby increasing
loss of heat by radiation.

4. Decreased Tactile Sensibility. The tactile sensibility of the
skin is greatest at 96 to 98 degrees, of the normal temperature of the sur-
face. Very hot applications, 110 and upwards lessen tactile sensibil-
ity. This fact explains the special value of the alternating or so-called
Scotch-douche, (--------). It renders much service in the treatment of
sciatica and other forms of neuralgia. At high temperatures 115 and
above, the tactile sensibility seems to be abolished. Sensibility of
pain remains, however. It is a curious fact that the sensation produced
by the application of intense heat is practically the same as that pro-
duced by intense cold.
9. Preparation for the Application of Cold. The impression made by an application of any sort depends primarily upon the temperature of the skin, which is the zero of the temperature sense. At least the first effect produced is determined by the difference between the temperature of the skin, and that of the application. By beginning the application at about the temperature of the skin, and gradually increasing it, a very high temperature may be borne without pain, as the zero of the temperature sense is gradually raised. This raising of the temperature of the skin has a special value in hydrotherapy as a preparation for the application of cold. The skin is thereby not only rendered more susceptible to the influence of cold, but is likewise prepared to stand it or to react after a cold application by reason of the increased nervous and vascular activity, and the large amount of heat stored up in this structure. For these reasons, the hot bath, contrary to what might appear to be the case, prepared the skin for cold applications, a fact which is of great service in the therapeutic applications of water. (Add a new item.)

When the skin is cold, in fatigue, pain, neuralgia, muscular joints, in neuralgia, in accidents and fragile persons, and in many other conditions as elsewhere indicated, the preliminary heating of the skin is of great importance in the use of cold water.
In studying the influence of heat upon the circulation, we must consider not only the heart as the center of this system, but especially the three great vascular areas,—the muscles, the portal system, and the skin, particularly the latter. Each of the parts named may be considered as a great reservoir, which is capable of retaining a large share of all the blood in the body. The portal areas excited and filled by digestive activity; the muscles by vigorous exercise, and the skin by percussion, friction, and heat, especially the latter.

It is impossible that each of these several vascular areas shall be excited to activity or completely filled with blood at once and the same time. Then one area is in a state of congestion; either one or the other must be in a condition of more or less marked anemia. These facts explain the pallor sometimes occasioned by excessively violent exercise and the pallor and giddiness which sometimes follow almost immediately upon the taking of food in certain forms of indigestion and the faintness which not infrequently overcomes a patient subjected suddenly to a high degree of heat in an upright position.

The effect upon the heart of a general application of heat is to produce at once a notable increase in the force and frequency of the heart's action. This is clearly shown by the accompanying sphygmographic tracings, the first of which was taken before, the second after, a hot full bath at a temperature of 110 degrees for two minutes. This increase in force and frequency diminishes somewhat as soon as free perspiration begins, owing in part, perhaps, to the cooling of perspiration, but in great part to the lessening of the arterial tension by the dilatation of the arteriae cutaneae of the skin, as Van Heist remarked, (-----) is to stimulate the vaso-constrictors,
Persists for several weeks.

A bath at 182°F produces centrally congesting the brain for about an hour. It stimulates the cerebral arteries, which continue for some time after the bath, with a marked acceleration of the pulse. The same effect upon the cerebral vessels is pronounced. Circulation may be obtained by a foot or leg bath at 104°F to 108°F.
resulting in contraction of the small blood vessels of the surface, which, together with the reflexed stimulus received by the heart from the periphery, accounts for the sudden increase in the force and frequency of the pulse. This effect is greatly increased if the water is applied in the form of a spray or a douche, owing to the mechanical or percutaneous effect added in these modes of application. This temporary excitation of the heart in connection with stimulation of the vaso-constrictors may give rise to intense congestion of important internal viscera, especially the brain; hence the danger of administering this form of bath to very plethoric persons, persons who have suffered from apoplexy or who give evidence of beginning arterio-sclerosis. This condition of internal congestion is evidenced by a sensation of throbbing in the head, and the visible beating and pulsation of the vessels of the throat and temples with flushing of veins and sensation of fullness in the head.

The reason for this increase of cardiac and vascular activity as the result of the application of heat is apparent when we consider the relation of cardiac activity to the condition of the surface vessels in relation to heat elimination. One of the most important functions of the skin is the cooling of the blood. It is evident that if the temperature of the skin is raised, these cooling processes will occur at a slower rate, and hence for an equal amount of cooling, the blood must be passed through the surface vessels more rapidly. Hence the nervous reflexes which regulate heat elimination are so arranged that an increase in the temperature of the skin or the media to which it is exposed results in a quickening of the cardiac activity as well as an increase in the size of the blood vessels of the skin, whereby a larger area of blood is exposed upon the surface of the body. The very opposite of this of course occurs in connection with cold applications. This interesting compensatory arrangement is continually brought into activity in the practice of hydrotherapy.
Very hot applications induce a protective contraction of the surface vessels.
THE INFLUENCE OF HEAT UPON RESPIRATION.

General applications of heat increase the rate and facility of respiratory movements. This is true, however, only of moist heat, so-called, as dry heat or rather the inhalation of dry hot air produces the opposite effect through its exciting influence upon the small air tubes. Excessive dryness of the air hinders the gaseous exchanges in the lungs. Moderate dryness promotes these exchanges. The increase of chest movements in moist hot air does not indicate an increase of oxidation in the body, but is probably due to a lessened rate of $\text{CO}_2$ elimination. Nothing so quickly relieves an asthmatic as a hot full bath, but an examination of the products of respiration shows a decided diminution in the amount of $\text{CO}_2$, the natural result of diminution in vital combustions which result from the influence of heat upon the thermo-genic centers. (----)

It should be noted, also, that while the respiratory movements are made with greater ease and frequency under the influence of heat, the depth of movement is considerably decreased;--- that is, the amount of the tidal air is diminished.

The after effect observed when the heat is withdrawn is temporarily diminished rate and depth of respiration.

General applications of heat temporarily raise the temperature of the blood, whereby the heat centers are excited and bring into play the processes of heat dissipation, which include increased lung activity as well as increase of skin perspiration and respiration, is increased. This fact explains the rapid respiration invariably when the temperature is high.
The two classes of muscular structures smooth and striated are, seriously enough, affected in an opposite way by applications of heat.

Moderate hot applications, from 98 to 104 degrees, have the effect to increase the energy and excitability of striated or voluntary muscle fibers, while on the other hand a very hot bath, 105 to 112 degrees, lessens muscular energy and excitability, and produces a sensation of great weakness and exhaustion with all the phenomena of fatigue. This exhausting effect of a very hot bath has often been demonstrated by dynamometric experiments, the results of which in a single case is well brought out in the following experiment:-

By the Writer

A vigorous young man of twenty years was submitted to a careful dynamometric test, and his total strength was found to be . . . . . .

After a very hot full bath (110° Fahrenheit) for ten minutes the tests were repeated, and his strength was found to be reduced nearly one half. The influence of the bath upon each particular group of muscles is well shown in the accompanying chart. The young man experienced such great weakness after the bath that he scarcely felt able to walk. It is, indeed, surprising, that the available energy of the body should be so greatly reduced within so short a time. It cannot be supposed that the actual store of force-producing material in the muscles or nerve-centers is exhausted by the bath, hence we must conclude that the results observed are due to lessened muscular excitability. Muscular irritability lessens very rapidly under the influence of a temperature of 120° degrees and above, and even at somewhat lower temperatures is decidedly lessened.

This phenomena may be observed very readily in cold blooded animals in which a temperature of a few degrees above the ordinary temperature of the medium in which the animal lives, produces almost complete paralysis.
through heat stiffening of the muscles.

Prolonged hot applications at temperatures not much above the body similarly give rise to muscular weakness. Notwithstanding the facts above stated, which have been abundantly verified by laboratory experiments, experience shows that short hot applications are the best of all means of recovering a person exhausted by prolonged or violent exercise. This means

It has been much-used for this purpose for the relief of exhausted soldiers. An eminent English army surgeon employed the hot enema for the same purpose more than a century ago. The nerve centers of a person who is in a state of extreme exhaustion will not respond to stimulation of cold; in other words, such a person will not react to cold, hence the necessity for an application of heat. The restorative effects of such an application of heat are doubtless due to the elimination of the fatigue poison or poisons which is thereby encouraged. The effect obtained is rendered much more decided and lasting if the hot application is succeeded by a short cold application such as a cold horizontal jet to the spine for three or four seconds, broken off on a scrubbing wet sheet.

It is worth while to note in this connection that the exhausting effects of a hot bath may be readily neutralized by an application of cold water in the form of a douche or shower bath. The exhaustion resulting from a hot bath is not due to an absolute loss of strength or energy in either the muscles or nerve centers, but is a nervous phenomenon, and expresses the peculiar effect upon the nerve centers of impressions of heat communicated through the peripheral nerves. The restorative effect of a cold bath administered after a hot bath is well shown in the following experiment:

A young man of ... years, when subjected to a careful dynamometric test, was found to have a total strength of ... as shown by "a" on the accompanying chart. After a hot bath, temperature 110 to 113 degrees for ten minutes, the total strength was found to be ...
The details of this test are shown in the tracing marked "d" on the accompanying chart. After a cold shower bath for one minute, followed by vigorous rubbing, the subject was immediately subjected to the same dynamometric test and was found to have a total strength of . . . . shown by the tracing "e" on the accompanying chart. To produce the maximum of restorative result, the hot bath should not be continued more than two to four minutes, and it should be followed by a cold shower spray or douche for ten seconds, and in a very cold dry room for 30 seconds.

Excess of muscular irritability, as in a person suffering from cramps, rigidity, or irregular muscular twitchings, is quieted by prolonged warm full bath, that is, at a temperature of 92 to 94 degrees.

The effect of very hot applications in lowering muscular irritability is often utilized therapeutically in the treatment of deformities resulting from muscular contraction, for the relief of vaginismus and in cases of contraction of the anal muscle.

Very hot applications increase the irritability of smooth or non-striated muscles. This is shown in the fact that prolonged application of the skin, causing contraction of the muscular walls of the small blood vessels, and the minute muscles connected with the hair bulbs, giving rise to goose-flesh and pallor. This physiological property of heat is utilized in the application of hot water to the uterus by vaginal injection for the relief of hemorrhage, to relieve chronic catarrh and congestion of this organ, and the condition known as sub-involvement. Hot rectal irrigation is one of the best means of combating congestion and resulting enlargement of the prostate gland in men. A large hot enema of coloalyser will not infrequently relieve constipation when other means are ineffectual, by stimulating the involuntary muscular fibres of the intestines.
The restorative effects of a cold bath in fatigue are well shown in the accompanying graph. The line #2 indicates the results of dynamic isometric tests made in the case of a vigorous young man who was exhausted by a long bicycle ride on a hot day. The line #3 shows the results of a second series of tests made immediately after a cold shower plus horizontal douche at a temperature of 60°F. for four seconds.

The restorative effects of the hot bath...
Heat may excite or exhaust the nervous system according to the mode of application. An application may at first be exciting, then exhausting. The effect of a neutral bath, 92 to 98 degrees, is to diminish nervous irritability, thus producing a sedative effect. This result is obtained through the protective influence of a neutral temperature. The body immersed in water near its own temperature is almost entirely shut away from a variety of disturbing influences which continually play upon the nerve centers through the sensory impulses transmitted from the peripheral. As a result, more opportunity is afforded for the accumulation of nervous energy in the cerebellar-spiral centers. To obtain a sedative effect, the bath must be considerably prolonged (30 min to an hour and a half).

A high temperature,—that is, hot and very hot baths, 100° to upwards, produces first, very exciting effects, manifested by a disturbed action of the heart, sleeplessness, nervousness, headache, etc., but are followed by exhaustion after. This heat stimulates protoplasmic activity. This is the fundamental fact upon which the physiological phenomena developed by its application is based. Heat is indeed one of the most powerful of physiological stimuli. Both the excitant and exhaustive effects of hot applications are explainable by this single fact. The excitant effects are due to the direct influence of heat upon the nerve filaments or other tissues, while the exhausting effects are due to the fact that while the protoplasmic, or vital activities of the body are excited by certain forms of hot applications, thus giving rise to an accumulation of tissue wastes or excrecentitious elements, the oxidation of these wastes is diminished by the effort of the body to prevent excessive accumulation of heat. The result is an accumulation within the body of tissue poisons which produce the phenomena similar to those resulting from prolonged or violent exercise.
the so-called "fatigue poisons", which have been shown by --

to possess properties almost identical with those of curari.

In harmony with this idea is the interesting fact recently developed
by -----(See Modern Medicine, recent number) that sunstroke
is really a toxaemia resulting either from the excessive accumulation of
poisons within the body, or the development of special poisons under the
influence of heat. May it not be possible that the well recognized de-

bilitating influence of heat is due to the same cause?

Special reflex effects are obtainable by hat applications to certain
areas of the skin, which sustain a known reflex relation with internal
viscera. These effects are obtained through impressions made upon the
ganglia of the great sympathetic and the vaso-motor and other ganglia of
the cord. To obtain effects of this sort, heat may be applied either
alone or in conjunction with hot water in the alternating douche. The
reflex effects thus obtained are either those of vaso-dilation or vaso-
constriction, according to the degree of heat employed. Warm or hot
water produces stimulates the vaso-dilators, while very hot water
(115 to 130) produces a vaso-constriction.

Winternitz, Brown-Saquard, Tholozan, Rosbach, and others, have ex-
perimentally worked out the topography of this reflex action, its refer-
ea to many of the internal viscera, pointing out the exact area of the
surface which must be operated upon in order to obtain the effects desir-
ed. Among the most important of these areas are the face and the back of
the neck, which are in relation to the brain; The upper portion of the
spine, the chest and shoulders, which are intimately associated reflexly
with the lungs through the pneumogastric; The hands and feet, which are
associated both with the brain, the mucous membrane of the nose, and the
organs of the chest; The middle dorsal region and the stomach, breast,
and the uterus; the skin covering the lumbar region with the kidneys, the
lumbar region with the uterus and the lower extremities; the internation.
surface of the thighs and the uterus; the plantar region and the uterus; the feet and the kidneys; skin covering the lower end of the sternum and the kidneys; the skin covering the liver, spleen, stomach, bowels, and bladder, with the corresponding organs. Very hot applications made over these surfaces stimulate simultaneously the vaso-constrictors of the area to which the application is made, and the internal region which is in reflex relation with it as designated above. The explanation of these interesting relations will be found in a study of the anatomical relations of the vaso-motor centers of the spine and other special ganglia with the other areas innervated by them.

The reflex effects of these localized applications at a high temperature are of great service in hydrotherapy; for example, cerebral congestion may be relieved by the hot foot bath, which Masso proved by experiments on a man, a portion of his skull having been removed, is capable of producing even cerebral anemia. The temperature should be 105 to 110 degrees. A hot full bath at 102 degrees is often more effective in relieving cerebral hyperemia. Washing the face with very hot water is a most effective means of checking nose bleed. Hot sponging of the head and neck often gives complete relief in insomnia from cerebral congestion.

Spleenic and hepatic congestion, the usual accompaniment of malarial diseases, are relieved by very hot fomentations applied over these organs. Uterine hemorrhage may not infrequently be checked by a very hot foot bath 105 to 115 degrees, although the warm foot bath, 93 to 110 degrees, causes dilatation of the uterine vessels. Congestive headache may often be relieved by very hot sponging of the back of the neck, an effect which is evidently due to the fact that the circulation of the brain is controlled by vaso-motor centers situated in the cervical region, which likewise supply the skin covering this portion of the spinal column. The application of heat to the spine for relief of pulmonary
hemorrhage, the best effects are obtained by the application of heat to the skin overlying the first dorsal vertebrae, as the vaso-motor center controlling the vessels of the lungs is situated at this level of the spinal cord.

The Influence of Heat Upon the Blood.

Winternitz first, and many other observers subsequently, have pointed out the interesting fact that under the influence of hot baths the blood count is considerably diminished, sometimes to the extent of \( \cdots \cdots \cdots \). (Look up original paper of Winternitz in the Modern Medicine.)

There is also observed a diminution in the percentage of hemoglobin present in proportion to the decrease of red blood corpuscles. Winternitz also pointed out the remarkable fact that diminution in the number of leucocytes is much greater than that of the red blood corpuscles. In an observation made by the writer the number of red corpuscles was found to be diminished from \( \cdots \cdots \cdots \) before the bath to \( \cdots \cdots \cdots \) after the bath, and the number of leucocytes from \( \cdots \cdots \cdots \) before to \( \cdots \cdots \cdots \) after.

The percentage diminution was for the red corpuscles \( \cdots \cdots \cdots \), and for the white corpuscles \( \cdots \cdots \cdots \).

The stimulating effect of heat upon cell life may be easily studied under the microscope by the application of heat to the ameboid white blood corpuscles of the blood. Nothing could be more interesting than to note the readiness with which these cells respond to the very slightest increase of temperature. When heat is applied to the surface of the body, not only the skin, but the entire body, is to some degree excited thereby, both through the transmission of the heat by the conductivity of the tissue to the internal parts, and its transportation by the blood.
current from the skin to the viscera. The result is an increase of the
activity of the cell life of the body so far as is possible without in-
creased absorption of oxygen. Oxidation is diminished as is indicated
by the diminished absorption of oxygen and exhalation of CO₂. But the
increase of cell activity is nevertheless established by the increased
elimination of nitrogen, the increase being largely in the form of uric
acid, which represents imperfectly oxidized nitrogenous waste.

The diminution of oxidation may occur to such a degree as to pro-
duce an increase of sugar in the blood, and often give rise to its ap-
pearance in the urine. It is on this account that hot baths must be used
with great discretion in diabetes, and in all other maladies characteriz-
ed by deficient oxidation.

That heat stimulates vital activity is clearly shown by its influ-
ence upon the skin. A patient who has worn the stout abdominal bandage
for some time, or has been subjected to daily application of presentations
solely to the same portion of the body, for a few weeks will present a mottled
appearance of the skin to which the application has been made and this
is very striking, the result of the stimulating effect upon the present
cells. The heat from the direct rays of the sun produces a similar
effect, giving rise to freckles, thus deepening the color of the complexion
often to a remarkable degree. The same effects are likewise produced
by the electric light, and often by the newly discovered X ray. The
stimulating effect of the electric light upon the growth of plants and
the opening of fruits affords further evidence that heat and light act
powerfully in stimulating vital activity.

EFFECTS OF HEAT UPON THE STOMACH,
LIVER, AND OTHER DIGESTIVE ORGANS.

It has been experimentally proven that the amount of hydrochloric
acid secreted by the stomach may be increased by means of fermentation
in the stomach of four or two after eating a hot meal. This observation is made by
... (See Sajors Annual, and Modern medicine.) The writer has a number of times confirmed experimentally and in one experiment, the following results were obtained: (The experimental results should be placed side by side.)

Hot applications made over the region of the liver by means of hot compresses or fomentations unquestionably increase the flow of bile, and doubtless also stimulate all the other activities of the liver. The writer has often demonstrated this clinically in patients suffering from deficient activity of the liver as indicated by clay colored stools, without jaundice, or without evidence of obstruction of the biliary ducts.

There is every reason to believe that application of heat over the abdomen may increase the activity of the digestive processes in the intestines and the functional activity of the pancreas and the spleen along with the other vessels which may be thus brought both directly and indirectly under the influence of the application.

**The Effects**

**Action of Heat Upon Bodily Temperature and Heat Production.**

The immediate effect of a general application of heat to the body is to occasion a rise of temperature; in fact, immersion of the body in a bath at a temperature of the body will in the course of ....... cause a rise of temperature to the amount of ........ degrees, while immersion of the body in water at ........ temperature will occasion a rise of three or four degrees within ...... time.

An interesting observation first made by Hippocrates, and which has been verified by all students of hydrotherapy, is that a short application of heat to the body is followed by a lowering of the temperature with
increased susceptibility to the influence of cold. Modern calorimetric studies have shown (check up authority in Landolsi and Stirling) that the effect of the application of heat to the body is to diminish heat production while at the same time heat elimination is encouraged by increased perspiration, relaxation of the surface vessels, and increased activity of the heart.

It is not necessary in order that the effects of heat should be obtained that the application made should be above the temperature of the body. A bath at the exact temperature of the body will cause a rise of general temperature amounting to ........in ........

THERMIC REACTION FOLLOWING AN APPLICATION OF HEAT.

For most purposes it is doubtless true that the reaction effects to be obtained from cold are to be preferred to those which result from hot applications; nevertheless, the peculiar effects obtainable from heat will sometimes be found much better suited to the case in hand than those obtainable from cold applications. Indeed, cases are not infrequently encountered in which the dread of cold water on the part of the patient is so intense as to make its use inadmissible until the patient has been subjected to a long course of training. In these cases, the effects which may be obtained from heat are particularly serviceable. The reaction effects produced by intense, short, general applications of heat, however, are not without disadvantages and their employment prevents the development of a positive idiosyncrasy against cold whereby its use might be wholly interdicted, and by degrees the patient may be trained to react normally and beneficially to applications of water of temperature progressively lower. The reaction effects produced by intense, short, general applications of heat are as follows:

[Signature]
REACTION.

1. Relaxation of small veins, causing venous congestion of the skin.

2. Dusky red color.

3. Skin soft and moist.

4. Pulse frequent and soft, high-tension pulse.

5. Respiration frequent, free, superficial.


7. Depression of internal temperature from increased heat elimination and decreased heat production.

8. Perspiration increased.

9. Diminished nervous and mental irritability, drowsiness, and exhaustion.

10. Muscular weakness and indigestion, sense of comfort and relief, position to muscular effort.

10. Increased muscular irritability and ease of muscular effort for a short time.

1. Contraction of the small blood vessels.

2. Slight pallor if previously red.


4. Strong, excited, quickened/tension low.

5. Perspiration checked, thin, frequent, easy, but superficial.

6. Heating of skin.

7. Rise of internal temperature from diminished heat elimination.

8. Perspiration checked.

9. General nervous excitation, sense of comfort and relief, position to muscular effort.
Prolonged applications of heat always give rise to increase of temperature, both by diminishing heat elimination and by increasing heat production. Heat stimulates vital activity. It is one of the most powerful of all physiological excitants. There is perhaps no other agent capable of exerting so remarkable an influence upon vital process as does heat. By a prolonged bath at a few degrees above the normal body temperature, the increase of heat production and heat accumulation may becomedangerous to life in a few minutes. Even warm air will increase over
heat production to a most remarkable degree. As temperature a few degrees above the body temperature may increase heat production more than three hundred percent.

Whatever causes success a rise of body temperature increases heat production, at least in all physiological conditions, although there may be a possible exception in some conditions of disease.

A rise of 20°F in external temperature occasions a rise of 1°F in temperature, and a further rise of one degree takes place for each additional rise of 20°F in external temperature.
The Neutral Bath. From a comparison of the above tables, it will be noticed that temperature designated as "warm," that is, ranging between 92 and 98 degrees, varies but slightly from the general temperature of the surface. It is thus apparent that the warm bath must be very nearly neutral as regards calorific effects and in the form of the full bath must be also quite devoid of mechanical effects. A moment's consideration, however, will show that an absolutely neutral bath is practically impossible, for the reason that a bath exactly the temperature of the skin would check the elimination of heat, and hence occasion a rise of body temperature while a bath a few degrees below the temperature of the would excite the temperature sense, and thus give rise to increased heat production and other reflex effects.

The vital perturbations set up by the warm bath, however, are so slight as to be scarcely perceptible, and the characteristic effect of the bath is its sedative or quieting effect. This result is not obtained by any sedative action, but by the protection afforded by the medium so employed as to be absolutely unirritating, and of such a temperature, shield the body from the continued excitation resulting from the contact with the clothing, with the atmosphere constantly changing in temperature and in force of movement, and various other disturbing influences presented by the ordinary environment.

As the result of this protection the nerve centers are completely at rest, and are thus afforded an opportunity to accumulate a store of energy so that the warm or so-called neutral bath is after all not really neutral in its physiological effects, but is recuperative and energizing through the promotion of the nutritive processes, and the accumulation of force-producing material in the nerve cells. (See Sjöqvist Annual for report of bath of 95 degrees by Russian physicians. Find reference in Memo.)
EFFECTS OF ALTERNATE HOT AND COLD APPLICATIONS TO THE SKIN.

The alternating douche: In this form of application the skin is first heated considerable above its normal temperature. Then by the application of cold water the temperature is again lowered, but not below the normal point. Consequently the only reaction which takes place as the result of the application of the alternating douche is circulatory in character. This form of application is therefore a most efficient means of stimulating nutritive changes, obtaining derivative effects, etc., and without creating thermic disturbances of any sort in the body.

Pfluger found that a short hot bath, following a cold bath increased the reduction of temperature.

Vinaj based upon this observation the recommendation to follow the cold bath employed for reducing temperature in fever with a hot bath, continued for two or three minutes. The writer has found the hot wet sheet a most advantageous method of making practical use of this most interesting fact, and has for more than twenty years made use of the principle in treating fevers of certain types.

GENERAL VITAL REACTIONS RESULTING FROM HYDROTHERAPEUTIC PROCEDURES.

As previously intimated, the circulatory and thermic reactions which occur as results of cold applications to the surface are only two of a considerable number of distinct reactions which result from the cutaneous excitation occasioned by an intense application of cold. A consideration of the effects of such forms of stimulation in the light of modern physiological research which leads directly to the conclusion that the reactions produced involve not only the nerve centers, blood vessels, and involuntary muscles, but every cell and tissue in the entire body.
The circulatory and thermic reactions are only in disease two of the more complex and universal reactions which are involved in the general perturbation set up by cold applications to the surface of the body. It is doubtless to these more subtle and less easily observed reactions that a large part of the therapeutic value of hydrotherapy must be attributed.

The profound effects produced upon the nervous system by application of water to the skin enables us through this agent, to influence every bodily function, or as Sir Humphry Davy well said, "The nervous system dominates all the phenomena of organic life directly or indirectly, or depend upon it. Nothing transpires in the body of the animal without its intervention. The cells are the artisans in the organic works, but the nerves are the overseers."

Experience, as well as the physiological considerations which have been adduced, has abundantly demonstrated the value of hydrotherapy as a means of awakening dormant activities within the body, increasing general vitality, improving digestion, assimilation and absorption, increasing both muscular energy and the disposition for exertion, producing a sensation of well-being, of physical, intellectual and moral equilibrium, all of which remarkable properties constitute hydrotherapy not only a therapeutic system unequalled in value, but a hygienic means of highest excellence. (Put in a footnote "Better.")
Whatever agent affects the heat-producing process of the body affects likewise in a most pronounced degree all of the vital process, As Lubansky has well said, "To touch calorification is, in a certain sense, to touch the spring of existence." Any disturbance of the heat making functions of the body produces a corresponding disturbance in the most important functions of the system. To place the body under the necessity of producing an increased quantity of heat by exposing it to continued loss of heat is to accelerate the consumption of organic matter, and thereby to increase the rate of disintegration; it is to stimulate respiration and maximium oxygenation of the blood, the natural result of increased oxidation; it is to excite the circulation and the change of matter in the remotest capillary divisions of the blood vessels; it is to create the necessity of repair and to impress directly and profoundly the general nervous system."
THE PRINCIPLES OF HYDROTHERAPY.

In the employment of water as a therapeutic agent, it is valuable,—
1. As a nutrient, entering into the composition of every structure, and serving a useful purpose in nearly every function.
2. As a means of abstracting heat from the body by contact and by evaporation.
3. As a means of communicating heat to the body.
4. As a means of producing certain mechanical or other percutent effects.

Similar effects may be obtained by other means and agents which are capable of impressing the system in like manner,---as, for example, hot and cold air, hot vapor, the electric light, sunlight, and friction or percussion of the skin administered by the hands of an attendant, or mechanically. These measures, because of the kindred effects produced by them, are universally employed in connection with water in hydrotherapy, and hence will be considered in connection with measures which are more strictly hydrotherapeutic in character.

A very large proportion of those applications of water which are made to the surface of the body depend for their efficiency upon the fact that the skin is reflexly connected with the interior of the body, its portion of the skin periphery being associated through the nerve center which supplies it, with nerve filaments, with some special visceral periphery or vascular area.

In the study of the effects of water upon the internal structures, it should be noted that whatever effect is produced upon a vascular area in the skin, is likewise produced in the internal vascular area associated with it. The intensity of the effect produced in the internal vascular area, however, is generally less intense than that produced upon the surface, although this is by no means always the case.
Before entering upon the explicit consideration of the subject of hydrotherapeutics, it will be profitable to review briefly the physiological effects of thermic applications of heat and cold, and of water-drinking.

SUMMARY OF THE PHYSIOLOGICAL EFFECTS OF COLD APPLICATIONS.

General Effects:  1. Cold is primarily depressing or sedative in its effects, lowers temperature, lessens vital activity.

2. A secondary excitant effect follows a short, cold application, as the result of the reaction of the body against the depressing influence of cold, since the practical result of a short cold application is exciting.

3. Short cold applications cause contraction of the small vessels both of the skin and of the internal organs. The contraction of the vessels of the interior of the body is quickly followed, however, by relaxation, when the cold application is brief, and may begin while the application is still in process, if it is somewhat prolonged.
4. A prolonged cold application causes prolonged contraction of the vessels of the internal viscera.

The Skin. -- 1. General cold applications diminish the activity of the skin and increase the action of the kidneys.

2. Short cold applications decrease heat elimination, but increase heat production.

3. Prolonged cold applications diminish heat production as well as heat elimination.

4. Cold applications to the skin lessen the sensibility of all the nerves of the skin, hence diminish reflex action.

The Circulation. -- 1. General cold applications slow the heart beat and the circulation, after first temporarily exciting increased cardiac activity.

2. Cold applied to one hand causes contraction of the vessels of the other hand. Similar relations exist between other symmetrically related organs.

3. Cold applied over an arterial trunk causes contraction of its distal branches. A compensatory effect sometimes results from increased heat production.

4. A thermometer placed in the axilla shows increase of temperature when the elbow is held in water at 50° for some time.

5. Short cold applications over the heart increase activity, while prolonged applications lessen the pulse rate.

6. Short cold applications to a limited area of any portion of the body anywhere increase the pulse rate.

7. The mucous membrane is less sensitive than the skin, but reacts to cold in essentially the same manner as does the skin.

Respiration. -- 1. Cold douche causes quick gasping respiration.

2. A non-percutaneous application causes deeper and slower respiratory movements.
3. Oxidation of the tissues is increased by cold applications, and the amount of CO₂ in the expired air is correspondingly increased. Prolonged cold applications decrease muscular irritability and energy.

2. Cold objects feel heavier than warm ones: the force of a cold douche feels heavier than the force of a hot douche at the same pressure.

3. The reaction following a cold bath augments muscular activity and energy.

4. Cold applications excite the smooth muscular fibers, as those of the skin, blood vessels, bladder, bowels, etc.

5. Cold applications to a small area, as the feet, may cause goose flesh appearance, pallor, and shivering of the whole body.

The Nervous System. 1. Cold applied to a nerve trunk paralyzes the parts supplied by it.

2. Cold diminishes rate of transmission of nervous impulses.

3. Prolonged cold applications to the head diminish mental activity and may produce unconsciousness.

The Reflex Effect of Cold Applications. 1. Short, very cold applications, with high pressure, to a reflex area, causes vaso-dilatation of the related viscera.

2. Prolonged non-percutent cold applications produce internal vaso-constriction.

3. Short applications to the face and neck stimulate the circulation and activity of the brain.

4. Short very cold douche to the chest first excites, then slows the pulse.

5. Prolonged immersion of the hands in cold water causes contraction of the vessels of the brain and the nasal mucous membrane.

6. Short cold applications cause contraction of the vessels of the uterus.

7. Short very cold douche to the feet, with strong pressure,
dilates the vessels of the uterus.

9. Prolonged applications of cold to the feet cause contraction of the vessels of the brain, nasal and mucous membranes, increase the activity of the kidneys, and cause contraction of the bladder and increased intestinal peristalsis.

10. Short very cold applications to the mammae, the abdomen, the hands, and the feet, cause contractions of the vessels of the bladder, bowels, and uterus.

11. Prolonged applications of cold to the upper dorsal region relieve congestion of the nasal mucous membrane and the lungs.

12. Ice bag to the dorsal region causes contraction of the vessels of the stomach.

13. Cold lumbar douche, moderate pressure, fifteen to forty-five seconds, causes contraction of the uterine vessels.

14. Very cold short douche to the lumbar region, two to four seconds, with strong pressure, causes dilatation of the uterine vessels.

15. Cold applications to the thighs cause contraction of the vessels of the lungs.

16. Short cold douche to the lower portion of the sternum causes increased activity of the kidneys.

17. Short cold applications, with strong pressure, over the stomach, liver, spleen, bowels, causes dilatation of the vessels of these organs, with increased activity.

18. Prolonged cold applications over the same organs, without pressure, produces contraction of their blood vessels.

19. The reaction following cold applications increases the number of corpuscles in circulation, and the cold application increases the amount of the oxygen absorbed by the blood and the rate of oxidation, the result is the reduction of oxy-hemoglobin.

Absorption, Secretion, and Excretion.-- 1. Cold applications in-
crease the rate of absorption from the alimentary canal.

2. Short cold applications to the surface increase the activity of the glands of the stomach, liver, and other secreting viscera.

3. Short applications of cold to the skin increase perspiration, also the activity of the kidneys, and the amount of CO₂ given off by the lungs, the increase occurring during the reaction following the application.

Animal Heat and Temperature. -- 1. Cold applications to the surface diminish the temperature of the skin.

2. Cold spray to the soles of the feet produces slight lowering of the general temperature.

3. Cold applications to the surface decrease increase the thermo-electrical phenomena.

4. Short cold applications stimulate heat production and decrease heat elimination.

5. Prolonged cold applications at first increase, then decrease heat production, and increase heat elimination.

6. Shivering under an application of cold is an evidence of lowered internal temperature and the beginning of increased heat production.

7. Applications to the head lower the temperature, by influencing the thermogenic centers.

8. Secretary reaction is produced by the reflex influence of cold applications upon the vaso-motor centers of the spine and the individual ganglia of the blood vessels.

9. Thermic reaction is produced by lowering the temperature of the skin and of the blood.
SUMMARY OF EFFECTS OF HOT APPLICATIONS.

Water is said to be warm at a temperature of 92° to 98°, hot at 98° to 104°, and very hot when at 106° or above, 107°F.

General Effects.—1. Heat is one of the most powerful of all vital excitants. Its effect is primarily stimulating. It increases vital activity, elevates the temperature, excites brain and nerve centers.

2. The secondary effect of heat, which appears after the application has been withdrawn, is depressing, the result of atonic reaction, lowering of the temperature through lessened heat production, and increased heat elimination, and generally diminished tissue activity.

3. Short hot applications to the surface cause irritation of the small veins of the skin, with strong revulsive effects upon the related internal parts.

4. Prolonged hot applications may give rise to both excitation and exhaustion, either of which may predominate.

Effects of Heat upon the Skin.—1. Contraction of the yellow elastic tissue, relaxation of the white fibrous tissue.

2. Goose flesh appearance from contraction of smooth muscular fibers.

3. Reddening of the skin, or, if applied suddenly at a temperature of 110° to 130°, pallor, from strong stimulation of the vaso-constrictors, followed by reddening of the skin due to dilatation of the small veins.

To the presence of venous blood is due the disky red appearance of the skin under the influence of heat. The contraction of the vessels of the skin also occurs after the heat is withdrawn, when the application has been prolonged.

4. Increased perspiratory activity.

5. Decrease of tactile sensibility at temperatures of 113° upwards.

6. Preparatory for cold applications.

7. Increased heat elimination through dilatation of the surface vessels, increase of the flow of blood through the skin, increased...
Evaporation of moisture from the surface, and increased conductivity of
the skin.

Effects of Heat upon the Circulation. - 1. A general application of
heat increases the force and frequency of the pulse, which diminishes
when free perspiration begins.

2. Very hot applications (104° upwards) cause slight contraction
of the small vessels of the skin, soon followed by relaxation. Warm
and hot applications cause dilatation of the surface vessels, especially
of the small veins. Heat produces a dusky red color of the skin, owing to
the increased quantity of venous blood in the skin.

The Effects of Heat upon Respiration. - 1. A general application of
moist heat increases the rate and ease of respiration. Hot dry applica-
tions hinder respiration.

2. After the withdrawal of a very hot application there is for a
while diminished rate and depth of respiration. The increased rate of
lung movements following the application of heat is due to diminished
heat elimination, whereby all heat eliminative processes are quickened.

Influence of Heat upon the Muscles. - 1. Short hot applications,
98° to 104°, increase the excitability and energy of the striated or
voluntary muscles.

2. Very hot applications (106° to 120°) lessen the energy and
excitability of the voluntary muscles.

3. Very hot applications increase the excitability of the non-
striated or involuntary muscles, as shown by goose-flesh appearance of
the skin following a very hot application, and the contraction of the
small vessels of the skin and other organs.

Effects of Heat upon the Nervous System. - 1. Very hot baths pro-
duce various nervous disturbances, as sleeplessness, nervousness, head-
ache, and various other symptoms of nervous exhaustion.

2. Extreme heat, as in sunstroke, may give rise to development of
An external temperature of 70°F to 70°F increases CO₂ elimination while a temperature within 210°F, decidedly increases CO₂ elimination, in the first case by raising the temperature of the blood, in the second case by producing the vasoconstriction. Cold air does not increase heat production so long as the body is so protected that chilling of the surface and consequent lowering of the temperature of the blood is not induced.
x per 100

11. Neutral applications diminish the muscular excitability of the striated muscles, hence the relaxing effect of a neutral bath.
special poisons, which act upon the nerve centers of the brain and cord.

3. The practical result of the application of warm and hot water is to cause dilatation of the vessels.

4. Very hot water (115° to 130°) produces contraction of the small vessels.

The Influence of Heat upon the Blood. -- Hot applications, especially when followed by cold, increase the number of blood corpuscles in circulation.

The Influence of Heat upon General Nutrition. -- Heat stimulates vital activity. The sunlight and the electric light are especially active and useful.

The Influence of Heat upon the Functions of the Stomach, Liver, and Abdominal other Digestive Organs. -- 1. Applications of heat over the region of the stomach in the form of either fomentations or the hot douche, increase the amount of hydrochloric acid secreted by the stomach.

2. Applications of heat over the region of the liver stimulate the flow of bile and other liver activities.

3. Applications of heat over the abdomen increase the activity of all the abdominal viscera.

Effects of Hot Applications upon Heat Production and Bodily Temperature. -- 1. General applications of heat cause immediate rise of temperature. This is true when the temperature of the bath is no higher than that of the body itself.

2. The application of heat is followed by a fall of temperature due to diminished heat production, the result of a tonic reaction.

3. General applications of heat increase heat elimination.

2. An external temperature above 60°F to 70°F occasions increase of heat production. A temperature of 104°F increases heat production to the extent of three hundred and fifty percent in dogs, and to a corresponding extent in man.
1. Short but applications, especially the
shortest, diminish the secretion of
saliva.

2. Short but applications, especially
the shortest, diminish the secretion of
the liver.

4. Short but applications over the
kidneys and the short, but real
drinking, diminish renal activity.
Heat is a purely physical phenomenon, involving both the thermal and electrical effects. The heat of a substance is directly proportional to its temperature. When two substances come into contact, heat is transferred from the hotter to the colder substance. The measurement of heat is often done in terms of calories or joules. Heat is essential for life processes, as it is involved in the functioning of all living organisms. The study of heat transfer is crucial in various fields, including engineering, physics, and chemistry.
CLASSIFICATION OF HYDROTHERAPEUTIC EFFECTS.

The classification of hydrotherapeutic procedures has given rise to much discussion among writers and practitioners. This discussion has grown out of the fact that thremic applications are capable of producing a great variety of effects, and that these effects are not infrequently so mixed that it is not easy, in all cases, to decide which is the dominant effect produced. It has also been observed that an application of water made in a definite manner and of a definite temperature may, at one time and under one set of circumstances, produce an effect radically different from that produced by an identical application at another time and under different circumstances; for example, an application which, in one patient might prove to be exciting or tonic, in another would produce decidedly sedative or depressant effects, and the reverse.

This characteristic, however, is not peculiar to water. It is one which applies to all classes of therapeutic agents. No two persons are exactly alike, and the state of the system in every individual is constantly varying; from hour to hour and from day to day, the condition at each moment differing from that of every other moment, past or future. Particular individuals also present special peculiarities or idiosyncrasies of constitution which must be taken into account in the employment of thremic applications as well as in the use of other therapeutic measures. Nevertheless, amidst all this apparent confusion, there is a sufficient amount of stability and unity to enable us to find a basis for a simple and comprehensive classification of the effects which may be expected from definite and exact hydratic applications under clearly and accurately defined conditions.

From a careful study of the physiological effects of water, it is evident that, in general, two classes of effects are produced. These are excitation and depression. This naturally leads to a similar grouping of therapeutic applications into two general classes,
1. Excitant; and
2. Sedative.

These two groups of effects may be almost indefinitely subdivided, but the leading and essential subdivisions are included in the following table:

**CLASSIFICATION OF HYDROTHERAPEUTIC MEASURES.**

1. Excitant.
2. Sedative.

**1. EXCITANT EFFECTS.**

a. Primary (action effects).

b. Secondary (reaction effects).

   a. Primary excitant effects.

      1. General.
      2. Local.

      a. Hemostatic
         (Direct, Indirect or reflex.

      b. Cardiac excitant.

      c. Uterine excitant.

      d. Intestinal excitant.

   b. Secondary (reaction) excitant effects.

      1. General.
      2. Local.

      a. Spoliative or reducing
         (a. Sudorific
         (b. Eliminative.

      b. Expectorant,

      c. Diuretic,

      d. Cholagogue,

      e. Peptogenic,

      f. Emmenagogue,
2. SEDATIVE EFFECTS.
   a. Direct sedative effects.
      1. Nerve sedative.
         a. Hypnotic
            b. Calmative
   b. Hemostatic.
   c. Resolutive.
   d. Alterative.
   e. Calerific.

   2. Antispasmodic.
   c. Analgesic.
   d. Anesthetic.

   4. Circulatory sedative.
      a. Antiphlogistic.
         a. Vascular.
         b. Cardiac.
      b. Hemostatic.

3. Thermic sedative.
   a. Antithermic.
   b. Antipyretic.

b. Indirect--tonic.

General Principles.-- The following brief statement of the general principles which determine the effects of hot, cold, and neutral applications, will be found of service in the study of the special effects resulting from the employment of applications of varying temperature.

Respecting Hot Applications.--- 1. The primary effect (action) of an application of heat, is excitant.

   2. The secondary effect (reaction) of an application of heat is depressant, sedative, atonic.

   3. The actual effect of an application of heat depends upon many
factors, as, the condition of the patient, the intensity and length of
the application, the form of the application, etc. In general, it may
be said that--

a. The effect of a very short application of very high tempera-
ture is strongly excitant, the depressant effects being practically im-
perceptible.

b. The effect of a less intense and slightly prolonged appli-
cation of heat is moderately excitant during the application; after the
application decidedly depressant effects appear, resulting from a lessens-
ing of thermic and other tissue activities through atonic reaction.

c. The effect of a prolonged application of heat at a high tem-
perature is both excitant and exhausting; or depressant, the excitation
resulting from the elevation of the temperature of the body, the depress-
ion being due to the exhaustion of nervous energy, the usual result of
long-continued stimulation. The depressing effects may appear before
the application is withdrawn.

Respecting Cold Applications.-- 1. The primary effect (action) of
excitant.

2. The secondary effect (reaction) of an application of cold is
invigorating, restorative, tonic.

3. The actual effect of an application of cold depends upon the
method of making the application, the temperature, the susceptibility,
and condition of the patient, and many other factors; in general it may
be said that--

a. A short application of intense cold is excitant, and, if
repeated daily, tonic.

b. A more prolonged application of cold at a moderately low
temperature is less exciting and less tonic.

c. A prolonged cold application is both excitant or tonic, and
sedative, the depressant effects resulting from the exhaustion of the
nervous centers from prolonged excitation and the lowering of
the blood.
Respecting Neutral and Intermediate Applications.-- 1. A neutral bath (92° to 96° F.) produces no reaction, circulatory or thermic, but suppresses reflex activity, consequently the effect is calmative. A neutral bath is also restorative by checking or abolishing the loss of energy.

2. Baths at intermediate temperatures produce mixed effects, the dominant effects being those of the class most nearly approached, cold, neutral, or hot.

3. The characteristic effects of baths, either hot or cold, may be intensified by the mechanical effects of percussion, as by means of the douche, by friction with the hand, towel, sheet, or by other suitable means.

4. The effects of baths may also be intensified by various means which favor or delay reaction, applied before, during, or after the bath, such as exercise, artificial heat, etc.

EXCITANT EFFECTS (Chapter head).

The excitant effects of therapeutic applications of water and of other thermic applications are all reflex in character. They may be divided into two classes—(a) Primary; (b) Secondary.

a. Primary Excitant Effects:—Primary excitant effects are those which are the immediate result of the motor impulses sent out by the nerve-centers under the stimulus of the impression produced upon the skin or mucous membrane by the application made. All thermic applications, whether at a temperature above or below that of the body which produce decided sensations or impressions are excitant in character; but only those applications are classed as excitant which are managed in such a way that the excitant effect is the sole or dominant effect; hence, as will readily be seen by consulting the above statement of principles, applications for excitant effects must necessarily be very short; as a
rule, the shorter the application, the better the effect,—that is, the more purely excitant will be the effects produced.

Excitant effects may be produced by either hot or cold applications. Very cold applications are much more excitant than cold or cool applications. Likewise very hot applications are much more highly excitant than applications which are simply hot or warm. The greater the difference between the temperature of the application and that of the surface to which it is applied, the more highly exciting the effect will be, whether heat or cold is applied.
the function of any organ or set of organs in the body. The chief local effects, however, to which we desire to call attention, are the following: sudorific, expectorant, cholagogue, peptogenic, hemostatic, revulsive, derivative, calorific, resolutive, and alterative. We will briefly consider each one of these local excitant effects, which, as previously intimated, are for the most part to be obtained by applications of cold water, either by itself or in connection with heat.

Sudorific Effects.—Sudorific effects or stimulation of the perspiratory function are obtained by various means which are capable of raising the bodily temperature. Bouchard has shown that an elevation of the temperature of the blood of two or three degrees is sufficient to induce general sensible perspiration by stimulation of the sweat centers.

Local perspiration may be induced by circumscribed hot applications or by retention of the natural heat of a part, through direct excitement of the perspiratory glands.

The measures which may be most conveniently employed for the production of active perspiration are, the Turkish bath, the Russian bath, the hot air bath, the vapor bath, hot full bath, the wet sheet pack, the dry pack, the hot douche, the vapor douche, the hot blanket pack, the hot sitz bath, hot water drinking, the hot enema, hot fomentations to the spine, the electric light bath and the sun bath. Any one of these measures may, under special circumstances, be found most convenient and serviceable.

The electric light bath is without doubt the most efficient and satisfactory of all modes of producing perspiration, for it produces the most powerful stimulation of the perspiratory glands and other structures of the skin, induces perspiration in a remarkably short space of time, thus not necessitating the exposure of the body to the exhausting effect of prolonged exposure to heat. Profuse perspiration generally appears in the electric light bath in three to five minutes, and often
when the temperature of the air surrounding the patient is not above 85°F, while the dry pack not infrequently fails to produce vigorous activity of the skin within less than an hour and a half or two hours, a longer time being sometimes required.

When one considers the amount of secreting surface presented by the skin, the area of the perspiratory ducts being more than ten thousand square feet, it is evident that this organ is the most extensive of all the eliminating structures of the body. The skin throws off each hour from an ounce to an ounce and a half of insensible perspiration in the form of an invisible vapor. In this form of activity the whole skin takes part, acting essentially in the same manner as does the mucous membrane lining the lungs, the function of which the activity of the skin still further resembles in the fact that carbonic acid gas is also eliminated by it, as has elsewhere been pointed out. In profuse perspiration, the sudoriparous glands are brought into vigorous activity, sometimes pouring out their secretion at the rate of thirty ounces per hour, twenty times the ordinary amount excreted.

The perspiration produced by the sweat glands closely resembles urine in its character, containing urine and various other toxic matters, and particularly, as has been shown by Bouchard, a ptomaine or toxin capable of causing a fall of bodily temperature when injected into the veins of an animal. Formic acid, butyric acid, and various other acid substances and poisonous matters are also eliminated in the sweat.

The healthful activity of the skin is one of the conditions most essential to physical well-being. The condition of inactivity and disease which is found present in nearly all chronic maladies is not only a consequence but a cause of a large number of serious morbid conditions, and it is quite impossible to effect a cure in a great majority of cases without bringing the skin into a healthy condition by a process of treatment and patient and persevering training. The dry, sallow, dingy skin so often
observed in the chronic dyspeptic, in fact, in most forms of chronic
disease, is not only a symptom of the disordered bodily state, but is a
cause of the perpetuation of this condition. The dull, sily appearance
of the skin is due to the accumulation of effete matters in it. This
state exists not only in the skin, but also in the entire body, hence the
correctness of the observation of the empirical but not infrequently very
sagacious practitioners of the cold-water cure in the early part of the
present century, which led them to rely upon the condition of the skin as
a perfect index to the patient's general vital condition in the examina-
tion of his case, and as a test of his progress toward recovery.

It is practically impossible to effect a permanent cure in a large
number of chronic disorders without restoring the skin to a normal and
healthy state.

Sweating baths are of the highest value as a means of ridding
the skin of its contained impurities, opening up the obstructed lymph
channels and spaces, and thereby encouraging the circulation of the nu-
tritive fluids and the development of normal nerve and gland structures,
and unloading obstructed sebaceous follicles of their hardened contents,
while at the same time arousing to activity the ganglia and secreting
cells of the internal organs, through the reflex movements set up by the
sensory impressions made upon the skin.

A diseased state of the skin is always connected with a congested
or otherwise disordered condition of important internal viscera, while
the restoration of the skin to activity is the most normal means of re-
lief from visceral congestion and other functional disturbances.

The value of hot applications as a therapeutic means has not gener-
ally been sufficiently appreciated by those who have undertaken to employ
water in a scientific manner. Indeed many hydrotherapeutists, as Fleury
and his followers, have maintained that scientific hydrotherapy is con-
fined to the use of cold water exclusively. On the other hand, there
have been those who have made excessive use of hot applications, particularly the Turkish bath, the Russian bath, hot mineral baths, mud baths, etc., and a vast deal of harm has unquestionably been done by the depressing effects of frequently repeated and prolonged hot baths without the association therewith of the cold douche or some other means of producing tonic effects whereby the excessive sedative and spoliative effects of the hot applications might be antidoted or antagonized. This is one of the serious faults which is almost universally committed in the methods employed at mineral bath establishments and popular bathing resorts, especially at resorts connected with natural sources of hot water.

We were glad to note that there is an exception to this general rule and practice prevalent at Leukerbad and Berchtoldsee. At this quaint old place the patient sometimes spends six or eight hours "soaking" in the great tanks filled with warm alkaline waters derived from artesian wells at a temperature of about 100°, but on leaving the bath the massage douche is employed, and must certainly produce decidedly tonic effects. The massage douche consists of the application of a jet douche chiefly to the spine and the posterior parts of the body and over the region of the liver, the water being applied with high pressure while the attendant at the same time vigorously rubs and kneads the tissues with the hand, covered with a hair mitt. In taking a massage douche at the end of an hour's seance in the tank, I found it necessary to keep fast hold of a strong iron bar arranged for the purpose, and to keep my feet firmly braced to avoid being thrown down and washed away by the force of the large stream of cold water directed upon me by the attendant. By a powerfully tonic application of this sort, the debilitating effect of the warm bath is prevented. The cold bath should be universally employed after sweating baths, except when contraindicated, as in the case of Bright's disease, rheumatism, neuralgia, and cases in which the sedative effect of the heat is desirable.
Alternative or Spoliative Effects.--Sweating baths may be employed advantageously for the purpose of reducing the weight, as in obesity, or to remove serous deposits in the tissues, as in anasarca, and as a hygienic or prophylactic measure for the purpose of atoning, to some degree, for a lack of active physical exercise. It is perhaps most valuable as a hydrotherapeutic means to be employed in obesity. It must be remembered, however, that the sweating produced by heat is by no means so efficient in reducing flesh as perspiration induced by exercise. By a combination of the two means the most pronounced effects obtainable may be realized. The author has obtained excellent success in the treatment of very obstinate cases of obesity by making the patient, while taking a Turkish bath, perform vigorous muscular work, as by lifting heavy dumbbells, working hard with chest weights, or engaging in similar exercise. The execution of leg, arm, and trunk movements according to the Swedish system of gymnastics, may be employed most advantageously in cases of this sort. In very feeble cases, massage and friction may be employed by an attendant during a Turkish, Russian, or electric light bath, or a hot full or immersion bath. It must be remembered, however, that in cases of obesity there is great danger of overheating the blood in consequence of the protection against heat elimination afforded by a thick layer of non-conducting fat. Hot applications for the reduction of flesh should never be too greatly prolonged, on this account, and the bath should always be completed by a vigorous cold application.

It must also be remembered that the sudden removal from the blood of a large quantity of fluid has to some degree the same effect as bleeding from a vein, weakening the heart's action by lessening the volume of the blood and thus exposing the patient to risk from cardiac weakness, a condition not infrequently present in cases of extreme obesity, either from actual fatty degeneration or from accumulation of fat about the heart or beneath the serous lining of the chest and mediastinum.
A short general cold application following the application of heat for producing perspiration to reduce weight in obesity has the effect to restore and increase the disposition for muscular effort in addition to the tonic effect upon the general nervous system, thus enabling the patient to add to the apolliative effect of the hot bath the more thorough going reducing effects of prolonged moderate exercise.

In administering a sweating bath for the purpose of reducing flesh, it is an excellent plan to interrupt the hot application at intervals by an application of cold— a cold shower bath, a cold douche or affusion being employed for the purpose. The water should be employed at a temperature of 50° or 60° if possible. The application should be long enough to remove from the skin the surplus heat which has been absorbed, and should be continued a few seconds longer, so as to produce a strong reaction, thus the atomic reaction of the hot bath, whereby heat production and tissue activity in general will be antagonized, oxidation will be encouraged, effete matters and surplus tissue will be broken down, and prepared for elimination, which will be effected by the succeeding application of heat. A change in the color of the skin under the application of cold through the appearance of the bright red flush in the place of the dark purplish tint produced by heat, through dilatation of the vessels.

In the application of hot baths for the relief of dropsy, great care must be exercised, especially in cases of cardiac dropsy. The appearance of dropsy in these cases indicates that the small blood vessels have lost their power of contraction. The heart is weak and dilated. The stimulating effect of strong applications of heat to the surface may cause still further dilatation of the heart, which is already unable to completely empty itself of its contents through muscular weakness. The depression which follows as the result of the atomic reaction of heat will still further weaken the heart, and may result in so embarrassing
the organ as to induce grave symptoms. Death from cardiac weakness has not infrequently occurred in Turkish bath establishments. The risk is even greater in the Russian bath.

The ill effects produced by a sweating bath in cases of cardiac weakness may not end with the bath, or may even be less apparent during the bath than subsequently. The writer has known cases in which the application of the hot bath, as a vapor or Russian bath, for two or three days in succession, has produced a very rapid decline to which the patient has succumbed a week or two later.

A cold application following a hot bath in dropsy due to cardiac disease is especially important as a means of increasing the tone of both the blood vessels and the heart, but it must be remembered that a severe cold application to the surface momentarily congests the internal viscera, and brings a very great strain upon the heart during the primary contraction of the small vessels, which is induced throughout the entire body, hence the application made must be managed with great care. Extreme temperatures must not be employed.

A douche at 70° or 80° is better suited to these cases than a lower temperature. The application should be made first to the feet and legs, then to the arms and back, and lastly the chest. It is well to mitigate the shock to the lungs and heart by the hand or towel dipped in cold water and applied to the face, neck, and chest before making a general cold application.

The hot bath is also an invaluable remedy in certain cases of dropsy of renal origin. It is of special value in dropsy due to the acute nephritis sometimes encountered as a complication in scarlet fever, smallpox, diphtheria, and in the puerperal or pre-puerperal state. In these cases it is highly beneficial, chiefly by withdrawing a large quantity of blood to the surface and thus relieving the congestion of the inflamed organ. It is of course also of some service through the elimination of
toxins, which takes place by way of the sudoriparous glands; but the amount of urea and other toxins thus eliminated, even during the most profuse perspiration, is comparatively small.

The hot blanket pack is one of the most serviceable measures for cases of this sort. The author has employed this very convenient mode of inducing perspiration in numerous cases, and with most excellent results. The hot blanket pack is most admirably adapted for use in cases of acute nephritis in children. Care must be taken to keep the head moistened with cool water during the application, but the head should not be cooled to such a degree as to antagonize the effect of the pack.

In chronic dropsy or chronic nephritis, the hot bath is less serviceable in consequence of the organic nature of the affection and the almost certain reappearance of the symptom after it may have been removed. In these cases, there is also great constitutional weakness in consequence of the disease, so that the system is very poorly prepared to endure the effect of the hot bath. The hot bath also has the effect to leave the patient in a condition of diminished resistance, thus exposing him to risks from cold, one of the most serious dangers to which the chronic sufferer from Bright's disease is exposed. Some eminent authorities on this account wholly forbid the use of hot baths in this class of cases. The writer has, however, found the hot bath invaluable even in these cases, in one special condition,—namely, when the sufferer from chronic nephritis has suddenly become dropsical through an acute onset or exacerbation of the disease, the result of exposure to cold, or through some departure from the required diet or regimen, or other similar cause. Under these circumstances, the hot bath may be employed with advantage, and, if properly managed, without injury. The bath must be short, ten to twenty minutes, and it must be administered in such a manner as to give the patient as little fatigue as possible, and should never be carried to the extent of weakening or exhausting the patient.
In most chronic cases of renal disease, the neutral bath at a temperature of 92° to 95°, and especially the effervescent bath, has proved more serviceable than the sweating bath, producing stimulation of the skin circulation without inducing exhausting effects. The well known effect of the neutral bath in stimulation renal activity is also here made serviceable.

The electric light bath is far superior to any other form of sweating bath for cases of Bright's disease, for the reason that the skin may be stimulated to most pronounced activity by a very short application and without exposing the patient to the risk involved in the breathing of highly heated dry air or a hot atmosphere saturated with moisture, as in the Turkish or the Russian bath. During the last five or six years the author has employed this bath in a great number of cases of this kind, and without witnessing any untoward effects, but with advantages which are not afforded by other methods of applying heat. The medium about the patient is not overheated, hence the air may be readily maintained at a temperature of 85° to 90°, so that heat elimination goes on normally, which cannot be the case in any other form of hot bath.

In the hot immersion bath, heat elimination is entirely suspended except through the lungs. In the Russian bath heat elimination from both the skin and the lungs is almost wholly interrupted. In the Turkish bath, heat elimination takes place by evaporation only, both the skin and the mucous membrane receiving heat by conduction from the highly heated atmosphere surrounding the body.

In the electric light bath, heat is produced in the depths of the tissues as well as at the surface, through the resistance encountered by the rays of light in passing through the numerous layers of tissues which it penetrates, reaching with some degree of intensity at least, the innermost recesses of the body.

In dropy due to anemia, sweating baths may be employed, if carefully
administered, but they should be very short, owing to the extreme degree of cardiac weakness usually present in these cases, and the general vital and nervous weakness resulting from the impoverished conditions of the blood and other vital fluids and the general interference with nutrition. Here again the electric light bath shows itself superior to other measures of applying heat for inducing perspiration for the reasons already pointed out. In dropsy from anemia, the sweating bath is particularly serviceable as a means of preparing the body for an application of cold, the combination of these two measures having been shown by Winternitz and others to be among the most effective measures for the enrichment of the blood if not by the actual production of blood corpuscles, by bringing into the blood-current a vast number of blood-cells previously hidden away in the vessels of the liver, spleen, and other internal viscera, perhaps exposed to excessive destruction by the large cells situated in these organs which have for their functions the destruction of blood-cells.

The sweating bath may be advantageously employed in cases of dropsy of the abdomen and of the chest through spoliative effects of this powerful bath. One not infrequently sees absorption set up at such a rapid rate that within a few days there is a very marked diminution or a complete disappearance of the effused fluid which had previously resisted with stubbornness tapping, counter-irritation, and all other ordinary means of treatment. The sweating bath is certainly not a panacea for cases of this sort, but it is a most serviceable measure.

It must be remembered that a cold application must always be administered after a sweating bath when employed for spoliative purposes, as well as in most other cases. Great care, however, is needed in the adaptation of the cold application at the conclusion of the bath to the serious morbid conditions which are almost invariably present in connection with dropsy, whether local or general in character. It is not
necessary to repeat the remarks already made with reference to cold applications after the sweating bath in cases of obesity. Respecting the application of cold in cardiac cases, it is only necessary to add that in many cases the cold towel rub or sponge bath, and, in persons sufficiently strong and vigorous, the wet sheet rub, in all cases followed by vigorous dry friction, are measures to be preferred to the cold douche, the cold immersion, or other stronger measures of treatment.

In cases of dropsy resulting from renal disease, cold applications must be administered with the very greatest care. If the application of cold is so intense as to produce the slightest indication of chill, it will be followed by congestion of all the viscera, and consequently increased activity of the renal disease. The cold douche, and similar shocking applications, must be entirely avoided. Cooling off after a hot bath must be also managed with great care. The best method of cooling the patient is to wrap him in blankets after the hot bath, then cool the skin by applications to limited portions of the surface, taking first one arm, then the other, one limb and then the opposite, and thus proceeding to extend the cooling to various parts of the body until the whole surface has been treated. It is sometimes necessary to go over the whole surface two or three times to complete the cooling in a satisfactory manner. The covering should be at the same time gradually withdrawn, also. If too strongly sedative effects are obtained by the bath, managed in this way, a tonic effect may be secured by supplementing the bath, after the surface has been cooled, by hot and cold sponging of the spine. The patient must not be allowed to dress nor to leave the treatment room until the surface has thoroughly cooled and the pulse returned to its normal rate, so as to avoid the possibility of taking cold. The skin must not only be superficially dry, but must be thoroughly dried out by the evaporation of the absorbed moisture, as indicated by the condition of normal smoothness and firmness. On account of
the great liability of chilling after a warm bath, it is better in renal cases treated in this way, that the patient should be confined to his room for several hours after treatment. The treatment is, on this account, best administered in the evening, so that the patient can retire at once to his bed. By morning, the normal equilibrium will have been so completely established as to reduce the risk of taking cold to a minimum.

In cold applications immediately after sweating baths, in cases of abdominal dropsy and dropsy of the chest, special regard should be paid to the local condition present. In abdominal dropsy cold applications should be made first and chiefly to the arms and the upper portion of the back, while in dropsy of the chest the chief portion of the application should be made to the lower half of the body, the purpose being to prevent too strong a reaction in the congested and disabled parts by first producing reaction in the parts of the body most remote from the diseased structures.

Sweating baths may be advantageously used as a means of producing general muscular relaxation for the purpose of aiding in the reduction of a hernia or a dislocated limb. The relaxing effect of a general hot bath is partly due to the diminished muscular tone which lessens the tension of the muscles controlling the joint and in part to the peculiar influence of heat upon the white fibrous tissue, the chief constituent of the ligaments which bind together the bony structures entering into the formation of a joint. Heat expands white fibrous tissue, though acting in the opposite manner upon yellow elastic tissue.
The hot bath is of great value in icterus as a means of relieving the intolerable itching, and aiding the elimination of bile. The electric light bath is especially valuable for this purpose. The hot bath should be employed only until profuse perspiration is induced. The neutral bath should then be administered for twenty to thirty minutes at a temperature of 92° to 95°. Hot sponging frequently relieves pruritis when other measures fail.

The general sweating bath should be employed in cases of hernia when not readily reduced by skillful taxis without the bath. The hot immersion bath is perhaps the most appropriate measure for this purpose. The writer has often found the bath of very great service in cases of this sort. The patient lies in the bath with the head (not the shoulders)
raised, the elbows well drawn up. After the bath has been continued long enough to induce prompt perspiration, the physician employs the usual means for reducing the hernia, the patient still remaining in the bath.

In case of dislocation, the general sweating bath is not always required. It is usually sufficient to apply a large fomentation or a hot pack over the joint and over the muscles controlling it, to secure the necessary relaxation of the muscles and ligaments.

Depurative or Eliminative Effects.—The value of the sweating bath as an eliminative measure is perhaps not so great as it has been popularly believed to be, as the percentage of urea and other toxins contained in the sweat, especially when profuse perspiration is induced, is small, indeed, very small when compared with the percentage of these tissue poisons ordinarily found in the urine. That a considerable amount of the waste elements which are ordinarily eliminated through the urine may be, however, under some circumstances, carried off through the skin, is evidenced by the peculiar urinous odor which is noticeable when profuse perspiration is induced in a patient suffering from renal insufficiency. The writer has often seen most excellent results from the application of the hot blanket pack and other forms of the sweating bath in cases of uremic poisoning arising from sudden suppression of renal activity as a complication of the latter stages of pregnancy, and in urinary suppression occurring in surgical cases, especially after a severe abdominal operation, as a hysterectomy or a prolonged operation for removal of diseased uterine appendages.

The sweating bath is occasionally valuable as a means of averting or aborting a threatened attack of uremic convulsions. A patient under the writer's care many years ago, who had for some years suffered from chronic Bright's disease, discovered for himself that the characteristic group of symptoms accompanying uremic poisoning might be thoroughly con-
trolled by a hot bath, and had accordingly fitted up in his own home a vapor bath, into which he entered whenever threatened with an attack of convulsions, remaining in the bath until the symptoms had entirely disappeared. He stated that he sometimes remained in the bath more than forty-eight hours continuously. Such prolonged applications are not, however, to be commended as generally useful, at least not without interruption every hour or two for the application of cold in the form of heat and cold to the spine, or a cold trunk pack, applied by means of a single thickness of linen wrung very dry out of very cold water and well covered, so as to secure prompt reaction.

The eliminative effects of the sweating bath may be resorted to with advantage in all forms of toxicemia due to the retention of tissue poisons, gastric neurasthenia, migraine, jaundice, and chronic biliousness. To be of the greatest service in these cases, the sweating bath should not be too prolonged, and should be immediately followed by short tonic applications of cold water, in the form of the cold douche, cold wet sheet rub, or a cold plunge. The electric light bath is one of the most suitable means of applying heat in cases of this sort, as it induces profuse perspiration without long exposure of the body to a high temperature, and produces tonic as well as eliminative effects.

Sweating applications may be applied to a limited portion of the body when desirable, as in the treatment of exudates, enlarged and stiffened joints, pluritic adhesions in the chest, chronic peritonitis, and certain forms of neuralgia.

The most serious objection to the application of heat in many of the cases mentioned, especially in rheumatism and gout, is the danger of diminishing the general bodily resistance, and the contracting of colds through slight exposures, by which any good effect which may have been effected by the treatment, may be more than lost.

Expectorant Effects.—The mucous membrane is closely allied to the
exciting

and any food, which

should be eliminated.

in excess by the

sugar, enzymes, or

glucose.

and when the

bacteria are

acidic or

alkaline.

and when the

patient does
skin in its structure and functions. It should always be remembered that applications which produce general perspiration of the skin, at the same time produce an increased secretion of the mucous membrane, which is in close sympathy with the skin. This explains the great relief experienced by persons suffering from a severe cold, with obstruction of the respiratory passages, within a few moments after entering a Russian or vapor bath. A dry, painful cough is quickly "loosened" under the influence of a sweating bath, but if great care is not exercised, the condition is greatly aggravated by the acquisition of a new cold which will very likely be contracted as a result of diminished vital resistance due to the atonic reaction of heat. Persons suffering from hay fever and other forms of asthma are often quickly relieved by the Russian bath, but the relief is only temporary and the distressing symptoms are very likely to return with redoubled force as the result of some inadvertent exposure.

Local applications of vapor in the form of steam inhalations are also of great value in the treatment of throat, ear, and nose affections. Hot water drinking is one of the most efficient means of stimulating the mucous membrane to activity. The expectorant effects of water, particularly of the sweating bath, are often of service in breaking up a hard cold, especially if taken at the beginning. If, however, several days have elapsed since the exposure, the sweating bath is not likely to effect a radical cure, but it may be the means of shortening the disease, provided, of course, care is taken that an additional cold is not contracted through exposure to chill subsequent to the bath.

Direct Effects. The cold douche applied over the lower portion of the abdomen, has long been recognized as a means by which the kidneys might be stimulated to greater activity. A douche to the loins is also
Water drinking, and especially the free use of hot water internally, is of the highest value as a means of encouraging perspiration. A copious draught of hot water should always be swallowed by a person who is about to take a sweating bath. Cold water may be taken if greatly preferred, provided it is not swallowed so rapidly and in such great quantity as to produce a chill.

The cold trunk pack is also a very efficient method of stimulating the activity of the kidneys. When used for this purpose, the trunk pack must be confined to the central and lower portions of the trunk, and the sheet with which it is applied should be wrung dry as possible out of very cold water. The pack may be allowed to remain in place for two or three hours, or until dry. It may be renewed every hour or two in cases in which active diuresis is required.

The hot enema is a very efficient method of stimulating renal activity. The temperature of the water should be nearly that of the body, to avoid excessive stimulation of peristaltic movement, which is likely to follow the employment of very hot or very cold water. If the water is introduced slowly, and if necessary retained forcibly for a short time, two or three pints may be thus introduced without much inconvenience to the patient, provided that the patient co-operates in endeavoring to avoid the discharge of the water which has been introduced.

The administration of water as a diluent by enema, is a method which is not generally so highly appreciated as it should be. It may be employed with great advantage as a means of encouraging kidney action in fevers, to supply the demand for water in cases of uncontrollable vomiting, and is perhaps in no class of cases more useful than in cholera and cholera morbus, in which the patient is weakened by the great loss of fluid from the blood. By the partial introduction of warm water in these cases, the bowels are not only cleansed, but the loss of water from the body is to some degree lessened. The subject of water drinking will be treated more at length elsewhere.
Injections to the lumbar region may be advantageously employed in cases of renal insufficiency, and for the purpose of obtaining resolving effects in cases of pain in the kidney.
Cholagogue Effects:-- The cold hepatic douche is certainly one of the most effective means of stimulating the liver. Both the circulation and the functional activity of the liver may be profoundly influenced by the application of cold water by means of the horizontal jet with considerable pressure over the lower portion of the right chest and the hypogastrrium. The alternating douche is a more agreeable and in most cases a powerfully exciting measure. In cases in which congestion or pain are present, the hot or check douche may be substituted for the cold douche, or in cases in which the douche cannot be conveniently administered because of the feebleness of the patient, or for other reasons, the fomentation may be substituted. The effect of the fomentation may be prolonged by the application of the heating compress. In painful affections of the liver, fomentations repeated every two or three hours with the heating compress applied during the interim, are the most efficient means of relieving pain and restoring the organ to its normal state. The hot douche and fomentation with the wet girdle are of the highest value in cases of infectious jaundice, gall-stones, and in all acute congestions and inflammations of the liver.

Peptogenic Effects:-- The cold douche administered over the region of the stomach by means of the horizontal jet with considerable pressure is the most efficient means of stimulating the production of an abundant quantity of gastric juice of efficient quality. This is the measure par excellence to be employed in the treatment of hypopepsia. The effects of a cold douche may be encouraged by cold-water drinking, care being taken to avoid the use of cold water at meal times or for some time after eating. The water should be taken at a temperature of about 60° in quantities of three to four ounces, and half an hour before meal time.

The application of heat over the stomach for an hour or two after eating is also a peptogenic measure of high value. The effect of hot applications over the region of the stomach may be increased by the simultaneous application of an ice bag to the spine. The ice bag should
The alternate douche may be employed with to better advantage than the cold douche in many cases. The doctor makes use of the circle douche which is not only most convenient for the purpose, but produces more pronounced effects than the ordinary horizontal jet.

The percussive douche may be employed in place of the cold application, as the mechanical effects of percussive contribute to the effects produced.
be about one foot in length and should cover the spine from a point opposite the stomach upward and between the shoulders.

In cases of hyperpepsia in which it is desirable to diminish the secretion of hydrochloric acid or lessen the production of gastric juice, as in cases of gastrorrhoeas, it is necessary to employ measures of a character opposite to those used for peptogenic effects; in other words, to secure antipeptogenic effects. This may be best accomplished by means of the hot douche applied over the region of the stomach. The heating trunk compress, or hot and cold trunk pack applied just before eating, and retained for an hour or two afterwards, is a most excellent means for relieving gastric irritability and combating hyperpepsia.

Emmenagogue Effects. — Of all methods whereby the menstrual function may be stimulated, water is the safest, and at the same time one of the most effective. Drugs which stimulate the menstrual function are, without exception, powerful poisons, and are capable of doing serious mischief in doses but little larger than those ordinarily employed for the desired therapeutic effect. They provoke intestinal irritation and inflammation, disturb the kidneys, and are altogether unphysiological in their effects. They act as poisons. Water, properly applied, operates in as a physiological and consequently a rational remedy, and without involving the risk of injury.

Perhaps the most powerful of all excitants of the menstrual function is the cold douche to the loins.

**Horizontal Jet or Spray:**

Temperature,  
50° F. to 70° F.

Time,  
2 seconds to 10 seconds.

Pressure,  
15 pounds to 25 pounds.

The prolonged hot foot bath (temperature 98° F. to 104° F.), hot sitz (temperature 100° to 102° F.), hot enema (temperature 105° F.), hot h̄ép pack (temperature 120° F. for ten to fifteen minutes), are among the
best measures for use in cases of this sort. General tonic measures are of course needed when the amenorrhea is due to anemia.

Hemostatic Effects: — The most useful hemostatic effects may be obtained through the tonic reaction effects obtainable by the application of cold water, with or without percussion, in a variety of conditions.

Among the most useful of the applications of this sort are the following: very short hot barbouche, prolonged cold applications to the inner surfaces of the thighs and the soles of the feet to combat uterine hemorrhage. These applications may be made either with or without a simultaneous use of the hot uterine or vaginal douche, according to the severity of the case. It should be stated, however, that cold applications cannot be used in cases of menorrhagia without the greatest care and discretion, on account of the danger of producing hematoma or hematosalpinx through the sudden checking of the outflow of blood at the beginning of a catamenial period. On this account, less violent measures should be employed during the first twenty-four to thirty-six hours, the application of cold water being reserved to a later period. The hot vaginal douche, and even the astringent douche may be employed with greater safety during the first day in menorrhagia. The danger of producing hematoma is, in the writer's opinion, very small indeed after the first day.

The writer recalls a case which came under his observation in practice some twenty years ago which illustrates very well the value of cold applications of this sort: a girl about fifteen years of age who had suffered for nearly a year with most extreme menorrhagia until she had become exsanguinated to a very remarkable extent, and was frequently in a state bordering on collapse. The attending physician employed every sort of medicinal and many non-medicinal means for checking the hemorrhage, but without avail. Packing of the uterus had not been tried, but tamponment of the vagina with alum and other astringents had been thor-
oughly employed, but without material effect. The patient was placed at once in a sitz bath of about 80° F. for fifteen minutes, the feet being placed in cold water at the same time, and with the result that the hemorrhage ceased at once, and by continued and repeated application of the cool sitz bath for a few weeks, the patient was relieved of her difficulty. A few years later the hemorrhage returned. At that time the great value of carbetocin having come to be understood, this measure was employed and the patient was completely relieved, a large number of vegetations being found present.

Placing the hands in ice water and the application of ice to the spine from the base of the cranium to the spine, especially the cervical and the upper dorsal of the spine, are very effective means of checking nose-bleed when other measures have proved futile. Placing the patient's feet in cold water constricts the blood vessels of the nasal mucous membrane, and may be advantageously combined with the other measures mentioned.

The application of an ice-bag or an ice compress to the neck is an important means of combating cerebral hemorrhage in cases in which there is evidence of progressive mischief of this sort in the cerebrum.

Ice over the stomach and abdomen likewise exercises a controlling effect of high value in cases of stomach and intestinal hemorrhage. The writer has used this measure with great advantage in cases of stomach and intestinal hemorrhage. The writer has used this measure with great advantage in cases of hemorrhage of the stomach due to a varicoso condition of the organ resulting from cirrhosis of the liver.

Revulsive Effects.-- The revulsive effects obtainable by water constitute one of its most interesting and valuable therapeutic uses. The revulsive effect of water is nothing more nor less than a strong circulatory reaction localized in accordance with the indication present. The anatomical basis of this therapeutic effect is the association of vascular areas in the skin with definite and well understood visceral
areas. These associations have been elsewhere carefully pointed out, so that we need not here devote space to a lengthy description of them. We shall only undertake to point out the principle upon which the method rests, and the best methods for obtaining them.

As we have elsewhere learned, applications of cold water to the surface of the body set up both circulatory and thermic reactions. In revulsion pure and simple, we desire to obtain only the circulatory reaction, hence the method should be so managed as to avoid thermic reaction except in those cases in which the excitement of tissue activity by the aid of the thermic reaction will not interfere with the results sought.

It may be recalled that the contraction of the surface vessels set up by the application of cold water is accompanied by a similar but a more brief contraction of that particular vascular area which is in reflex nervous relation with the area operated upon. An application made to the entire surface of the body causes a momentary contraction of the peripheral vessels throughout the entire body, raising the blood pressure and forcing the surplus blood into the large venous channels, especially those of the portal circulation and the associated viscera,-- the spleen, the liver, the stomach, the pancreas, and the intestines.

Reaction quickly follows if the cold application is a short one,-- more quickly, in fact, in the internal parts than at the surface, for the reason that the internal tissues are surrounded by heated organs, and are not exposed to the continued influence of cold through evaporation.

When the application is made to a circumscribed portion of the surface, the reaction which follows is likewise circumscribed, both external and internal, and particularly as regards the viscus or viscera associated with the area operated upon-- which may be the muscles, the liver, the kidneys, the brain, the uterus, or some other internal part. The circulatory activity of the skin following such an application, indicated by
redness and heat, is simply an outward indication of an identical state which exists in the associated internal part. Every local application, produces, of course, more or less reactive disturbance throughout the system.

For purely revulsive effects, we seek to obtain results very different from those which follow a short cold application, but depend upon the same reflex activities and the same exciting measures for accomplishing the desired end. We are able to do this by a carefully managed combination of the atonic reaction of heat with the tonic reaction of cold, so manipulating the measures employed as to secure the strongest possible circulatory reaction while wholly suppressing the thermic reaction, the purpose being to divert the blood current from a congested organ, thus quenching the fire of inflammation by cutting off the supply of fuel.

As inflammation involves increased cell-activity, it is evident that the suppression of thermic reaction in obtaining revulsive effects is a matter of primary importance; but, singularly enough, it is a thing which has generally been entirely overlooked, and hence the common failure of attempts to employ water for revulsive effects. The physician or attendant who knows how to apply, under varied circumstances, hydro-therapeutic measures so as to produce the best revulsive effects, is an adept in the employment of water, and is entitled to be called a hydro-therapist. Certainly the number of such persons is very small.

The revulsive application invariably begins with an application of heat. The application may take the form of a douche, a fomentation, dry heat, as a hot bath, an electric light bath, immersion, affusion, etc. Powerful revulsive effects may be obtained from the application of heat alone, provided the temperature is sufficiently high. The temperature required is from 110° to 130°. If the surface involved is very small, even higher temperatures may be used. The effect of such an application is to dilate the surface vessels, particularly the venules, and thus to divert to the surface a considerable amount of blood.
Revulsion by heat cannot be relied upon, however, in cases in which it is necessary to extend the application to the whole surface of the body, or to a very large area, for the reason that such extensive applications of heat give rise to the excitation of the cerebral and spinal centers, which interfere with the application, and produce untoward effects.

Revulsive effects are also obtainable by the application of cold, but the objection to revulsion by cold is the too strong and undesirable thermic reaction which is set up in connection with the desired circulatory reaction. By a proper combination of heat and cold, we are able to obtain not only a more powerful circulatory reaction, and hence more powerful revulsive effects, but also a controllable combination of the two measures, thermic reaction may be wholly suppressed, or may be permitted to any degree, more or less, as may be advantageous to the results sought.

When a hot application is made to the surface, a considerable amount of artificial heat is absorbed by the skin and underlying tissues. If the hot application is followed by a suitable cold application so adjusted and manipulated as to absorb just the amount of heat which has been applied to the skin, -- in other words, so as to antidote and neutralize the artificial heat to which the skin has been subjected, the skin is left at its normal temperature. Thermic reaction is set up by the lowering of the temperature of the skin below the normal point; hence, if the application of cold is barely sufficient to bring the skin to the normal temperature, no thermic reaction will take place.

How may this be accomplished? It is certainly apparent that it is practically impossible to make such use of a thermometer as to enable one to apply cold in just the measure to exactly balance the previous application of heat. But, fortunately, nature has given us a perfect indicator whereby this may be accomplished. The reaction produced by heat results in a dilatation of the surface vessels, but this dilatation involves the small veins to a much greater degree than the small arteries; in other words, heat relaxes the venules rather than the arterioles, thus
giving rise to a disproportionate increase of venous blood in the skin. The result is a dusky or purplish red color, as a characteristic effect of hot applications to the skin. The reaction induced by cold, on the other hand, produces a dilatation of all the surface vessels, both arterioles and venules, thus producing a quickened circulation through the skin rather than venous stagnation.

This effect of cold in increasing the circulation of the blood through the skin and dilating the small arterioles as well as the veins, gives rise to a crimson or a bright red color, which is easily distinguished from the dusky hue resulting from a hot application.

It is evident that if an application of cold succeeds an application of heat upon the same surface, a change of color will appear. This change of color begins the instant the heat communicated to the skin has been absorbed by the cold application; hence the change in the color of the skin becomes a perfect guide to the hydrotherapeutist in the employment of revulsive measures, making it possible to check the cold application at just the right instant to secure a purely circulatory reaction and to wholly suppress all thermic reaction. A very little practice is required to enable one to distinguish at a glance the color produced by heat reaction from that produced by cold reaction. It is of course evident that in making an application of this sort, the effect of the cold application must be watched with the greatest care and must be interrupted the instant the looked for change in color appears.

In the employment of heat for revulsive effects, the result will be as much more intense as the temperature is high and the application prolonged. The maximum effect is usually reached in five to ten minutes.

In the employment of cold applications for revulsive effects, the effect will be as much more intense as the temperature is low and the percussion strong.

In the production of revulsive effects by the combined use of heat and cold, the effects will be the more intense the greater the difference
in temperature between the hot and the cold applications; hence, for the strongest effects the hot application should be as hot as can be borne. If the area is small, the temperature may be 115° F. to 130° F. A temperature of 110° F. or 112° F. is generally safer. The higher temperature may be readily used if the horizontal jet or spray is employed, instead of the immersion bath, since the current of water may be applied with asperations and made in rapid succession upon different portions of the surface.

In the alternation, a temperature of 45° to 50° for the cold application is desirable, and a still lower temperature may sometimes be employed, though ice water and ice are seldom used except when the application is confined to very limited areas.

Reulsive effects may be produced either by percussive or non-percussive applications, or by a combination of percussive and non-percussive means; for example, reulsion to the lower extremities may be obtained by a very hot foot- or leg-bath followed by a cold spray. The leg- or foot-bath may be of five to ten minutes' duration, but generally, exposure of the surface to an application of heat for four or five minutes is sufficient to obtain the effects desired.

During the application of the cold spray, the color of the surface acted upon must be carefully watched, and the instant the bright red produced by the reaction of cold begins to make its appearance, the cold application should cease. By subsequent friction, the circulatory reaction may be increased. The length of the cold application generally need not exceed ten to fifteen seconds. Equally good effects are obtained, and somewhat more speedily, by the employment of the hot douche preceding the cold douche. Three or four minutes suffice for the hot application, and ten to fifteen seconds for the cold application.

When neither immersion nor the cold douche can be employed, a fermentation followed by a cold compress or cold towel friction, may be employ-
ed. The latter is an excellent measure to be used in cases of bedridden patients, and when the skin surface to be acted upon is so sensitive that the percutant applications cannot be tolerated, the towel should be wrung out of very cold water, and dry as possible.

One of the most generally useful of all the various revulsive applications which can be made is the Scotch douche, which consists of a hot horizontal jet or spray for three or four minutes, followed by a cold douche for five to fifteen seconds.

Revulsion is perhaps most valuable as a means of relieving pain. When analgesic effects are desired, the greatest care must be taken to avoid all thermic reaction, by the methods which have been already outlined. The Scotch douche has been used with great success in hundreds of cases of sciatic neuralgia, to the relief of which it seems to be especially adapted. It may be used with equal success in neuralgia in other regions, though with less convenience. In spinal irritation, in intercostal neuralgia, in lumbago, in crural neuralgia and even in cases of facial neuralgia, the Scotch douche may be relied upon as a sovereign remedy, though the application must be more or less modified to suit the varying conditions under which it must be employed. For enteralgia, gastralgia, and allied painful affections of the abdomen, a fomentation for five to ten minutes, followed by a cold towel friction until the characteristic change of color appears, is more suitable than percutant applications.

The revulsive douche is a most useful agent in producing derivative effects in chronic visceral congestion, especially in congestion of the liver, spleen, kidneys, and pelvic viscera. In these cases, it is only necessary to administer the Scotch revulsive douche to the special areas of the skin which are in reflex relation with the several viscera. When it is desired to draw the blood away from the upper part of the body, it is necessary to localize the application to the lower extremities by means of a hot leg or sitz bath followed by a short cold application, or
In cases of neuralgia accompanied by extreme sensitiveness of the skin, strong pressures must be avoided; in some cases, also, extremes of temperature give pain. In such cases the neuralgic doth with little pressure (3-5 lbs) must be used. The patient is covered, as a preparation for the stretch doth, which should at first be employed at very moderate temperatures, and with little pressure, progressively increased as a tolerance is established.
by means of the Scotch douche. When it is desirable to produce revulsion in the opposite direction, the Scotch douche may be administered to the back and arms. The last named measure is often useful in cases of pelvic congestion or hemorrhage, while at the same time necessary measures are being employed to reduce the congestion of the affected parts by suitable measures. Revulsive applications may be advantageously employed for the relief of pain in strained or over-worked muscles, and in cases of chronic myalgia.

General revulsive effects may be advantageously employed in such disorders as cholera, chronic rheumatism,—when the joints are universally affected,—and in cases of heat stroke in which the surface is pale. It is a useful measure in all forms of shock and collapse, as a means of combatting internal congestion. Revulsion in these cases may be sought without care to suppress the thermic reaction, hence it is not always necessary to precede the cold application by an application of heat, although as a rule this is desirable when it can be accomplished without too much delay, and the cold application may be continued long enough to obtain the excitant or tonic effect. The lumberman brings the blood warmth and life to his blanched and freezing feet by pulling off his boots and socks and rubbing the parts with snow. The Persians combat the collapse from cholera by vigorously rubbing the surface with cold water. For this reason it has been the practice from time immemorial in Persian cities to place upon every street corner pails of water during epidemics of cholera; and if a person falls upon the streets, a few bystanders immediately deluge him with water and rub the whole surface of the body with the greatest vigor. The writer has for many years made use of similar means in collapse under anesthesia, in surgical shock, and in similar cases, preferring, however, whenever possible, to make the cold application short and to precede it or alternate it with a hot application. In this manner it is possible to obtain both an excellent a circulatory reaction, and simultaneously a calorific effect.
When the suppression of the thermic reaction is not necessary, as when purely revulsive effects are not required, the alternate douche may be employed instead of the Scotch douche. In this douche, as elsewhere explained, the applications of heat and cold are of equal length. The extremes of temperature are as great as can be borne, provided the exciting effects of such an application are not contraindicated, and the alternations should be eight or ten in number. The application may be renewed several times a day, or as frequently as may be required.

In place of the alternate douche, the alternate foot bath, alternate affusion, alternate compresses, and various other forms of applying heat and cold in alternation may be used, adapting the measure to the case in hand.

The alternate douche differs from the Scotch douche in that it is exciting rather than calming or analgesic in its effects. It is one of the most exciting of all hydrotherapeutic applications.

The alternate douche is extremely useful as a means of stimulating the absorption of exudates in joints or muscles and about tendons. The resolvent effects which can be obtained by its means are highly valuable. Similar effects, though less vigorous, may be obtained by nonpercutaneous applications, such as the fomentation, followed by the heating compress, or by alternate hot and cold compresses, hot and cold pour, etc. In the employment of alternate hot and cold compresses or other applications for resolvent effects, the length of the hot and cold applications should usually be approximately equal, about 15 seconds each.

**Alterative Effects.**—The multiple reflex activities which may be set up in the body through the agency of therapeutic applications of water to the surface, may give rise to effects to which the term alterative has been applied, and to a degree unequalled by any other therapeutie agent. An alterative effect may be roughly defined as an agitation, a change, a disturbance. The beneficial effects of such an application are perhaps not easily explained, but it may be that there is something
When the part under treatment is painful, the hot application should be some-what prolonged, making the times as follows: heat 60 sec., cold 15 sec., or heat 2 min., cold 15 sec. This means strongly resolving effects today be obtained while pain is at the same time mitigated or wholly relieved.
more than a rhetorical figure in the suggestion of Fonssagrives that such
an application lifts the patient out of an abnormal state by untying a
bundle of pathological habits, thus giving nature, relieved of embarrass-
ing obstacles, an opportunity to organize her resources and to set in
operation a favorable vital process or recuperative action.

The alterative effects of water are obtained by the cold douche, the
alternating douche, the wet sheet pack, sweating procedures, and in fact
nearly all general applications, both hot and cold. The most effective,
however, are cold applications, and especially those which are accompa-
nied by strong percussion, as the jet douche or spray. The massage douche is perhaps the most powerful of all means for producing the gen-
eral alterative effects.

Local alterative effects are likewise produced by circumscribed
applications, such as the various forms of special douches which have
been elsewhere described, the hepatic douche, the splenic douche, etc.

The general alterative effects of water are the most efficient of
all means of treating refractory cases of malarial infection, a variety
of chronic neuroses, neuralgias, migraine, and neurasthenia. In fact,
the alterative effects of cold water must be regarded as among the most
important and fundamental means by which this agent proves serviceable
in the treatment of most chronic affections.

The neutral bath at bedtime is worth more as a genuine and efficient
hypnotic than all medicinal hypnotic agents known to pharmacy.

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length of time, and often unfavorable effects follow immediately when

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Sedative Effects.

Water, properly employed, is superior to all other remedial agents as a sedative. Of the various classes of sedatives, hypnotics, heart sedatives, and pain sedatives or anodynes, those of a medicinal character are all powerful toxic agents. Bromide of potash, chloral, sulphonal, paraldehyde, and all the rest of the long list of hypnotics are each and all productive of most pernicious effects when used for any considerable length of time, and often undesirable effects follow immediately after.

In a recent discussion of this subject in the British Medical Journal, most pronounced views against the use of medicinal hypnotics of any sort
were recorded by leading English and American authorities. It was shown by indubitable evidence that hypnotic drugs of all sorts are poisons and capable of great mischief if habitually used.

Digitalis, strophanthus, and all the other heart sedatives are likewise toxic agents which, unless used with the very greatest discretion, may produce highly untoward or even fatal effects. There is no drug sedative which can be used for any considerable length of time which will not sooner or later produce injurious effects sufficiently marked to be readily recognizable, and it is more than probable that such drugs cannot be used even temporarily without some minute damage to the body which, though not readily apparent, is nevertheless a real and definite injury, the results of which will sometime appear, though they may not be easily traceable.

Water, on the other hand, may be made to produce prompt and highly sedative effects without leaving behind any damaging influence which must be subsequently corrected or become the means of precipitating a physical bankruptcy on some occasion when an emergency creates an urgent demand upon the reserve forces of the body. The habitual use of digitalis or any other heart sedative must be regarded as in the highest degree pernicious.

Pain sedatives or analgesics may be almost entirely dispensed with if the resources of water are utilized to the fullest extent. The ice pack and the hot fomentation are capable of controlling a large proportion of all the painful ailments to which flesh is heir. The employment of measures of this sort are certainly less convenient than the administration of a pill or hypodermic injection, but the question with both the patient and the physician should be not what remedy can be most conveniently employed, but what remedy will accomplish the best and most permanent results in the amelioration of the patient's sufferings.
SEDA TIVE EFFECTS.

A sedative is an agent which moderates the abnormal, increased action of an organ or set of organs. There are three general classes of sedative effects which are therapeutically indicated:

1. Sedatives of nervous action, known as,
   a. Antispasmodic.
   b. Analgesic.
   c. Anesthetic.

2. Sedatives of the circulatory system, known as,
   a. Antiphlogistic (a) vascular
       (b) cardiac
   b. Hemostatic.

3. Sedatives of cell activities, known as,
   a. Antithermic.
   b. Antipyretic.

Sedative applications and effects may be either general or local. Antiphlogistic and hemostatic remedies are usually applied to obtain local effects. The same is true of anesthetic and analgesic measures, while antithermic and antipyretic measures are necessarily general in character, owing to the nature of the indications to be met. There are, however, cases in which a general febrile state may be combated by local means applied to subdue the pathological processes to which the rise of temperature is due.

Sedative or depressing effects may be produced by precisely the same means as are employed for excitant and tonic effects, differently managed.

Whether a particular application of water at a given temperature is to prove tonic or sedative may also depend as much upon the temperament of the patient and the special conditions in which he may happen to be for the time being, as on the particular method of procedure itself. The only hydrotherapeutic procedure which is immediately, directly, and
always sedative, is the full or immersion bath, at 92° to 97° F., the neutral bath.

Sedative effects may be either immediate or remote. Remote sedative effects may often be produced by the application of excitant or tonic measures, whereby the irritation which exists, the condition which an eminent clinical teacher so well defined as "irritable weakness," is made to disappear under the tonic influence of cold applications systematically employed.

Sedative effects may be obtained, (1) by cold applications; (2) by warm applications, and in two ways by each class of measures.

(1) Sedative effects may be obtained by cold applications—

   (a) By restoring nerve tone through the effect of tonic applications systematically employed for the necessary length of time (remote effect), and

   (b) By the prolonged application of water at some temperature below 90° (immediate effect). Water at a temperature below 90° produces at first an excitant effect through arousing the resistance of the body, and thermic reaction provoked, extending to every cell and tissue of the system. If the application is short, as has been elsewhere shown, the excitant effect is dominant; but if the application is sufficiently prolonged, the reactive powers of the system are at last exhausted, and after many oscillatory attempts at reaction of gradually decreasing intensity, the ability to react is finally wholly exhausted, and a decidedly sedative effect is established.

(2) Sedative effects from warm applications may be produced in two ways, as follows:

   (a) Short applications of hot water, producing an atonic or asthenic reaction, the reverse of the reaction produced by cold; and

   (b) By prolonged applications of water at a neutral temperature, 92° to 97° Fahrenheit.

We will now consider the leading sedative effects obtained by water,
and the most convenient methods for obtaining the same.

Circulatory Sedatives. — The effect of cold, when directly applied to the tissues, is to cause contraction of the small blood vessels throughout the body, thereby diminishing the blood current. Cold applications of sufficient intensity may even absolutely arrest the blood stream in the small vessels. In order, however, that this effect should be obtained, it is necessary that reaction should be wholly suppressed, for in the state of reaction which follows an application of cold, there is an adverse condition, namely, dilatation of the small vessels, both venules and arterioles, giving rise to a greatly increased rate of flow in the blood current. For the tonic reaction, it is necessary—

1. That the cold application should be prolonged; and

2. That percussion and friction should be wholly avoided in the mode of application, since these mechanical stimuli encourage tonic reaction.

Cold causes at first a strong contraction of the blood vessels, which is quickly followed by a dilatation of all the small vessels of the skin, which continues for a considerable time, as illustrated by the ruddy nose and cheeks of the woodchopper. On the other hand, the application of heat produces, after the first instant, strong dilatation of the small veins, which is later followed by prolonged contraction, as shown by the white and almost bloodless hands of the washerwoman. A prolonged application of cold and a short application of heat are alike in producing at first stimulation, later sedation. These effects are obtained when cold is employed, by the suppression of the usual tonic reaction; in the case of the hot applications, the sedation is due to the a tonic reaction of heat.

Sedative baths are beneficial only when well borne. Weakness after the bath, sedentary chill, headache, and nervousness are evidences of too low a temperature or too prolonged an application; or in case the hot bath has been employed, the indication is that the temperature was too
high or the bath too prolonged, or that the concluding cold application was not employed for a sufficient length of time to remove the heat communicated to the skin.

Antiphlogistic Effects. -- Under this head are included applications which have for their purpose to suppress or combat a local acute congestion or inflammation, such as a boil, felon, an acutely inflamed joint, a pneumonia, a pleurisy, a perforitis, an iritis, a phlebitis, an arethema, or a circumscribed erysipelas-like inflammation. In the application of cold for antiphlogistic effects, it is, as above stated, of the highest importance to avoid percussion and friction, and to make the applications continuous until the desired effect is obtained. Compresses saturated with cold water, rubber bags filled with ice, or iced water, the cold immersion, and the evaporating compress, are the chief and most convenient methods for producing antiphlogistic effects by means of cold.

In obtaining the atomic antiphlogistic effects of heat, fomentations, the poultice, the hot water bag, hot irrigation, and hot immersion are the chief measures. Pennaagrivives maintains that the relief obtained by warm or emollient applications in acute congestions and inflammations may be in part attributed to dilution of the blood by absorption of the fluid from the moist mass in contact with the skin, producing a local hydremia, whereby the blood is rendered less stimulating to the irritated tissues. This idea, expressed more than a dozen years ago, seems to be sustained by our present notions respecting the part played by toxins of bacterial origin in provoking and maintaining local congestive and inflammatory processes.

It seems reasonable, also, that dilution of the blood, which is approximately normal, may serve to lessen the activity of morbid processes in a congested or inflamed part, by diminishing the number of blood cells present and diluting the blood serum.

The employment of the hot foot bath for the relief and prevention of congestion and inflammation in sprains of the ankle and other joints...
The dilution and neutralization of the poisons must certainly tend to lessen the intensity of the morbid changes set up by them, and to aid the tissues in their efforts to combat the causative elements present, whatever they may be.
It must be ever borne in mind that if a cold application becomes
warmed by contact with the skin it is because reaction has occurred
and to the extent to which there has been reaction, the antiphlogis-
getic effect has been spoiled.

One must be taken that the cold
compress, when used, is renewed as
soon as it begins to approach the
temperature of the skin. A large, thick,
well-saturated compress may remain
retain its efficiency for five minutes
or even a little longer; while a com-
press of two or three thicknesses, will need
to be renewed every minute.

In the use of the ice bag or the
ice compress, a piece of rather thick,
well-saturated woollen cloth should
be placed next the body to avoid
excessive chilling of the skin. If this
precaution is omitted great some must
be perceived in transient injury, and the
application must be renewed for a few
minutes.
minutes every half hour so that partial reaction may be allowed to occur, thus maintaining the vitality of the part.
affords an excellent illustration of the sedative effect of the hot application.

Prolonged immersion of a part in water at a temperature of 95° to 97° is a most effective means of preventing inflammation in cases of badly contused and lacerated wounds. Dr. Frank Hamilton, of Bellevue Hospital, New York, when the writer was a student in that institution, made large use of the immersion bath in the treatment of injuries resulting from street railway accidents, and demonstrated the value of this method by saving a large number of badly bruised limbs which his railway colleagues condemned to amputation.

This is also an extremely excellent method of preventing inflammation and other complications in case of severe burns. Many years ago the writer heard in Rokitansky's Hospital for Skin Diseases at Vienna, who had suffered from a severe burn who had been immersed in a full bath for a number of months, ultimately made a good recovery from an injury which without the advantage of this measure, would probably have proved fatal.

For general antiphlogistic effects,—that is, for subduing a condition commonly known as feverishness, but without actual rise of temperature,—the neutral bath should be employed, and will be found a sovereign remedy. The excessive action of the heart is controlled, the bounding, feverish pulse becomes soft and returns to the normal rate, the flushed face acquires its normal hue, and the patient finds complete relief by remaining half or three fourths of an hour in a bath at the temperature named. Care should be taken to avoid friction in the bath, or after it, and the patient should avoid exercise after the bath.

Immediately on removal from the bath, the patient should be wrapped in a Turkish sheet and woolen blankets, and should be dried by allowing the moisture upon the surface to be imbibed by the sheet, and without any friction whatever. The patient should remain quiet for some hours after the bath, so that the tendency to reaction may be suppressed.
In case of acute inflammation, accompanied by exudate, as in pneumonia, pleurisy, and inflammation of the joints, continuous cold applications should be employed during the early state of the disease, but after the plastic exudation has occurred, the cold application should be exchanged for intermittent hot applications. Fomentations and equivalent measures may be applied regularly every two or three hours, tepid compresses being employed in the interval.

In the transition stage between the first and second periods of the disease, the continual cold applications may be interrupted every two or three hours by hot applications for ten or fifteen minutes. This method the author has found eminently successful in the treatment of pneumonia, erysipelas, acute arthritis, and similar conditions. Care must be taken in making continuous cold applications at very low temperatures, that the vitality of the tissues is not destroyed by complete interruption of the circulation. To avoid this, the applications, if the temperature employed is below 50°, should be removed every hour or two for a short time, so as to allow partial restoration of the circulation. After the very first onset of acute inflammatory affection,—that is, after the first twelve or twenty-four hours, hot applications may be applied for three or four minutes with advantage in the interval occasioned by the interruption of the cold applications.

Of sedative measures especially applicable to particular regions of the body, the most useful are the application of cold to the base of the skull and about the neck (for the relief of cerebral congestion); heat to the upper spine; cold to the face and top of head; the short cold douche to the hands, arms, feet, and legs; leg or hip bath at 105° to 110° for four minutes, followed by a cold douche for fifteen to twenty seconds; heating pack about the trunk; half pack to legs and hips; wet, sheet pack at 70°; prolonged douche, one or two minutes, at 70° to 80°; pack over the heart to diminish cardiac activity and blood pressure, thus relieving the
brain. The heart's action may also be lessened by cold water drinking. Congestion of the stomach, as in hyperpepsia, is best relieved by prolonged hot douche over the stomach and the spine opposite.

Hemostatic Effects.—The depressing influence of cold may be employed as an efficient means of checking hemorrhage, as in the application of ice to a wound to check capillary ooze, plugging of nostrils with ice and swallowing of bits of ice in epistaxis, the swallowing of ice pills in hemorrhage from the stomach, the application of the ice pack to the loins in hemorrhage from the kidney, and ice pack over the abdomen in case of hemorrhage from the bowels.

It must be remembered that in the use of cold for the purpose of controlling hemorrhage, great care must be exercised to prevent reaction, since this would cause dilatation of the vessels, which would defeat the object sought.

Very hot as well as very cold applications of water are effective means of controlling hemorrhage. A sponge or napkin saturated with water at a temperature of 112° to 120° is the most efficient means of checking capillary ooze. This means of controlling hemorrhage has been very extensively used in operations involving the peritoneal cavity, and is not infrequently of very great service in shortening the time required for the completion of an operation by facilitating the preparation of wounds for closing. The application of water at a temperature of 115° to 120° to the interior of the uterus will almost instantaneously control uterine hemorrhage. Heat may also be applied to the uterine cavity by means of a hollow metal sound, through which a stream of hot water is allowed to flow. The writer has made use in this way of water at a temperature of 160° with advantage.

Nerve Sedatives.—Those measures which are sedative to the circulation and which have been described as antiphlogistic, are without exception also sedative in their effect upon the nervous system, as the cir-
cular system is of course controlled by vaso-motor, sympathetic nerves. It is not easy, in fact, to distinguish definitely between circulatory and nerve sedatives, though for convenience it is perhaps wise to specially designate those measures which are particularly helpful in lessening the activity of the cerebral spinal system of the nerves.

Remedies of this sort are usually classed as hypnotic, calmative, anti-spasmodic, analgesic, and anesthetic.

Hypnotic

For hypnotic or general sedative effects there is no measure superior to the neutral bath, which should be given at a temperature of 93° to 97°, and may be continued for thirty minutes to two hours. It should be taken at bedtime. The wet sheet pack is very similar in its effects. It should not be administered very cold, but at a temperature of 70° to 75°. The sheet should be wrung very dry, and the patient should not be too warmly covered, so that the disposition to perspire may be avoided.

The horizontal jet douche, at 75° to 80° for three minutes; the ice cap, or cold compress, to the head; evaporating headcap; hot and cold to the spine, are measures of the highest value. The alternate application to the spine may consist of compresses, hot and cold sponging, alternate pouring hot and cold water, or the alternate hot and cold douche. Care should be taken to avoid percussion effects or shocks from too strong impression, the effect of which would be exciting to brain and nerves.

The moist girdle or heating compress applied over the abdomen and worn at night, and in some instances during the day, is also a measure of great value, and much relied upon in Germany as a remedy for the relief of insomnia.

The wet sheet pack is a very effective means of relieving sleeplessness due to nervousness or fidgets. It is also a valuable remedy in acute mania, often giving such complete relief to the patient that he very soon becomes quiet. In the delirium of typhoid fever, when not accompanied by high temperature, the application of the wet sheet pack
will often secure almost immediate relief, and not infrequently bring a
sleep from which the patient awakes refreshed.

**Analgesic Effects.**—Patients suffering from acute inflammation and
certain neuralgias unaccompanied by any inflammatory condition, are often
relieved in an almost marvelous manner by the cold compress, the ice
pack, or the evaporating compress. As a rule, quite an intense degree
of cold is necessary to secure the desired effect. The analgesic effect
of cold applications is well illustrated in the use of a continuous cold
compress in the case of burns. On one occasion in which the writer was
involved in a serious railway wreck, he succeeded in bringing almost im-
mediate relief to two badly scalded porters by wrapping their burned legs
in wet towels which were kept cool by continually pouring water over them
In ten or fifteen minutes the poor fellows, who had been writhing and
groaning in agony, were almost entirely at ease. The relief was so com-
plete and permanent that both secured a good night's rest, without morphe-
For the relief of pain unaccompanied by inflammation, hot fomentations
and the hot douche are generally most effective. Dry heat is sometimes
more serviceable than moist heat. Fomentations or poultices or similar
measures are also often extremely useful in relieving pain accompanying
local inflammatory processes.

**Anesthetics.**—It is unnecessary to do more than call attention to
the well known anesthetic effects of cold. When the temperature of the
skin is lowered very much below normal, the sensibility of numerous
classes of nerve filaments which it contains, and especially of the sen-
sory nerves, is diminished to a marked degree. The application of ice
for a few minutes will almost completely abolish sensibility in the part
to which the application is made. By the employment of freezing mix-
tures of salt and ice or an ether or rhigoline spray, the skin and sub-
adjacent parts may be so thoroughly benumbed that almost any minor opera-
tion may be performed by the aid of the local anesthetic effect produced
Calamine. — For general calaminic effects, the same measures should be adopted that have been recommended for hypnotic effects. For local quieting effects the neutral douche (92°F to 98°F) for five to fifteen minutes, with little friction, is a measure of great value, in cases of locomotor ataxia and sciaries of the spine, and in cases of neuralgic pain with marked exaggeration of the deep reflexes, the neutral douche to the spine, for three to fifteen minutes will be found highly useful. The heating cadpress also proves serviceable in cases in which a circumscripted irritation exists without inflammatory action or active congestion, as in hyperesthesia of the lumbar ganglia or of the abdominal sympathetic area of the solar plexus, in which the records of experimental work show it can be employed, as in "pudenda," or as a means of introducing neural therapeutics.
by cold. In the employment of this measure it must be remembered that if the part is kept too long in a frozen state, its vitality may be destroyed, so that sloughing will occur.

**Antispasmodic Effects.**—For true antispasmodic effects we are obliged to rely wholly upon heat employed at a temperature such that the exciting effects of very hot applications are avoided, as well as the exciting thermic reaction of cold. The neutral bath at 92° to 98° is precisely adapted to the indications presented in cases of hysteria, extreme nervous agitation, insomnia from restlessness, etc. The full or immersion bath should be employed at a temperature of 92° to 98°. The neutral douche, which is specially serviceable in cases of nervous agitation and insomnia, should be given at a temperature of 95° to 97°. The neutral immersion bath may be continued for one or two hours at a time. It is a sovereign remedy for hysteria, and will usually avert a threatened attack if perseveringly employed. It must be remembered that the neutral bath as well as the hot bath is debilitating, hence its use should not be continued for any considerable length of time. It should be employed only as an introduction measure, to be followed by tonic applications as rapidly as the patient can be trained to endure them.

**Antithermic Effects.**—The antithermic or refrigerant effects of water are among the most important and valuable used to which this therapeutic agent can be put. It has been known from the earliest ages, certainly since the time of Hippocrates, that the application to the body of water at a temperature lower than the body temperature is a most perfect means of antagonizing the elevation of temperature which occurs in connection with fevers of all classes, and a large share of all acute diseases, especially those of an infectious nature. All applications of water at a temperature lower than that of the body may be utilized for combating a disposition to the production of an excess of heat. A few general principles may be usefully borne in mind in the application of water for the reduction of temperature.
** Local anti-spasmodic effects may be obtained by the application of the neutral dermic plasma (mother) compresses, the neutral pain, and when the dermatitis are involved, by the neutral zonarthe, without pression.
Mr. Rossiter—please insert this some place, perhaps in the beginning of the article would be best.
First, the greater the difference in the temperature of the body and that of the water, the greater the effect, other things being equal.

Second, the application, to be of real permanent value, must be prolonged. The length of the application may vary from ten to fifteen minutes to half an hour or even longer. The average time of a cold bath for lowering the temperature, as in typhoid fever, is about twenty minutes. The exact time, of course, must be made to depend upon the condition of the patient, the degree of elevation of the temperature above normal, and the temperature of the bath.

Third, all forms of the bath which are accompanied by percussion effects must be avoided, as must also friction after the patient is removed from the bath, except that there may be pronounced shivering or other similar symptoms needing such assistance to produce sufficient reaction to insure the visceras against injury from prolonged congestion. Friction may often be employed while the patient is in the cold bath to great advantage, as by this means the reaction is to a considerable degree repressed while circulatory reaction is promoted, and thus the lowering of the patient's temperature is encouraged. Winternitz has shown that friction of a patient in the cold bath increases the rate of heat elimination more than thirty per cent (?).

Antipyretic Effects.—The antipyretic effects of cold water are obtained by the systematic employment of antithermic measures. At the present time all leading medical authorities are agreed as to the extreme value of water as an antipyretic measure. There has within the last few years been a very strong reaction against the use of antipyretic drugs and in favor of a truly physiological and rational remedy. It is true that modern observations have shown that the danger from elevation of temperature is not so great as was formerly supposed, that in fact the rise in bodily temperature accompanying febrile activity is really a part of the remedial effort put forth by the system in combating the morbid process
to which the rise of temperature is due. It has been clearly shown by
Hare of Philadelphia, and others, that the mere lowering of temp-
perature by means of antipyretic drugs is not only not in any way ben-
eficial to the patient, but is decidedly detrimental, since the system of
the patient is thus compelled to struggle not only with the toxines which
are produced in connection with the morbid processes present, but
with the toxic drug introduced with therapeutic intent.

In visiting the surgical wards of a large city hospital some years
ago, the writer was particularly struck by the fact that patients whose
temperatures were normal as the result of the administration of several
large doses of antipyrin, wore the expression of persons in a state of
collapse or extreme shock, the evident result of the combined influence
of the toxines peculiar to the disease and the toxic effects of the med-
icine administered. In the reduction of temperature by means of hydro-
therapeutic applications, the situation is certainly different. No
toxic substance is introduced into the body. The cold applications,
while lessening to some degree the pathological thermogenic processes
which are in operation, at the same time as a tonic to the reparative
forces of the body, and stimulate the elimination of the toxic substances
to which the special symptoms characteristic of the disease are due.

As the result of the antipyretic application of water, the heart's
action is improved, the vital resistance of the patient is strengthened,
the eliminative action of both the skin and the kidneys is encouraged,
and all the graver symptoms of disease are mitigated, and often to such a
degree that the disease is scarcely recognizable from the classical des-
cRIPTION of the textbooks, which quote too often reports not of natural
diseases but of natural diseases modified by artificial and irrational and
meddlesome therapeutics.

From the practice and the teachings of most hydrotherapeutists, it
would appear that antipyretic hydrotherapeutic means consisted wholly in
applications of cold water. It is true that in the first attempts to combat febrile conditions by means of baths, cold water was employed, but modern laboratory researches and clinical experience have brought us to an appreciation of the fact that water at a high temperature as well as water at a temperature some degrees below that of the body, is capable of employment in such a manner as to secure a considerable reduction of temperature in febrile states. It should be noted that in the febrile state the thermogenetic and thermoregulative mechanism of the body are profoundly disturbed, and in such a manner that they are influenced by causes which have no effect whatever upon the body in the non-febrile state. A rise in temperature of a few degrees in the sick room, sitting up in bed, talking with a friend, reading, taking a slight excess of food, and other similar causes are sufficient to occasion a considerable rise of temperature in a febrile patient, and might even give rise to a relapse in a recent convalescent. Likewise, hydrotherapeutic applications which are not capable of producing temperature in a healthy person have a decided effect when employed in persons in a febrile state.

Of the various measures which may be employed for the reduction of temperature, we mention the following, all of which we have tested in actual clinical experience, and have found useful and efficient, some being best adapted to one particular set of circumstances, others to other circumstances, each having its particular utility, for rational hydrotherapy gives no countenance to routine methods, and recognizes no panacea:

**Relation of Heat Production and Heat Elimination to Antipyretic Methods.**—A general rise of bodily temperature in cases of fever may result, (a) from increased heat production, (b) from diminished heat elimination, or (c) both increased heat production and diminished heat elimination may be present.

It is also possible, of course, that there may be, in a certain case, both increased heat production and increased heat elimination, the
rise of temperature being due to the fact that the increased heat production is out of proportion to the increase of heat elimination.

There is always a disturbance of the thermotaxic or heat regulating function in fever. It is important to ascertain, in a given case, as nearly as possible, the condition present, and the question should always be asked before making a hydrotherapeutic application of any sort, "Is the rise of temperature in this case chiefly due to increased heat production or to diminished heat elimination?" The neglect to ask this question and to find a definite answer to it, is responsible for much of the opposition to the use of hydrotherapeutic measures in fever which has arisen among practitioners. Conditions are sometimes present in which there is greatly increased heat production, and also a great increase of heat elimination, and it is apparent that nature is doing all that can be done to combat the rise of temperature and that interference on the part of a physician would be in the highest degree meddlesome and possibly injurious.

This is practically true in cases of fever in which profuse perspiration is present. In such a case, neither hot nor cold applications are needed. All that is required is that the perspiration should be gently removed by means of a soft linen cloth every few minutes. By keeping the surface free from sensible perspiration or visible moisture, evaporation will be greatly promoted, and thus the cooling effect will be increased. To apply a wet sheet pack, a cold bath, a cold sponge, or, in fact, any other measure than the simple means mentioned in such a case, would be to run great risk of inflicting serious, and possibly irreparable damage upon the patient.

In evaporation of water from the surface, an enormous amount of heat is absorbed. The ordinary amount of water evaporated is about one to one and one-half ounces per hour. Suppose this to be increased to eight ounces per hour, as might be the case in a fever patient sweating freely,
The result would be the removal by evaporation alone of nearly 500 heat units. In case of a patient weighing 160 pounds, this would be equivalent to a fall of $3^\circ$ F. in temperature. If the heat production in the meantime were no more than double the normal amount, there would be an actual reduction of temperature to the amount of one degree, a better result than could be hoped for by any antipyretic method which could be safely employed.

It should be remembered that cold applications, while aiding heat elimination in some ways, diminish elimination by lessening the conducting power of the skin, by diminishing the blood supply and checking perspiration. It is, consequently, evident that to make a cold application in a case in which the surface is already pale, cold, and dry,—in other words, a case in which there is a decided diminution in heat elimination, would be ill-advised and likely to do harm. Indeed, the persistent application of cold measures in such a case might induce a fatal result.

It is true that in persons possessed of considerable vitality, a very cold application might set up such vigorous resistance on the part of the system as to produce reaction to the surface, thus increasing the heat elimination, and so restoring the heat eliminating power of the skin;—indeed, it is more than probable that this result might occur in quite a large proportion of cases, so that the danger from the application of cold water in a manner theoretically wrong may not be so great as might at first seem; nevertheless, it is far better to recognize the exact condition present and to select the most appropriate measures for meeting existing indications. The physician who depends upon the reserve resources of the body and the versatile powers of nature to avert the consequences of his blundering methods in the therapeutic uses of water, can hardly be regarded as a scientific hydrotherapeutist.

**Indications of Increased Heat Production.**—In persons presenting an abnormally high temperature, the following symptoms, if present, may
The great loss of heat by evaporation explains the subnormal temperature observed after prolonged sweating, as in intermittent fever and pulmonary tuberculosis.
be regarded as indicating that the elevation of temperature is the result of increased heat production:—

1. Not dry skin.
2. Not perspiring skin.
3. Not and flushed moist skin.

Symptoms Indicating Decreased Heat Elimination.—The following symptoms accompanying an elevation of temperature may be regarded as indicating that the rise in temperature is chiefly due to decreased heat elimination:—

1. Cold, dry skin.
2. Cole moist skin.
4. Blueness of the skin.
5. Chilly sensations.
6. Chivering.

Principles which Govern the Application of Hydrotherapeutic Measures for the Reduction of Temperature in Fevers.—

1. A general cold application increases heat production, and heat elimination. Which affects in duration depends upon the duration and intensity of the heat.

2. A general cold application, if very brief, causes no perceptible loss of heat, and may occasion a slight rise of temperature, but if prolonged lowers the temperature by increasing heat elimination, and also by diminishing heat production, through the general sedative effect upon the nervous system and the metabolic processes of the body.

3. The appearance of chill and shivering marks the beginning of the lowering of the body temperature, and diminishes heat elimination as a conservative measure.

4. Dryness of the skin, goose-flesh appearance, chilliness, blueness of the skin, and coldness of surface can be diminished heat elimination.

5. A general hot application diminishes heat production, by its effect when the heat center and

6. A hot application tends to increase heat elimination by increasing the skin circulation and causing perspiration. The effect upon the digestive and circulatory systems
(7) Prolonged application of heat tends to raise the temperature by checking heat elimination and communicating heat to the body.

(8) Friction during a cold bath increases heat elimination.

(9) In general, thermic reaction should be, so far as possible, suppressed by avoiding percussion and friction, in fever.

(6) A general short, hot application tends to lower the temperature.

And fall of temperature during the bath, but should be avoided after the bath, too soon, as reaction encourages the subsequent rise of temperature.

Methods which may be efficiently employed in the Mariposa, Largo conditions are accompanied by a rise in temperature.
1. The Cold Affusion. -- This method, first employed by Curry and
Jackson, was found to be most efficient in lowering temperature, and the
mortality rate was reduced from 30% to 40% to almost nothing. The
patient simply stands up in a large tub, while several pails of water at
the ordinary temperature are poured over him.

2. The Cold Immersion Bath. -- This bath was first systematically em-
ployed by Brandt, who by its means reduced the mortality of typhoid fever
more than two-thirds. The method of Brandt required that the patient
should be placed every three hours, day and night, in a bath at 68° for
fifteen minutes. Brandt required the administration of the bath whenever
the rectal temperature of the patient reached 102°. At the begin-
ning of the bath, at the end of seven or eight minutes, and at the end of
the bath, Brandt directs than an affusion of water at 59° F. should be
slowly poured upon the back of the neck during two minutes. He also re-
quired that the patient should drink freely during the bath. After the
bath, the patient is placed in a sheet in which he is wrapped and care-
fully dried, but without touching the abdomen. The patient is only
slightly covered after drying, and is expected to continue to shiver for
some time after the bath. Shivering is an indication of an actual lower-
ing of the bodily temperature. The temperature is taken twenty minutes
after the bath and recorded.

3. Cold Friction Bath. -- The utility of the cold bath as
practiced by Brandt cannot be questioned, but Winternitz has shown that
the amount of heat elimination may be very greatly increased by rubbing
the patient vigorously during the bath. Those authors who forbid fric-
tion during the bath because of the supposition that heat production may
thereby be increased evidently do not recognize the fact that by the
maintenance of vigorous surface circulation, the rate of heat elimination
is increased out of proportion to the slight increase of heat production,
so that there is a decided gain to the patient by friction employed dur-
ing the bath.

This method also presents the great advantage that the patient is
much more comfortable in the bath and will tolerate the application for a
longer time and at a lower temperature than when it is administered without friction.

4. The Tepid or Neutral Bath.-- A bath at $92^\circ F$ to $95^\circ F$ would produce
little or no fall of temperature in a healthy person, but experience has
shown that by the employment of a bath at $92^\circ$ to $95^\circ$ in fever cases, a
marked fall of temperature may often be induced. The reason for this is
that when the patient's temperature is three or four degrees above the
normal, the difference in the temperature of the body and that of the bath
is much greater than under ordinary circumstances, and, consequently, the
temperature-reducing effect of the bath is proportionately greater. A
bath administered at a temperature of $90^\circ$ to $90^\circ$ is highly effective in
reducing temperature if sufficiently prolonged, and a bath of this tem-
peratures has the decided advantage that it does not provoke thermic reaction
to any considerable degree, and hence does not increase heat produc-
tion. A temperature of $90^\circ$ to $92^\circ$ is often tolerated without difficulty
by a feeble typhoid fever patient who could not support a more vigorous
application, and is found to be really effective in lowering bodily tem-
perature.

5. The Graduated Bath.-- Glenard first, and later Bouchard, have
recommended in high terms the so-called graduated bath, in which the
patient is placed in an immersion bath, the temperature of which is not
more than five or six degrees below that of the body. The temperature
is then steadily lowered at the rate of about one degree a minute, until
a temperature of $85^\circ$ is reached. This method has the advantage that no
shock is produced, as when the patient is placed in water at $68^\circ$, as by
the Brandt method. There is accordingly little or no thermic reaction.
The temperature is steadily lowered at the rate named until the patient
The claim made by some authorities that friction during the bath lessens the permanency of the temperature reduction, is perhaps correct to a degree, but this only necessitates the more frequent use of the bath which the friction renders readily tolerable.
becomes slightly chilly or until a temperature of 85° has been reached. The bath should be accompanied by vigorous friction for the purpose of preventing chill and increasing heat elimination.

The results in temperature reduction obtained by the graduated bath are claimed by some to be more permanent than those obtained from the cold bath of Brandt or the cold affusion of Curry. After several years experience with this bath, the writer fully agrees in this view, and believes the graduated bath to be one of the most efficient and satisfactory of all the methods employed for reducing temperature in fever. Unfortunately, it is much less convenient for use in the ordinary home or in private practice, than in hospitals. There are, however, other means by which very similar, and perhaps equally good, effects may be secured.

6. The Cooling Wet Sheet Pack.— When employed for reduction of temperature, the sheet should be wet in cold or cool water, and should be wrung out slightly, then wrapped about the patient in such a manner as to come into immediate contact with every part, being tucked in closely around each limb and about the neck. The patient should be covered very lightly, or not at all. In a few moments, the temperature of the sheet will be raised to nearly that of the body, and then it should be renewed, a fresh pail of cold water should be employed each time, and the sheet should be wrung out as dry as possible, so as to remove the warm water which it contains before dipping into the cold water for the second application. The application may be renewed in this manner five or six times, or even more. Heating occurs so quickly in most cases that when the temperature is so high, the sheet is so rapidly heated that it must be removed and must be renewed within five to seven minutes, to make the cooling effect continuous. It must of course be remembered that the true sedative effect can be obtained only when reaction is suppressed.

7. The Cold Shower Pack.— Instead of removing the sheet from the
In theFeeble fatigues who endure lower

Easily, the temperature of the bath

may be made 90°F or 92°F at first, the
bath being more prolonged than when the
lower temperature is employed.
patient, the same effect may be accomplished, though not quite so well, by opening the sheet and sprinkling the body of the patient as well as the sheet with cold water. The patient should be made to turn, first upon one side and then the other, so that the whole body may be exposed to the cold application. A better method is to place the patient upon a cot covered with oil cloth, so arranged in relation to the tub placed at the foot of the cot that any surplus water may be caught as it runs away; then the water may be turned upon the patient from a watering-pot or may be poured over him either from a dipper or other convenient vessel. By this means, the cooling effect of the sheet may be continued, and may be made almost as intense as the cold bath. Water at any desired temperature may be used. If the patient does not well tolerate cold water, water at a temperature of 70° or 80° or even 85° will be found efficient in lowering the temperature, provided the application is continued for a sufficient length of time. When very cold water is employed, the disposition to chill may be prevented by friction with the hands applied outside of the sheet.

8. The Cold Compress. -- The cold compress may be efficiently used for reducing temperature in cases in which febrile action is not so intense as to require more vigorous measures. The compress should consist of two or three thicknesses of linen, or twice as many thicknesses of cheesecloth. The fabric should be soft, so that it will fit the skin perfectly. It must be thin enough so that the whole thickness may be influenced by the cooling effect of evaporation from the surface. It is necessary that the compress should be changed and recooled as soon as it approaches the bodily temperature. It should not be allowed to become warm. The compress should be wet in cool or cold water, and should be but slightly wrung. The more water it contains, the less frequently will a change be required. In many cases, a compress sufficiently large to cover the front of the trunk answers all requirements. In other cases,
several compresses will be required, one for the front of the trunk, another for the back, and additional compresses for each limb. Restless and nervous patients often tolerate such an application much better than the wet sheet pack. The compresses can be changed also with less inconvenience to the patient than is occasioned by renewing the wet sheet.

9. The Cold Sponge Bath.—This is an exceedingly useful measure in cases of fever in which the temperature is not high, but the skin flushed and dry. If a sponge is used, it should be as wet as possible, so that the surface will not be simply moistened, but thoroughly wet. The intensity of the bath may be increased by the amount of surface exposed at one time. If the patient is very sensitive to cold and complains much of disagreeable sensations produced, small areas, as a single limb, may be sponged in succession, each part being covered as soon as gone over with a sponge, or the whole body may be sponged and left uncovered to cool by evaporation.

10. The Cold Towel Bath.—The cold towel bath is essentially the same as the cold sponge bath, only applied somewhat differently. A towel of ordinary size is wrung out of cool or cold water, then instead of being rubbed over the surface, is simply spread out and quickly applied over a surface of corresponding area. It is allowed to remain in contact with the surface only a few seconds, or until slightly warmed. It is then quickly renewed by dipping in cold water and wringing slightly, and applied to another adjacent or corresponding surface, and so on, until the entire body has been gone over, the operation being continued as long as may be necessary to procure the desired results. This method is applicable only to cases in which there is only a slight rise of temperature, and in which the patient is too feeble to be subjected to more vigorous measures.

11. The Evaporating Sheet.—A linen sheet should be wrung out of cold water and wrapped about the patient, who is left uncovered. The
skin is cooled by evaporation of water from the sheet, which may be encouraged by vigorous fanning by an ordinary fan or by means of a current prepared by means of an electric fan. It is easy by this means to produce a degree of refrigeration as intense as the patient is able to endure. It is only necessary to keep the sheet moist to continue the effect as long as may be desired. If the patient suffers to an unpleasant degree from chilly sensations, moderate friction may be employed by the hands placed outside the sheet.

12. The Hot Evaporating Sheet.—This measure is precisely the same as the preceding, except that the sheet is wrung out of hot water. The temperature of the water should be, not as can be borne, -- 100° to 120°. The purpose of the hot evaporating sheet is to obtain the combined effects of heat and cold. The impression of heat which lasts for a few seconds at the beginning of the application produces an atomic reaction, diminishing the heat production, and thus preparing the way for the largest benefit to be derived from the cold impression which quickly follows as the sheet is cooled by the rapid evaporation. Evaporation may be stimulated by fanning, as in the case of the cold evaporating sheet. This measure may be regarded as a modification of the graduated bath.

13. The Hot Sponge Bath.—The hot sponge bath is an application sometimes useful in febrile conditions. The brief impression of heat produces an atomic reaction with diminished heat production, while the evaporation taking place from the moistened surface subsequently produces slight cooling effects. This method is of comparatively limited value, but we have nevertheless found it useful in special cases, as will be more fully explained.

14. The Hot Blanket Pack.—This is a very useful means for reducing temperature in certain cases in which cold applications cannot be employed without serious risk, and hence are contra-indicated. The hot blanket pack acts, of course, by producing atomic reaction, thus lessening
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+ as in cases in which is blueness of the surface, shivering, chilliness of a dread of cold water, and in which the temperature rise is slight, as two or three degrees only.
heat production, and is in some cases especially useful as a preparation for a subsequent cold application, the heat preparing the skin for rapid heat elimination.

15. Fomentation to the Spine.—It would be perhaps more proper to describe this measure as a fomentation to the back, as the fomentation should not be confined to the spine, but should extend to the whole surface of the trunk. Fomentation to the spine acts in a manner similar to the hot blanket pack, but its effect is of course less intense unless the temperature is very high; the application usually gives rise to perspiration whereby a considerable amount of heat elimination takes place. It is also a good preparation for a cold application. It is especially applicable to certain cases in which cold applications cannot be applied without risk, as will be indicated later. In some cases alternate hot and cold compresses to the spine are more effective in reducing perspiration than fomentation alone, and hence greatly promote heat elimination. A hot application to the spine encouraged heat elimination by stimulation of the sweat centers, thus inducing perspiration.

16. The Alternate Immersion Bath.—In many cases, and especially in persons in whom the surface circulation is not very active, more pronounced antipyretic effects may be produced by preceding a cold bath with a hot bath at a temperature of 105° to 107° for three or four minutes, and then by immediate application of the cold bath. Heat dilates the surface vessels and thus prepares the way for the development of the most pronounced effects from the cold bath which follows.

Vinay suggests that the hot bath for three minutes, followed by a bath of 95°, gradually lowered to 80° during five to fifteen minutes, is more effective in lowering the temperature than the cold bath, and produces more permanent results.

Pflüger found that greater refrigerant effects were produced by the hot spray for one minute, followed by short cold spray, than by the cold
The hot blanket pack is of greatest service as a means of aiding the reduction of temperature in cases in which there is decreased heat elimination. The duration should be brief; time to five minutes. Continued too long, it might occasion a dangerous rise of temperature. The hot blanket pack occurs for the time seems off heat elimination through the skin. With heat production proceeding at the ordinary rate heat will accumulate fast enough to raise the temperature of the body about one-third to one-half a degree in ten minutes. Heat is also communicated by the pack itself, so that there is real danger of causing a rapid and dangerous rise of temperature in the use of this application. If great discretion is not exercised for good effects the application must be light, and not as can be borne.
It must be remembered, also, that heat is not a salutary or a healthful factor; hence, the presence of cardiac weakness, a condition which every community accompanies the edaphic state in which the hot pack is
commande[d] indicated, must be most carefully considered in making an application of heat of any sort. Fortunately, short, but applications are depressing only in very slight degree, and very short applications are even excitable in their effects.
spray alone.

Finkler and Pletzer confirmed these results in experiments upon febrile rabbits.

doubtless due to the atomic reaction of heat, to the increased heat elimination due to dilatation of the surface vessels, and especially to the lessened heat production resulting from the application of the hot bath and the consequent delayed thermic reaction.

17. Cold applications to the Head and Abdomen. — Ice-bags to the abdomen and the application of the coil to the head or abdomen or to both regions, are powerful means of reducing general temperature, and have been successfully employed by Spencer Wells and others, in the treatment of patients suffering from a high temperature due to peritonitis. Cold applications to the head should never be neglected in fever cases, and it should be remembered that the hair should be thoroughly wet, as it is an excellent non-conductor, unless saturated with moisture. A continuous application of cold to the head and abdomen produces in some cases such marked effects that no other measures are required for controlling febrile action. Care must be exercised in the application of cold to the head, that too pronounced depressing effects are not produced.

18. The Cold Air Bath. — By simple exposure of the skin unprotected by clothing to cold air, a large number of heat units may be absorbed from the surface by convection. Air has a much lower specific heat than water, and is a less good conductor; and hence, cold air is inferior to cold water as a means of lowering the temperature, but this is nevertheless a measure which is sometimes of service. It should be recollected that when the body is exposed to air under ordinary circumstances, evaporation is constantly taking place, even when the sweat glands are not active, as a certain amount of water is constantly finding its way through the skin to the surface by osmosis. The practice of protecting fever patients with a number of woolen blankets or other covering to pre-
The observers above named noted also that a greater effect was produced by a short cold bath if the body was sprinkled with hot water at the moment of emerging from the bath than if the cold baths were prolonged. This method is well worthy of a trial.
vent "taking cold" is based upon a wholly groundless fear. A fever patient is very unlikely indeed to take cold. He may be overfed, he may be injured by too great exertion, but he is not at all likely to take cold, through the application of either cold water or cold air in almost any quantity. A patient exposed to cold air is benefited, not only by the air coming in contact with the surface of the body, but by inhalation of the cold air.

The temperature of the room has a most decided influence upon bodily temperature in the case of a fever patient. An increase of a few degrees in the temperature of the air of the sick room is often responsible for a rise of temperature in the patient which could not otherwise be accounted for. The fever patient has lost, to a considerable degree, the power of regulating the bodily temperature, and hence is brought somewhat into the condition of the so-called cold-blooded animals whose temperature rises and falls with that of the surrounding medium.

Breathing air of a low temperature, as well as exposing the skin to cold air, has a decided effect in lowering the temperature. This method has been adopted as a definite procedure, the patient being made to breathe artificially cooled air, brought to him through a tube.

The lungs present a surface of about 2,000 square feet, and the skin a surface of only 17 square feet. It should be noted, however, that the surface presented by the perspiratory ducts of the skin aggregate more than ten thousand square feet. All the blood in the body is spread out just beneath the lining surface of the air cells of the lungs every two and a half minutes, making this a very important cooling surface. But, unfortunately, the amount of air which can be introduced into the lungs is so small that the effect obtained, even when the rate of breathing is doubled and the volume of tidal air is considerably increased, cannot be very large. I have, however, succeeded in lowering the temperature in fever cases by means of reinforced respiration, causing the patient to
It is most prevalent in the heat of summer. The temperature is always high. When heat increases, the temperature also increases. The thermometer never decreases. It is never reached by any amount of water. Wax, fat, and oil are not affected by this heat. Th. cc. of water.

*Note:* The page is filled with handwritten text in English, but the content is not entirely legible due to the handwriting style. It appears to discuss temperature, heat, and related phenomena.
breathe deeply of cold air while the arms are raised above his head.

By making a patient breathe very cold air, say at 5° F., taking in 125 cubic inches at a breath, and breathing fourteen times a minute, he would take into his lungs about 60 feet of air per hour. To raise this air from 5° to the temperature of the patient, supposing the temperature of the patient to be 105°, would require the addition of 1000° of temperature. Thus the body might be made to give off heat to the lungs at the rate of about...... heat units per hour. A considerably amount of heat might be absorbed by evaporation, so that a considerable degree of cooling may be effected through the breathing of cold air provided pains are taken to increase the volume of respired air. If the patient is chilly, a gentle rubbing of the surface will dissipate the chilly sensation, and, by maintaining an active surface circulation, will promote heat elimination. Vigorous rubbing must be avoided, however, this will increase heat production.

19. The Graduated Compress.—The cold compress, as well as the cold bath, may be graduated, the first application being made at a temperature a few degrees below the temperature of the body, the temperature of each succeeding application being lowered two or three degrees. In patients who are very sensitive, the first compress may be wrung out of water at 105°. Such a compress, by producing an atomic reaction, prepared the way for the fullest effect to be derived from the cold applications to follow later.

20. Water Drinking.—The free drinking of cold water is an efficient means of lowering temperature. Two or three pints of water at a temperature of 40°, swallowed within ten minutes, may cause a fall of temperature of 1 1/2 to 2° F. This method has been systematically employed by a number of observers, with interesting results, but its chief utility is as an accompaniment of other antipyretic measures. Water-drinking lowers the temperature not only by extracting heat units, but by diluting the
blood, hence promoting evaporation from the surface, and also by exciting the kidneys to increased activity, thereby encouraging the elimination of toxins, to which the rise of temperature is due. A glass of cold water every hour is an excellent rule for fever patients when the febrile action has any considerable degree of intensity.

**The Cold Enema.** The enema affords a much more convenient means of introducing cold water into the alimentary canal than does water-drinking, for the reason that the patient usually refuses to swallow the amount of water required to produce any decided effects. Two or three pints of cold water may be easily introduced into the colon if care be taken to avoid the introduction of air and to allow the water to flow in slowly and with little pressure. The water should be retained for five to ten minutes, or as long as the patient can retain it without inconvenience. The amount should not be so large as to produce uncomfortable fullness or a painful desire for evacuation, but the patient should be instructed to make forcible efforts to retain the water, and if necessary, assistance should be rendered by pressure with a napkin.

The temperature of the water employed should be 30° to 50°, at beginning. The principle of graduation may be employed with the enema as with the cold bath. Beginning with a temperature of 90°, the water introduced may be steadily cooled by pouring cold water into the fountain until it is reduced to a temperature of 70° or even lower. As a rule, however, a temperature of 70° is sufficient to accomplish the desired result.

A moment’s consideration will show the efficiency of the enema as a means of lowering the temperature: suppose for example, the maximum quantity of water introduced to be five pounds, and the temperature 70°, the patient’s temperature being 105° and the weight of the patient 150 pounds. If on the withdrawal of the water, his temperature is found to be reduced to 100°, we should have absorbed by the water 150 pound
Fahrenheit calories. This would be an equivalent of one heat unit or 1^o of temperature to each pound of the body weight. In other words, if there had been, in the meantime, no heat production, the temperature of the body would be lowered one degree. Normally the body produces about seven heat units per minute. Suppose the enema to have been retained in the body ten minutes: the number of heat units produced by the body in this time would be 70; or, if the rate of heat production was increased 50%, the amount would be approximately 100 heat units. Subtracting 100 from 150, we have 50 heat units as the actual loss within fifteen minutes. Dividing this by 150 we have 3 1/3 10ths of a degree as the actual antipyretic result of the application. It is evident that by repetition of the same measure during a sufficient length of time, a very considerable degree of refrigeration may be produced.

A very convenient method of administering the enema is to supplement the ordinary tubing of the fountain syringe by a shorter piece of tubing, two or three feet in length, connected to it in such a way that it can be easily disconnected. It is advantageous to have the short piece of tubing somewhat larger than the ordinary size, so that it will not be easily obstructed. After being slowly introduced, the water should be retained for five, ten, or fifteen minutes if possible. Then by discontinuing the short tube without removing the rectal tube, the water may be allowed to escape and another portion of cool or tepid water may be immediately introduced. In a fever case under the writer's case a number of years ago, the cold enema was employed in this manner continuously for two or three hours, and with the result that the temperature of the patient, which was between 105^o and 106^o, and had proved refractory to every other measure, was reduced to 102^o, and was thereafter readily controlled by the repetition of the same procedure.

22. The Partial Cold Bath.—When the general febrile action is the result of a local inflammatory process, as in many pelvic inflammations,
appendicitis, pneumonia, pleurisy, peritonitis, acute arthritis, phlebom, iritis, and otitis media, the temperature may be best reduced in many instances by a very cold circumscribed application made to the affected part. Cold irrigation, cold compress, and the ice-bag, are among the most suitable measures in these cases, employed either alone or in combination with fomentations or hot applications of other sorts made either as a preliminary measure, or at intervals, as special conditions may indicate. Prolonged cold applications to the head diminish heat production and general temperature by depressing the thermogenic centers of the brain.

In certain cases, as in compound fractures of the limbs in which the surgical dressing for maintenance of the parts in proper position prohibits the employment of cold water to the affected part, much may be accomplished in adopting the principle discovered by Brown-Sequard, viz., that the temperature of a part, as a hand or foot, may be perceptibly lowered by the application of cold to the corresponding part of the opposite side. That is, in case of an injury to a foot in which a cold application cannot be made, but in which an acute inflammatory process may be present, continuous cold applications may be made to the sound foot.

Winternitz has shown that the application of an ice bag or ice-water coil over the heart cools the blood and lowers the general temperature. This measure may be advantageously associated with others in the treatment of fever cases.

Neale advocates the use of the ice bag to the spine as a measure of lowering temperature. The antipyretic effect of this measure is doubtless due, in part at least, to its influence upon the circulation in dilating the surface vessels.
Hydrotherapeutic Applications to be Employed in Cases in which the Lessening of Heat Production is the Leading Indication. -- In the following list the aim has been to arrange the various therapeutic measures suggested in the order of their practical utility, the most valuable being named first:--

1. The graduated bath.
2. The tepid bath.
3. The cold friction bath.
4. The cold bath.
5. Cold affusion.
7. The cold compress.
8. The evaporating sheet.
9. The cold sponge or towel bath.
10. The affusion.
11. Cold to head or abdomen.
12. Cold enema.
13. Cold air bath.
14. Water drinking, a measure which should be combined with all the measures named.

Hydrotherapeutic Measures to be Employed in Cases in which Increase of Heat Elimination is the Leading Indication.--

2. Hot evaporating sheet.
3. Hot blanket pack.
4. Fomentations to the spine.
5. Hot sponge bath.
6. Fomentations to the spine or abdomen, followed by the cold enema.
7. Fomentations to the spine, followed by wet sheet pack.
8. Hot blanket pack, followed by graduated bath.
Suggestions and Cautions Respecting the Use of Water for Antipyretic Effects.——Cold applications are contra-indicated in fever cases in which the skin is cold, the lips or skin blue, when goose flesh, perspiration, shivering, or chilliness are present, and when exceedingly disagreeable to the patient. In most cases of this sort, however, the contra-indication may be made to disappear by a short hot application, by which both the skin and the nervous system are prepared to receive beneficial effects from a cold application. When the cold enema produces colic pains or chilliness, fomentations over the stomach and bowels may be employed at the same time.

In the employment of the hot blanket pack, hot fomentations, and the hot bath, care must be taken to avoid prolonged applications. In an experiment, a healthy young man, one of my assistants, found that his temperature rose 20°F. in half an hour in a hot blanket pack. In a bath at the temperature of the body, or a few degrees above, the temperature is found to rise at about the same rate. In febrile conditions, the effect of a hot bath in causing elevation of temperature is liable to be still more pronounced.

It is clearly evident that such an application, if prolonged, might become seriously dangerous in a case in which the temperature is already elevated. For example, if a patient with a temperature at 105°F. were kept in a hot blanket pack or a hot bath for half an hour, the result might be an elevation of the temperature to 107°F. or 108°F., and serious if not fatal results might follow. The writer has known of several cases in which, under similar circumstances, the patient becomes delirious from the hyperpyrexia, and though quickly restored by the withdrawal of the heat and the application of cool sponging and cold compresses, the patient was left in a state of very great exhaustion for several hours.

The length of a hot blanket pack or hot bath of any sort for the purpose of warming the surface and exciting vascularity of the skin
should be usually not more than five to ten minutes.

The following case illustrates very clearly the advantages of the hot blanket pack in cases requiring increased heat elimination: a number of years ago the writer was called in consultation in the case of a child of four years, suffering from malignant diphtheria. The patient was found with a temperature of 106°, comatose, the skin pale and cold. A hot blanket pack was ordered immediately, which quickly brought the blood to the surface. In fifteen minutes the patient was revived to consciousness, and in two hours the temperature was fallen to 102°. The patient made a rapid and excellent recovery. Numerous similar cases might be cited in which a high temperature with diminished heat elimination accompanying typhoid fever and other febrile states has been promptly relieved by a preliminary hot application followed by cool or tepid compresses, sponging, and allied means.
The Comparative Merits of Hydrotherapy and other Measures in the Reduction of Temperature in Febrile Conditions. — From the time the value of water as an antipyretic was brought to the notice of the profession by Curry in the latter part of the last century, up to the present time, no one has undertaken to maintain that the death rate has not been uniformly lessened to a very marked degree whenever water has been systematically and intelligently used as a means of preventing febrile activity from whatever cause. A long list of eminent physicians, both English and Continental, as well as American, have given their adhesion unreservedly to the use of water as a means of reducing temperature, and one of the most valuable known to man.

In the treatment of a long series of typhoid fever by the cold bath in New York hospital, the mortality was reduced to 7.5%. The rate of mortality in over thirteen hundred cases previously treated by the usual method, was 20% to 30%.

The writer and his colleagues of the Battle Creek Sanitarium are able to report a series of over one hundred cases with a mortality of less than 1%. In one instance of thirty-six successive cases, all the patients recovered, although in several cases the symptoms were very grave, owing to delay in the beginning of treatment. In the series of cases referred to, the measures chiefly relied upon were water drinking, the enema, and the cooling pack. No medicinal antipyretics were employed.

J. C. Wilson reported, a few years ago, sixty-four cases of typhoid fever treated in the German Hospital, Philadelphia, Pa., without a single death. In one hundred and eight cases of pneumonia reported by Fenwick, all of which were treated by cold applications, the mortality was only 10%. In a series of nine hundred cases in which the ordinary methods were employed, the mortality was 20%.

Vogel published, several years ago, in a paper upon the subject of
hydrotherapy (Dietetic Gazette, New York), a number of aphorisms relating to the use of water in typhoid fever, which we condense as follows:

1. That the evening temperature should not advance beyond that reached on the day when hydrotherapeutic treatment is instituted.

2. If a bath is administered as soon as the thermometer indicates a rectal temperature of 102.2° F., the disease will never rise to the initial temperature, which is usually above 104° F.

3. By the repetition of the baths, the resistance of the body to the cooling process is gradually overcome; that is, the exaggerated heat production is lessened, each day the point reached by the temperature is a little lower than the day before, and the average temperature also diminishes.

4. The effect of baths upon the temperature is much more marked in mild than in severe cases, in mild cases the progressive reduction in temperature being evident from the first day.

5. Even in severe cases, however, it is possible to so control the fever that the temperature will never reach that of the first day after treatment has begun, and from week to week there will be noticed a distinct reduction in temperature.

6. After each bath there is a diminution of temperature, lasting for two or three hours. The succeeding rise of temperature is at once checked when another bath is taken, so that the patient is exposed to the injurious influence of the maximum temperature but a very short time.

7. The local and general symptoms arising from the infection as well as the elevation of temperature, are so favorably influenced by hydrotherapy that the typhoid state does not appear, or is very difficult to recognize.

8. The mortality rate is diminished to a marked degree, as has been shown by numerous observers in the United States and Europe, the old mortality rate of 20% or more being reduced to 3% or 4%, and in some
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instances a long series of cases, sixty or more, has been reported without a single fatality.

9. There are no serious objections to the employment of hydrotherapy in typhoid fever. It is safe, comforting to the patient, and easily available.

10. The objections to the use of medicinal antipyretics are:

   a. The total thermic effect is less, because of the great subsequent rise of temperature after the depression, and the short intermission.

   b. There is no steady fall in the maximum temperature from day to day or week to week, as when hydrotherapy is used, but often the opposite.

   c. Drug antipyretics do not favorably influence local and general symptoms, and do not shorten the course of the disease.

   d. The mortality is not lessened, but is as great as when no treatment at all is used.

   e. Medicinal antipyretics are not free from danger, as they produce marked depression and exhaustion, and often degenerations.

SPECIAL APPLICATIONS TO REFLEX AREAS--THE LOCALIZED DOUCHE; ETC.

All skin surfaces are related to some internal vascular area. In general, the skin overlying a part is reflexly related to the organ or structure covered. The principal relations which the scientific hydrotherapist needs to have ever in mind are the following:

The skin of the scalp, face, and back of the neck are in reflex relation with the brain. The circulation of the scalp is also immediately connected with the brain through the medium of the skull, the vessels of which anastomose both with those of the scalp and those of the cerebral covering.
The skin of the back is reflexly related with the centers of the spinal cord. This is also true of the entire skin surface of the trunk and the limbs.

The skin covering the neck is reflexly, through the spinal cord, related with the larynx.

The upper dorsal region has special reflex relation with the lungs.

The skin of the chest, in front and behind, is also reflexly associated with the lungs.

That portion of the chest-wall overlying the heart, the precordia, is reflexly associated with the heart.

The skin covering the lower portion of the right chest is reflexly related to the liver.

The skin surface of the lower left chest is associated with the spleen.

The skin covering the lumbar region is reflexly associated with the uterus, bladder, rectum, kidneys, and intestines.

The skin covering the shoulders and upper portion of the back and arms is an area which may be used advantageously for the production of derivative effects in favor of the uterus, ovaries, bladder, and rectum.

The dorsal spine is associated with the stomach, a fact which may often be made of great service in the suppression of nervous vomiting.

The lower part of the sternal region is associated with the kidneys.

The skin covering the hypogastrium has special relations with the stomach.

The whole abdominal surface is reflexly related to the intestines.

The lower abdomen is associated with the uterus, bladder, colon, and rectum.

The feet, and to a considerable extent the whole lower extremities, are associated with the bladder, uterus, and bowels.

The skin covering the hips, legs, and feet may be employed for
derivative effects in favor of the head and chest.

A cold application to the surface causes at first a brief contraction of the vessels in the internally related viscera as well as in the skin. This contraction is followed by reaction in both the skin and the internal part.

The internal reaction may be mitigated and controlled in a variety of ways, as follows:

1. By applying water of a higher temperature, thus lessening the external reaction.

2. By means of the alternate douche, or other form of alternate application, lessening the extremes of temperature. The greater the extremes of heat and cold the greater the internal reaction. By raising the temperature of the cold application and lowering the temperature of the hot application, thus lessening the difference between the two extremes, the intensity of the internal reaction may be diminished.

Both external and internal excitations may also be controlled by regulating the number of alternations. The greater the number of alternations the greater the excitation induced.

The internal reaction may be diminished by a third modification of the alternate douche, namely, the graduation of the alternation; that is, beginning the douche at a high temperature and gradually lowering it instead of making an abrupt change.

Graduation may be effected in still another manner, namely, by increasing the difference between the extremes of heat and cold with each successive alternation, either by increasing the temperature of the hot application or lowering the temperature of the cold application, or by changing both simultaneously.

A. Precede the local application by a general douche or a cold application of some other sort, so that the external and internal reactions are generalized. The general application may be either a general douche
165°F, and gradually lowering it to 90°F during the period of 90-60 sec.

In a typical day, the process begins with the back area being gradually turned over by the second person. The second person is the one who actually changes the bird's body position. The gradual turning is done to ensure the bird is evenly cooked. The bird is turned over several times during the cooking process to ensure even cooking. After the bird is fully cooked, it is removed from the oven and allowed to rest before being carved and served.
or some form of non-percutient application, as a wet sheet pack or a wet sheet rub, affusion, or even general friction, either moist or dry.

A. Follow the local application with a general douche or other cold application whereby general external and internal reaction may be accomplished.

B. Precede the local douche by the Scotch douche, the intensity of which may be graduated in any one of the several ways elsewhere pointed out.

**Various Procedures which may be Employed to Produce Reflex Effects.**

For production of reflex effects the douche is the most powerful measure, but various other means may be employed, as the following:

1. The dipper or spout douche, very cold—10 to 15 seconds.
2. Cold affusion.
3. Hot and cold affusion.
4. Cold foot bath for ten to twenty seconds, the water very cold and not more than one fourth of an inch deep.
5. Alternate foot bath.
6. Alternate immersion bath. (A)
7. Hot immersion bath followed by a cold affusion.
8. Ice-towel rub.
9. Ice rub.
10. Cold sponge bath.
11. Ice cold compress.
12. Pomentation followed by an ice-towel rub.
13. Pomentation followed by an ice compress for a few seconds.
14. Hot sponge bath followed by ice-water sponging.
15. Vapor douche followed by cold affusion, ice rub, or ice compress
16. The hot air blast, followed by a cold air blast, a cold compress or an ice rub.
17. Cold air blast.
SPECIAL INDICATIONS AND PRECAUTIONS RESPECTING LOCALIZED DOUCHES AND OTHER LOCAL APPLICATIONS.

Great care must always be employed in the application of douches or affusions to the head. A short cold application excites the brain and may be used in melancholia and cerebral anemia, and sun-stroke with pallor. The cold douche to the head is one of the most powerful of all depressing agencies when prolonged. Unless very short, the excitement may be too great, hence cold affusion is better.

A short tepid douche to the head, or affusion, will allay excitation. It may be usefully employed in insomnia, maniacal excitement, and cerebral irritation. The temperature should be $80^\circ$ to $92^\circ$ for three to five minutes. Affusion should be preferred to the douche. In the application of the douche to the head, strong percussion should always be avoided.

Hot applications to the head should be employed with great precaution. In cases of cerebral anemia, alternate applications may be employed instead of the cold short douche or the hot douche. In syncope apply hot or alternate hot and cold compresses or affusion to the head and face.

Long cold applications to the head are exceedingly depressing, but may be used in fever, in cerebral congestion, and in sun-stroke with congestion of the skin.

Affusion, the ice-compress, and the evaporating compress are usually more convenient than the douche, and safer, because less likely to be overdone.

Applications of all sorts to the head should be managed with great care and should be at first employed in a tentative manner, noting carefully the effect.

A douche to the back of the neck stimulates the respiratory centers. If too cold, or too prolonged, suffocation or the arrest of the heart may
result. The hot or cold compress, alternate compresses, or sponging are milder measures which produce similar effects, and are in general to be preferred.

The tepid thoracic douche relieves nervous asthma when applied to the back of the chest, and palpitation from irritability of the heart when applied over the heart. It is rare that very cold water can be employed in this case, hence it is better to employ water at 80° to 92°, lowering the temperature at successive applications if the patient is found to tolerate a lower temperature.

The Scotch douche may be employed with excellent success for relief of intercostal neuralgia, pleurodynia from chronic pleuritic adhesions, brachial neuralgia and reflex irritation arising from hyperesthesia of the solar plexus.

The Shoulder Douche. -- The Scotch douche is useful for the relief of pain in the shoulder joints.

The Scotch douche to the shoulder also serves as an excellent derivative in pelvic congestion. A very short cold douche may be employed for the same purpose.

The Vertebral Douche. -- In many cases, affusion or the dipper pour is to be preferred to the douche, and strong percussion should be avoided. The spray is preferable to the horizontal jet. If the jet is used the stream should be broken by the finger.

The tepid douche calms excitability of spinal origin, as in hysteria and spinal irritation, hyperesthesia of the lumbar ganglia of the abdominal sympathetic connected with irritation of the splanchnics, irritability of the bladder of spinal origin, irritability of the genito-urinary center, and incontinence in children.

The cold vertebral douche should be used in spinal anemia, in functional locomotor ataxia, in motor insufficiency of the bladder resulting in urinary incontinence or retention, in nervous vomiting, in diminished renal activity, and in melancholia.
but must be carefully avoided in cases of organic locomotor ataxia of organic origin, and other forms of structural disease of the spine.
The hot douche or vertebral douche should be applied to the vertebral column in gastralgia in connection with the hot douche to the hypogastrium, and the warm vertebral douche is of great value in locomotor ataxia with lightning pains, and in spinal sclerosis.

The Scotch douche to the back should also be employed in lumbago, and in cases of diabetes incipiens, and in irritation of the renal plexus of the sympathetic so often encountered in movable or floating kidney in connection with enterophtosis, and in neuralgia of the kidney.

The Lumbar Douche.——The cold lumbar douche is especially useful in cases of constipation, in motor insufficiency of the bladder resulting in incontinence or retention, in amenorrhea, in dysmenorrhea due to congestion, in renal insufficiency and in infantile uterus or delayed development of the pelvic viscera or functions. It should be borne in mind that a douche in this region, to obtain the effect above described, must be administered with a considerable degree of pressure at a low temperature, and very short.

The Scotch douche to the lumbar region is an excellent remedy in neuralgia of the uterus or ovaries, in renal congestion, in urinary retention due to spasm at the neck of the bladder, especially in lumbago. It is a sovereign remedy also for the backache so common in women suffering from pelvic disorders, though of course in these cases its effects are purely palliative.

In connection with the Scotch douche to the lumbar region for the relief of congestion, revulsive applications should be made to the feet and legs. Sometimes a better effect is obtained by applying the revulsive douche to the shoulders and upper part of the back.

The Sternal Douche.——A cold douche applied to the lower portion of the sternum stimulates the kidneys to increased activity, relieves congestion by causing contraction of the vessels, and thus may be usefully employed in a considerable variety of cases. The douche should be very cold with strong pressure and prolonged to thirty or forty seconds.
When a cold douche cannot be employed in this region in consequence of the unpleasant effects upon the lungs or heart, or for other reasons, the Scotch douche may be used instead.

**Hypogastric Douche.** -- This douche is of special service in relation to disorders of the stomach. The cold douche is to be employed in cases of anemia, hypopepsia, and dilatation.

The hot douche should be employed in cases of hyperpepsia, gastralgia, chronic gastritis. In very painful affections the Scotch douche may be employed instead. Care must be taken to make the cold application very short, -- for example, the hot application may be of three or four minutes' duration, but the cold not more than fifteen seconds.

**The Hepatic Douche.** -- Administered with proper care, there is no therapeutic measure which secures better results than does the hepatic douche. Lying close to the surface, and having an exceedingly vascular structure, the liver may be most profoundly affected by a douche properly administered, hence great care must be employed in applications of this sort. The douche is applied over the region of the liver--that is, the lower part of the chest and the hypogastrrium. To relieve congestion, the douche should be cold and very short, with considerable pressure; and the internal reaction should be suppressed by a general douche to the whole surface immediately following the hepatic douche, or by some of the other means elsewhere described ( ). If a considerable irritability exists the general douche may be employed first, the local application following immediately. In cases of chronic enlargement of the liver, the alternate douche should be employed. In acute congestion of the liver accompanied by pain, the tepid douche should be used.

In cases of extreme pain, as in gallstones, infectious jaundice, and inflammation of the liver, the Scotch douche is indicated. The hepatic douche is of especial value in the disorders of the liver encountered in hot countries, and especially those resulting from malarial infection.
The Splenic Douche.-- An enlargement of the spleen can be more effectively combated by the cold douche or the alternate douche than by any other known means. Not infrequently, a considerable degree of diminution in the size of the organ can be recognized immediately after an application of this sort. In general, the observations made in reference to the hepatic douche apply equally to the splenic douche.

The Abdominal Douche.-- A cold douche applied to the abdomen is highly useful in constipation, especially when due to dilatation of the colon and enteroptosis. It may be advantageously employed in chronic intestinal catarrh. The Scotch douche is most valuable for the relief of the pain due to irritation of the splanchnic nerves or of the lumbar ganglia of the abdominal sympathetic, a condition recognized by pressure upon Skert's points, found about two inches to the right and left of the umbilicus on the posterior wall of the abdominal cavity.

The cold hypogastric douche is of service in atony of the bladder, in enteroptosis due to relaxation of the abdominal muscles, and in pelvic displacement due to atony, when not accompanied by uterine ovarian congestions. The warm douche should be employed when pain or irritability exists in the bladder, uterus, ovaries, and other pelvic viscera.

The Scotch douche gives best effects in chronic diarrhoea, painful conditions of the hypogastrium due to congestion or chronic inflammation of the lower abdomen. The hot application should continue for four or five minutes, and the cold application should be short, not more than eight to ten seconds.

Douche to Feet.-- It is the usual practice to apply the cold douche to the feet for a few seconds at the end of general applications of the douche for the purpose of producing a certain amount of revulsive effect in this region of the body. In very susceptible persons the douche can be applied to the feet only, until the patient has been trained to bear a more general application. This is especially necessary in cases of persons who suffer from painful affections of the head or nervous affec-
tions of the chest and heart, as in cerebral hyperaemia, nervous asthma, palpitation of the heart of sympathetic origin, pulmonary congestion, exophthalmic goitre, and chronic migraine. The covering of flesh upon the feet is so thin that the douche in this region should be administered in either a broken jet or in the form of a spray.
Conditions which Control Reaction.-- The intensity and quantity of the reaction effects following a given application depend upon--

1. The method of application, especially whether percutaneous or non-percutaneous.
2. The temperature of the water.
3. The length of application.
4. Condition of the patient--
   (a) Whether febrile or non-febrile.
   (b) Whether weak or strong.
   (c) Whether fat or thin.
   (d) Whether rested or fatigued.
   (e) Whether warm or chilly.
5. The ability to develop animal heat.
6. The ability to quickly repair the loss of heat and to support its loss without serious inconvenience to important vital processes.
7. The condition of the nervous system at the time of application.
8. The mental state of the patient, whether apprehensive and fearful, or resigned, cheerful, and in a condition of mind to cooperate with the treatment.

In cases in which a patient cannot bear low temperatures, the reaction effect desired can be encouraged to a considerable degree by strongly increasing the percussion effect.

Oscillatory Reaction.-- Several oscillations of reaction are some-
CRANE'S

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times observed following a cold bath, each recurrent reaction being weaker than the preceding. These oscillations are doubtless due to the rapid rush of the blood to the skin during the first reaction, by evaporation from the moist surface which has perhaps been not sufficiently dried and also through the consumption of heat energy by its conversion into mechanical work by friction and exercise.

**Suppression of Reaction.**—While it is usually the aim to promote reaction, there are cases in which the suppression of reaction is of the highest importance. Sometimes reaction must be suppressed altogether, as sedative effects are desired, as in fever, local applications for relief of inflammation, in the application of baths for relief of nervous irritability, insomnia, and the use of water for burns, as a dressing for wounds of various sorts, and in applications for relief of hemorrhage.

**Exercise in Connection with Hydrotherapy.**—From the days of the earliest cold water cure, the importance of exercise in connection with treatment, especially applications of cold water, has been fully recognized. Priessnitz kept his patients sawing and chopping wood a considerable part of the time when they were not occupied with the multitudinous drinkings, packings, doublings, cold plunges, etc., to which they were subjected under the heroic regimen in vogue at Graefenberg. It is more than likely that a large share of the benefit obtained by patients from treatment under the old water cure system was the result of the muscular activity required of them in connection with the routine of baths to which each patient was required to daily submit himself. Extended trips along the steep paths of the neighboring mountains, and hard work at the wood pile were required of all patients able to endure any considerable degree of physical exertion. Patients who were not able to exercise were considered too weak to be subjected to cold water applications. No doubt many persons were damaged by the excessive amount of muscular work required of them; but as a large share of the patients who
visited Priessnitz were persons of robust constitution who were suffering chiefly from the effects of high living, sedentary habits, and wine drinking, the measures employed were for the most part successful.

Exercise not only encourages circulatory reaction, but especially stimulates thermic reaction. It has been clearly demonstrated by experience that the temperature lowering which begins fifteen or twenty minutes after a cold bath is continued and increased by exercise, so that the maximum diminution is several tenths of a degree greater, is fully half a degree greater with exercise than without it.

Exercise before the Bath. — To persons able to take exercise, a sufficient amount of physical activity to produce slight perspiration before a bath favors the effect of the bath as a tonic and reinforces it to a very considerable extent. Care should be taken, however, to avoid profuse perspiration in feeble persons, for the result would be so great an expenditure of energy that both circulatory and thermic reaction might fail, producing as a result a second chill and most unfavorable effects. The bath should be taken immediately after the termination of the exercise, and before there has been opportunity for cooling of the skin by evaporation, which takes place with great rapidity when the skin is exposed. If there is even the slightest interval between the removal of the clothing and the administration of the douche, the body should be protected by wrapping in a blanket or Turkish sheet.

Exercise should not be sufficiently vigorous to induce excessive action of either heart or lungs, as a cold bath should never be administered when these organs are excited. The best forms of exercise are walking, Swedish gymnastics, bicycle riding, dumb bell exercise, club swinging, and moderate exercise with chest weights.

Persons who are unable to take exercise may be prepared for a cold bath by massage, by vigorous friction, or by manual Swedish movements.

A preparation by exercise, either active or passive, is to be pre-
ferred to a preparatory hot bath; but when necessary, the hot douche, hot immersion, vapor douche, Turkish bath, or best of all, the electric light bath, may be employed. The electric light bath is preferable to all other means of heating the skin aside from exercise, for the reason that it quickly warms the skin and does not produce a depressing effect. The douche should be applied before profuse perspiration has been induced.

Violent exercise should always be avoided for the reason that the skin and the body become thereby so strongly overheated that the absorption of the surplus heat requires so prolonged an application of the cold douche or other cold application that the nerve centers might be quite exhausted by the too strong reflex activities set up, especially in feeble persons, resulting in incomplete reaction and depression.

Exercise after the Bath.—Imperfect reaction after the cold bath is in the highest degree injurious, and lack of knowledge how to avoid this exceedingly disagreeable and inconvenient application is responsible for much of the prejudice which exists against the employment of the cold bath as a hygienic or a therapeutic measure.

Incomplete reaction not only frequently results in a second chill, but in successive chills or an almost continuous chill, not only for an hour or two but often for several hours after the bath. The hands and feet are cold, there is headache, not infrequently diarrhea, and other evidences of internal congestion, such as abdominal and ovarian pain, and also rheumatic pains in the joints, neuralgic pains in various parts of the body, vertigo, lassitude, and an increase of catarrhal discharge from the nose, throat, lungs, or other mucous surfaces, when there is actively present a catarrhal affection of these parts.

As a rule, exercise should always be taken after a cold bath when a patient is sufficiently strong to walk. Reaction may be favored by covering the patient in blankets or surrounding him with hot water bags or other means of artificial heating, or by remaining in a warm room; but
the reaction effects thus obtained are far less beneficial than those which result from excitants. The reason of this will appear when it is remembered that exercise favors thermic reaction and that thermic reaction means metabolic activity not only in the nerve-muscular thermo-genetic apparatus, but in every cell and tissue of the entire body.

The application of artificial heat, on the other hand, lessens thermic reaction by the atomic reaction effect which is connected with hot applications of all sorts. Thus exercise promotes the most effective element of the reaction following cold applications, whereas artificial heat diminishes this most important factor. Exercise immediately following the bath favors regular and complete circulation and thermic reaction, thus increasing the fall of temperature, making the bath more thorough-going and efficient in its effects upon the system. The fall of temperature produced by exercise following the bath may amount to nearly 10°F.

An interesting fact has been pointed out by Delmas, to which attention should be called in this connection. Increase of blood pressure, whether induced by exercise or other agents, ordinarily causes a slowing of the pulse rate; but under the influence of cold, the increased blood pressure induced by contraction of the peripheral vessels is accompanied by a quickened pulse. The reason for this is obvious. When the blood pressure is raised by cold applications to the surface, nature increases the rate of heart action through the specific influence of cold upon the heart regulating mechanism, so that an increased amount of blood may be carried to the surface, thus compensating, to some degree, for the diminished caliber of the surface vessels, so that the parts may be, so far as possible, protected from refrigeration. When reaction begins, and blood pressure falls with the dilatation of the surface vessels, the heart's action is slowed, again the reverse of what ordinarily happens under diminished blood pressure.
The result of this slowing of the circulation is to delay reaction, which under ordinary conditions is desirable, as otherwise slight changes in atmospheric temperature might result in excessive and exhausting perturbations of the nervous and vascular systems by the excessive reaction which would be produced. But as it is the purpose of therapeutic applications to promote reaction for the very purpose of producing systemic perturbations and metabolic and catabolic changes, it is desirable that the tendency to slowing of the heart's action which sets in with the beginning of reaction, should be antagonized by means of exercise, whereby the heart's action is quickened and the blood promptly forced to the surface of the body.

The increased vascularity of the skin thus induced encouraged heat dissipation, and both thermic and circulatory reaction. If the exercise is moderate in degree, the heat elimination developed by it exceeds the heat production resulting from the muscular activity; but if it is too violent in character, heat production may be in excess of heat elimination, and then there will be a rise in temperature, and the effect of the bath will be antagonized. It is thus apparent that exercise after a bath, to be effective and helpful, must be moderate in character.

Walking at a moderate rate for twenty to sixty minutes after a vigorous cold douche is the most generally useful form of exercise. Very vigorous exercise for a short time cannot be substituted for moderate exercise for a longer time, for the reason that time must be allowed for heat elimination; besides, vigorous exercise for even a short time might, by over-exciting heat production, place the balance between heat production and heat elimination on the latter side, and thus occasion a rise of temperature, and to a considerable degree destroy the good effects of the bath. It is for this reason that it is best that reaction should take place slowly. It is for this reason, in the writer's opinion, that better results are obtained from reaction when the process takes place
regularly and slowly, as has long been known from clinical observation. A rule which was insisted upon by Priessnitz, and which is quite universally followed by hydrotherapeutists is that the sun, too warm clothing, heated rooms, and especially a stove or other means of artificial heat, should be sedulously avoided. By this artificial heating of the skin the heat elimination and thermic reaction necessary for a general systemic vital perturbation upon which the tonic and restorative effect of cold applications depend, are arrested before fully developed.

Great care should be taken after a cold bath to avoid any circumstance or condition which will cause perspiration, such as too vigorous exercise, overheated rooms, too warm clothing, etc. Perspiration produced in any manner whatever is followed by an undesirable sedative effect, whereby vital resistance is lessened, the tonic effect desired is antagonized, and the patient is exposed to the risk of taking cold.

Many patients imagine that they have taken cold in a bath from the application of cold water, whereas the effects which they thus erroneously attribute to a cold taken in the bath, are the result of either incomplete reaction after the bath or a reaction accompanied by perspiration.

There are, of course, cases in which cold applications are indicated, but in which the patient is too feeble to take the necessary amount of exercise by walking or by other means. In such cases, vigorous massage, especially friction and percussion movements, or manual Swedish movements and deep breathing, may be employed until the return of warmth to the surface, indicating that active reaction has begun. Occasionally cases are met in which the patient is so feeble that he cannot react spontaneously, even by the aid of massage. In such cases, artificial means must be employed to assist the reaction. The patient should be wrapped in a Turkish sheet as quickly as possible after the bath, should be covered with blankets, and dried by vigorous rubbing underneath the blankets. The moist sheet should be removed, the woolen blankets placed
next the body should be tucked carefully around each limb and close about the neck, and hot bags should be placed to the feet and the sides, extra blankets being thrown over all. The patient must be carefully watched by observing the condition of the skin of the face, and noting the pulse, and the hot bags and blankets should be carefully withdrawn as reaction sets in, so that excessive reaction, with sweating, may be prevented, as this will only destroy the tonic effect of the cold application.

**Careful Study of Each Case Necessary.**—1. A careful investigation of the urine is necessary in every case, not merely for the determination of the presence or absence of albumin, sugar, blood, urinary casts, or other morbid elements, but for the determination of the coefficient of elimination of nitrogenous wastes. Careful note must be taken of the relation of the total solids to the urea, as an indicator of the relative activity of destructive tissue processes.

2. An examination of the blood is essential for a determination of the color coefficient, the blood-count, and the relative proportion of white and red cells. It is also important to note in cases of anemia, the relative proportion of the different varieties of red cells. There is no means by which the blood-count and the quality of the blood can be so profoundly and so quickly modified as by the resources of hydrotherapy.

3. **Special, Prominent, or Constant Symptoms.**—Headache may mean cerebral congestion, cerebral anemia, or simple sympathetic nerve irritation. Fever may be the result of toxins of bacterial origin, as in typhoid fever, pneumonia, septic infection, or it may indicate the presence of an excess of ordinary tissue poisons or leucomasines, either from diminished excretion, as from cold, or from over-production, as in exhaustion, or a fatigue fever from muscular exertion. Neurasthenic symptoms of various sorts may be due either to the presence in excess of nitrogenous wastes, the so-called uric acid diathesis, or sympathetic irritation arising from enteroptosis.
4. The patient's case must be carefully investigated with reference to the existence of pathological changes, either functional or structural.

a. The functional disturbances which it is especially important to note are hypopepsia or aplepsia, hyperpepsia, local congestion or irritation of bowels, bladder, uterus, or ovaries, irritability of heart or lungs, cardiac weakness, catarrh of respiratory or digestive tracts, hyperesthesias of the skin, of the joints, or of the internal viscera. Each of these conditions requires special adaptation of measures of treatment employed to avoid untoward effects which might at least discourage the patient, and not infrequently much more serious damage might be done.

b. The structural changes such as those which are commonly found present in advanced cases of lithaemia, in arterio-sclerosis, Bright's disease, hepatic enlargement of sclerosis, must be carefully considered in arranging a hydrotherapeutic prescription. The same may be said respecting other structural changes, such as those found present in paresis, paralysis, from apoplexy or organic changes in the brain and spine, neuritis, chronic muscular spasm, epilepsy, chronic affections of the heart, varicose veins in the legs or other parts, fatty degeneration of the heart, liver, spleen, etc.

5. The general physical state of the patient must be considered: is he fat or lean? Is he weak or strong? Has he a thin skin or a thick skin? Is he a person of resolution and strong will, or a weak willed, irresolute individual? Is the patient of a persevering, reliable disposition, or is he unstable, vacillating, easily discouraged? Treatment must be carefully planned with reference to all these considerations.

6. It is of immense advantage to make a careful study of the patient's physical coefficients. By means of a graphic representation of the principal physical coefficients, one may learn more at a glance respecting the general vital capabilities and peculiarities of the
patient than by weeks of "cut-and-try" experience.* For description of
the author's method of determining physical coefficients, see appendix.
The chief practical deduction to be drawn from physical coefficients are
the following:

1. A high height-weight coefficient indicates an excess of reserve
tissue or fat, and hence ability to endure reducing or spoliative meas-
ures if otherwise indicated. 2. A low height-weight coefficient gives
contrary indications as regards the prolonged use of tissue wasting meas-
ures, though not forbidding their temporary or careful use.

A high strength-weight coefficient may indicate either a de-
iciency of fat or an unusual muscular development. This coefficient
must be considered in connection with the height-weight and strength-
weight coefficients.

3. A high strength-weight coefficient with normal height-
weight coefficient, indicates a good foundation for reaction to
cold applications, a constitution not greatly impaired, nutrition well
sustained.

4. A high strength-weight coefficient with high height-weight
coefficient indicates the ability to bear vigorous reducing measures and
a probable constitutional predisposition to obesity that ought to be com-
bated by daily cold baths and frequent sweating baths.

5. A high strength-weight coefficient indicates that with a de-
ficiency of reserve tissue and hence lack of ability for sustained resis-
tance to cold applications, there is at least fairly good vitality and
power to effect a cold reaction; but the cold applications must be
short and not too frequent.

A low strength-weight co-efficient with a normal height-
weight coefficient indicates diminished muscular and nervous energy and

* See paper entitled "Physical Coefficients," by the writer, pub-
the need of great care in the use of hydrotherapeutic measures. Very short cold applications will be best borne, especially douches with high pressure. Hot baths and all spoliative measures must be avoided, except in cases of toxemia in which short sweating baths accompanied by copious water drinking may be employed, especially the electric light bath; but care must be taken to follow the hot application with a short cold douche with high pressure.

A low strength-weight coefficient with a high height-weight coefficient indicates in general the need of spoliative measures, but small ability to bear general hot applications or sweating baths. There being good ability for sustained heat production, the patient should have frequent cold baths with abundance of exercise. Sweating baths may be employed later, as the patient's strength increases, and may be used at the beginning if very short, and not too frequently administered, provided the actual total strength of the patient is not much below the normal average for a person of his height; that is, provided the strength-height coefficient is nearly normal.

A low strength-weight coefficient with a low height-weight coefficient indicates a state of great debility and impairment of nutrition, little power to support either reducing measures or heat-making or calorification. Strongly tonic measures are needed, and careful avoidance of spoliative procedures. The patient will probably tolerate cold badly and will be easily over-stimulated. The Scotch douche is invaluable as a preparation for the short cold douche. Neutral baths may be needed to encourage elimination without depression, also the cold hepatic and renal douches and the epigastric douche. Cold in hypopepsia and hot in hyperpepsia.

3. The strength-height coefficient is a good general indication of the neuro-muscular condition of the patient.

A normal or high strength-height coefficient indicates a
good store of nerve-energy and good power of circulation and thermic reaction, the muscles being the seat of the most active heat-making processes. The nerve tone is good and all signs of autonomic-hydrotherapeutic failure will be well treated. A low strength-weight coefficient indicates a low state of nerve and muscular energy, little reaction power, and necessity for the use of all precautions in the arrangement of a hydrotherapeutic prescription. Tonic applications are specially needed, but any form of cold application must be preceded by a short hot application, preferably the hot douche or the electric light bath. Strongly persipient measures must be used, or in the absence of a douche apparatus, the cold towel rub or wet-sheet rub may be employed. The patient should have vigorous rubbing after the bath to promote reaction, but should not be required to exercise very freely until the muscular power is considerably increased.

Other deductions may be drawn from physical coefficients, as will be obvious without further elucidation here.

We must also carefully consider the patient's physical aptitudes or temperament: is he phlegmatic, nervous, or sanguine? Is he afraid of cold water, or has he any idiosyncrasy against it? Has he good powers of calorification—that is, has he good ability to endure cold, or does he become easily chilled by exposure to cold air or water? Has he good reaction powers? Determine this by test(). Before prescribing treatment for a new patient, Priessnitz invariably made a careful examination of the skin, and was always present at the application of the first bath, noting carefully the intensity of the reaction produced and the rapidity with which it occurred. This information is absolutely essential.

It is impossible to make a routine prescription of hydrotherapeutic measures. These powerful agencies must be regulated with even greater nicety than medicinal agents, as the difference of a few degrees
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although an empiric he was a remarkably successful one, and his success was largely due to his acute powers of observation.

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of temperature or a few seconds in the length of an application may not only negative the results expected, but produce results the very opposite in character, which, under some circumstances, might inflict irreparable injury upon the patient.

The patient's habits of life—whether he has been accustomed to cold bathing, to regular active exercise, what have been his habits as regards clothing, especially whether or not an excessive amount of clothing has been habitually worn, the length of time the patient intends to remain under treatment—these and other kindred matters must be carefully considered.

Before making a prescription for the patient it is also necessary to determine which most requires immediate attention—some urgent symptom, or the fundamental morbid condition which furnishes the background for the pathological picture presented. In general, the treatment must be both palliative and curative. Patients generally need to be encouraged by the relief of distressing and annoying symptoms, even though the measures employed therefore may not be radically curative in their character. At the same time, there must be systematic employment of those measures which, if perseveringly used, may ultimately result in abolishing the symptoms altogether.

Patients usually clamor for the relief of those symptoms which most urgently obtrude themselves upon his attention, and judged of his progress toward recovery by the extent to which a chronic pain, a palpitation, a gastric acidity, a structural discharge, or other definitely recognizable symptom, is relieved by the measures of treatment employed. The fact that certain symptoms, and, in particular, painful symptoms, such as neuralgia, migraine, and nervous attacks, which have sometimes been termed "nerve-storms," sometimes become more frequent after the first few weeks of treatment, often presents a perplexing problem to the inexperienced hydrotherapeutist, and occasions him much inconvenience because of
the necessity of maintaining the patient's courage so that he may be induced to persevere in his efforts. That some patients under a course of treatment by physiological measures which are addressed to the removal of causes and the reconstruction of disordered tissues and the reorganization of disordered functions, must pass through a period in which many symptoms and disturbances appear to undergo a temporary exacerbation, is a matter of common observation.

In French and German hydropathic establishments the more experienced patients often encourage novices with the remark, "You must expect to feel worse before you feel better." After studying this phenomenon in hundreds of cases during a quarter of a century of experience in the use of hydrotherapeutic measures, the writer feels confirmed in the view which he formulated many years ago, namely, that the exaggeration of symptoms and the occasional appearance of symptoms quite new must be attributed to the intensity of the visceral activity set up by the strong stimulation of the sympathetic nervous system produced by hydrotherapeutic applications, and especially those of a tonic character. This being true, it is evident that the exaggeration of symptoms occurring within the first four to six weeks after the patient begins a course of treatment need not necessarily be regarded as an indication that he is getting worse, or that his treatment does not agree with him. It is only an indication that the treatment is producing a powerful effect upon the system.

Haig has observed that when a highly nitrogenous diet is exchanged for a strictly non-flesh diet in a case of chronic migraine, for example, there is likely to be, within the first few weeks, an increased frequency in the occurrence of the paroxysm. This he explains by the supposition that the change in the character of the blood results in the dissolving out of the tissues of a large amount of uric acid, which being brought into the circulation, irritates the nerve-ends with which it comes in
contact, particularly those of the sympathetic, thus giving rise to a more frequent recurrence of the painful paroxysms.

This explanation seems rational, and the same principle may aid us in explaining the exaggeration of unpleasant symptoms which not infrequently occur within the first few weeks of a systematic course of hydrotherapeutic course of treatment. Whatever the explanation may be, experience shows that when the treatment is properly managed, and if the patient can be induced to persevere, the unpleasant symptoms soon disappear, and usually do not reappear, although sometimes it happens that the symptoms disappear in an oscillatory manner, being less pronounced at each reappearance until they finally disappear entirely. This is likely to be the case with such disorders as epilepsy, hysteria, periodical migraine, chronic malarial affection, with intermittent paroxysms, and other maladies in which periodicity is more or less marked.

In the management of cases, it is well to encourage patients to look less at symptoms and to consider more the fundamental morbid condition out of which the symptoms grow. Symptoms are nothing more than the leaves and fruit of the pathological tree, the roots of which are deeply seated in the hidden recesses of the system, and which consist, in the great majority of chronic cases, in disturbed nutritive processes. If too much attention is given to the relief of symptoms, the results may be so great exhaustion of the vital resources of the patient that he will not be able to respond to the more thorough-going measures which look toward the actual eradication of his malady. Let us suppose, for example, a patient is suffering from spinal irritation, a pain in the region of the liver, epigastric pain or tenderness, or from general muscular pain. The patient finds applications of heat very comforting; indeed, the Turkish bath, the hot spray bath, fomentations, the hot bag to the spine, and similar measures, afford such great comfort that the patient is likely to resort to them to such an extent as to suffer ser-
iously from the depressing effect of heat. While on the other hand, cold applications may temporarily aggravate some of these symptoms in spite of the greatest care that can be exercised. The patient will be very sure that hot applications do him good and that cold applications do him harm; whereas, the hot applications afford only temporary relief, while the cold applications, by increasing the general nerve tone, improving the character of the tissue processes and of visceral activity, are laying the foundation for ultimate care. No small degree of tact, scientific knowledge, and intuitive judgment are required to so combine local and systemic measures with palliative and systematic treatment that the greatest degree of comfort to the patient shall be secured simultaneously with the most rapid progress toward recovery.

It must not be forgotten, however, that symptoms are only the voice of nature declaring the existence of pathological conditions which must be removed, and hence the intensity of a symptom or of a group of symptoms is, on the whole, the best measure of the pathological state which gave rise to it, so that one cannot consistently say to a patient for an indefinite period that the condition which gives rise to a certain symptom is being removed when the symptom itself is steadily becoming more pronounced. No such encouragement should ever be given unless there is some reliable means at hand whereby the fundamental pathological conditions in question may be recognized and measured, and an improvement found definitely recognizable.

There are also cases in which symptoms may be so urgent in character as to require, for the time being, the principal or even exclusive attention of a physician, as in hemorrhage of pulmonary tuberculosis, ulcers, hemorrhoids, or in metrorrhagia or menorrhagia. In some cases, also, fever, though ordinarily demanding attention only secondarily, reaches so high a point that vital damage is threatened, making this the capital feature which would attract the attention of the physician, just as a
carpenter engaged in repairing the roof of a house or in replacing a shattered window or door, might leave his work to assist in putting out a fire.

In the organization of a plan of treatment in a given case, it is necessary to determine not only the course of treatment to be employed, but the length of each treatment and number of daily applications, and not infrequently the time of day when the applications should be made. The settlement of each of these questions depends upon the object to be accomplished by treatment, upon the mode of treatment employed, upon the strength and susceptibility of the patient, etc.

A general plan should be made also respecting the length of time for which the course of treatment may be continued. If the patient has but a few days or a few weeks to devote to treatment, the plan of treatment employed may be quite different from that which would be marked out if the patient were willing to devote a sufficient amount of time to render a more thorough-going renovation of his system and reorganization of his vital processes.

Patients should be made to appreciate the fact that in the employment of rational and physiological measures of treatment, the co-operation of the system is required; that whatever real progress is made is the result of a growth which takes place within the body, just as growth takes place in a tree or in a flower. Recovery from a chronic disease is simply growing out of a condition of disease into a state of health. Time is required for the development of health just as for the growth of a crop of grain. The physician tills the soil and plants the seed, to use an agricultural illustration, but nature grows the crop, and the patient must be content to wait for the harvest.

If the patient has but a few days or two or three weeks in which we can remain under treatment, perhaps the best that can be done for him is to teach him how to correct his habits of life, how to adjust his diet,
his exercise, work, etc., to the morbid conditions which exist, and to employ such palliative means as will give him some relief and encourage him to continue in a direction which may ultimately result in improvement. Moderately tonic measures may be added, but measures of treatment calculated to produce a high degree of perturbation, such as frequently repeated very cold applications, strongly eliminative treatment, and other powerful measures, should be used only with the very greatest care.

In cases of patients who are undertaking a systematic course of treatment for tonic effects, applications should be made daily, in some cases twice daily, very rarely three times a day. In acute disorders applications may be repeated hourly or many times a day, as when antipyretic effects are sought, and in many instances continuous treatment is required, especially when local antiphlogistic effects are desired.

Patients should be encouraged not to expect the best results of treatment during the first few weeks. If there is no unpleasant exacerbation of symptoms, there may be no diminution in the intensity of the chronic symptoms, a fact which is often a source of great discouragement to the patient. It is astonishing, however, how quickly most obstinate and distressing symptoms disappear either soon after the beginning of treatment, or after many weeks in which there has been no perceptible change for the better. The writer has known many instances in which a patient who had been under treatment for several months without apparent relief, has arisen in the morning entirely free from a symptom which had been incessantly present for months or even years, and has noticed a few cases in which the patient, after some weeks of treatment, experienced a sudden change of some sort not easily describable, and has immediately discovered himself to be wholly free from a most annoying pain or other symptom which had been present for several years. In one case, a gentleman who had suffered for several years with pain in the back, after a few weeks' treatment while bending forward, felt a "letting up," as he
expressed it, in the back, and at that moment was entirely free from the pain which had obstinately resisted the efforts of the most eminent physicians in the United States and Europe. The relief was permanent.

It is not easy to explain what has happened in a case like this, nevertheless something happened which brought deliverance to the patient; and the thing which happened, whatever it may be, is without doubt the sudden culmination of the beneficial effects which had been developed during preceding days or weeks during which treatment had been applied. Chronic symptoms often yield to therapeutic blows persistently administered by the physician, just as does the rock to the sledge-hammer of the stone-mason. Even after long and persistent hammering there may be no evidence of progress; but at the very next blow the rock may be shattered. It is nevertheless true that in a majority of cases the relief of symptoms is gradual; but unfortunately, it is rarely possible to keep patients under treatment long enough to insure the complete removal of all symptoms, a fact which is often most discouraging to the rational physician.

It is important for the permanency of the effects obtained that the patient under treatment for chronic disease should continue treatment until there has been a disappearance of all the symptoms of the malady, and not only so, but until the body has been so fortified by an increase of its vital resistance that the symptoms will not again return, provided of course that the patient pursues such a course of life as regards habits of diet, exercise, etc., as his particular malady may require.

It is important for the physician, as well as for the patient, to remember that chronic disease is rarely entirely cured; in fact, we may almost say that a complete cure of a chronic malady never occurs. Symptoms may disappear, but the patient's constitution has been permanently weakened in certain directions; his condition is analogous to that of a steam-engine which has been strained by over-pressure. There is a weak spot somewhere which is likely to give way, and it can be safely
used only at a low pressure. A patient who once succumbs to causes of chronic disease will ever afterwards be liable to another break-down of the same sort. Hence, he should sedulously guard himself against those causes which his system has lost the power to resist. The chief benefit derived from a course of hydrotherapeutic treatment are the result of constitutional changes which require a considerable length of time for their development, and consequently, the best results of treatment are experienced months, often many months, after the beginning of the treatment, and not infrequently the patient does not really appreciate the full benefit which he has received until several months after the course of treatment has been discontinued. This fact, however, should not encourage patients to abbreviate the course of treatment, which is almost certain to be too limited in extent, but should rather encourage them to lay a broad foundation in a prolonged and thorough-going course of treatment which may be expected to develop large and splendid results subsequently, when the process of regeneration of tissue and reorganization of function has been completed by those curative forces at work within the body which it is the purpose of rational hydrotherapeutic treatment to organize and set in operation.

**General Indications and Contra-Indications.** As suggestive of the general principles of adaptation of methods to cases, the following observations may be made:

Anemic patients require short cold treatment. Special care should be taken that the patient should be warm when the treatment is applied. Long hot baths should not be administered, however, because of the exhausting effects, but short exposures of one or two minutes in the electric light bath, just long enough to thoroughly heat the skin, is an excellent preparation for a cold application in the case of a pale, bloodless patient. The short hot shower may also be used.

Feeble neurasthenics, patients who are exhausted by loss of sleep or
other causes, chronic inebriation, and cases of hysteria with emaciation and general feebleness require such moderate measures as the Scotch douche, towel friction, wet sheet rub, affusions or full baths at moderate temperatures. Affusion constitutes an excellent method in these cases, for the reason that in many cases in which heat is needed as a preparation for the application of cold, the exciting effects of heat as well as those of cold, must be avoided.

An excellent measure in many cases is a bath at 92° to 96° for ten minutes, 103° for two or three minutes, followed by affusion at 80° for ten seconds.

Diabetics, if emaciated require long neutral baths. Very hot and very cold applications should be avoided. If in good health, and strong, the Scotch douche, the cold douche, short cold immersion, and other cold applications are not only admissible but highly advantageous.

Cases of neuralgia, myalgia, painful congestions, chronic rheumatism with painful joints, require the Scotch douche or very short (two or three seconds) cool douches. Affusion, cold immersions, and other non-percutent applications must be avoided. What is required is circulatory action or revulsion without thermic reaction; hence, measures involving strong percussion should be employed. Cold baths should seldom be employed alone, but should be preceded by heat, the succeeding cold application being just long enough to remove from the skin the surplus heat, of which the characteristic change of color is an indication.

The presence of cardiac disease, either as a complication or otherwise, especially demands consideration in the adjustment of a course of treatment. In cases of cardiac hypertrophy with over-compensation, and in cases of functional irritation of the heart, all extremes of temperature should be avoided. Neutral baths are indicated. The patient may be trained to endure a douche at 75° to 85°, but in the administration of the douche, care should be taken to begin at the feet, each day rising a
little higher, until the upper portion of the body is reached, always taking care to avoid the chest or region of the heart. In cases of weak heart, neutral baths and friction are indicated.

In cases of weak heart a general indication is for baths at 92° to 94° for five to ten minutes, accompanied by friction, followed by the short Scotch douche at 105° for two or three minutes, a short cold douche at 75° allowing the water to fall upon the legs, back, and arms only.

In the treatment of cardiac cases it is important to observe in which one of the four stages of disease the patient is found—

1. Is over-compensation present?

2. Is there beginning a dilatation of the heart, as shown by loss of power in the cardiac muscles?

3. Have the small arteries lost, or are they beginning to lose, their contracting power, as indicated by oedema of dependent portions of the body, as the hands and feet?

4. Are there evidences of lesions in the viscera, such as passive congestion or hypertrophy of the liver, congestion of the stomach, etc.

In cases in which an excessive compensation exists, exciting measures must of course be avoided, whereas in cases in which the vessels have lost their power to contract, there is likewise a loss of ability to react, hence vigorous treatment cannot be successfully employed except in a limited way.

Cold applications when made should be applied to small areas by means of compresses or towels wrung very dry from very cold water, and the application should be accompanied by vigorous friction. When made in this way, cold applications may sometimes be employed with advantage in exciting a weak heart to increased activity.

Both extreme hot and extreme cold applications should be avoided in cases of cardiac disease with aortic insufficiency, in which sudden death sometimes occurs, and has, in a few instances, been occasioned by
a cold douche or exposure to excessive heat in the Russian bath. In aneurism of the aorta, in advanced arterio-sclerosis, and in apoplexy, the same precautions must be observed. Shocking treatment of any kind should be avoided. Non-percutent measures are best in these cases, and moderate temperatures only should be used.

In Bright's disease and other forms of renal disease, very cold treatment must be avoided. Short hot applications are very valuable, especially in acute nephritis.

Very fleshy persons do not at first react so well as lean persons, but bear prolonged treatment much better in consequence of their large heat-making resources. Lean persons react well, but their powers of reaction are quickly exhausted, hence they are more likely to suffer from secondary chill and untoward results.

Thick-skinned persons of phlegmatic temperament readily tolerate a very cold douche and a very high pressure,—that is, if no contra-indicating symptom is present.

In cases of very sensitive and timid persons, begin treatment with the very short cold douche or the Scotch douche. An excellent plan of dealing with these persons is to make the patient stand in a hot footbath increasing the temperature of the water until the heat is almost unendurable, so that the patient can hardly stand still. The heat impression made by the foot-bath thus administered is so generalized that a short application of cold may be simultaneously made without occasioning much inconvenience or complaint.

If cold applications cause unpleasant after-effects in very sensitive patients, the method should be modified by employing less force, using non-percutent measures or employing a higher temperature, as, for example, seventy to eighty degrees instead of sixty or seventy degrees or a lower temperature. Some authorities recommend in such cases that the bath should be prolonged instead of moderated in temperature. According
to the writer's experience, the longer the application in such cases the more intense are the unpleasant after-effects. In cases in which the douche is not tolerated, a wet-sheet rub, a towel rub, a sponge bath, the graduated Scotch douche, or a tepid immersion bath, may be advantageously employed.

Neurasthenics and persons suffering from enteroptosis with extreme irritability of the lumbar ganglia of the abdominal sympathetic cannot endure a cold douche to the abdomen. A hot douche may be employed without pressure, and cold friction with the hand or with a towel may be employed, but percutent measures must be avoided.

Hypochondriacs are often very sensitive and unable to bear the cold douche. In such cases the neutral bath should be employed. The patient should be gradually trained to employ water at a lower temperature until a short cold immersion can be tolerated. The tepid affusion, the cool wet sheet rub, and finally the Scotch douche or the graduated alternate douche may be applied.

In persons suffering from nervous irritability, the irritable state of the reflex and automatic centers is indicated by palpitation of the heart, a sense of weight in the chest, by prickling, numbness, and other peculiar sensations, wandering pains, headache and malaise. In very sensitive persons it is not infrequently difficult to avoid such effects. It is advisable in some cases to precede the use of the douche in its various forms by a period of training by means of sponge baths, towel rubs, short wet sheet packs, and the wet sheet rub. The temperature should not be low, and the towel or sheet employed should be wrung as dry as possible, so that the effect of the cold applications may not be too prolonged. Short affusions, a very short douche applied to the spine only, or to the spine and legs, with very light pressure, and especially the employment of moderate temperatures, 60° - 80° F., or the Scotch douche, or the employment of moderate temperatures, 60° - 80° F., or the Scotch douche, or the employment of moderate temperatures, 60° - 80° F., or the Scotch douche, or the employment of moderate temperatures, 60° - 80° F., or the Scotch douche, or the employment of moderate temperatures, 60° - 80° F., or the Scotch douche,
other form for three or four minutes prior to the cold application.

If short cold applications are not well borne, a slightly higher temperature should be used, with stronger percussion. This method is preferable to that suggested by Beni-Bardi and others, viz., to attempt to modify the excitant effects of short very cold applications by prolonging the application, thereby producing a slight sedation, or lessened excitation. While this method seems to be theoretically rational, in practice it fails, for the sensitive patient who cannot tolerate a short cold application because of too great reaction, generally fails to react well to a longer application, and thus suffers greater inconvenience than from the short cold bath. The better plan is to raise the temperature, also prolonging the application.

Cold water as a therapeutic agent is especially adapted to the treatment of acute maladies in which fever or pain are present or in which diminished activity or overactivity of special organs is a fundamental condition.

In chronic disease, hydrotherapeutics may always be employed with great advantage. The tonic effects of cold water are almost universally required in the treatment of chronic maladies.

Surgical cases involving pain, fever, or danger of inflammation, such as compound fractures and other wounds of various sorts, burns, scalds, and many other forms of accidents and injuries, afford most excellent opportunities for the therapeutic employment of water.

Those who have assigned to hydrotherapy a narrower sphere of usefulness than that which we claim for it have been led to this narrowness of view by the failure to recognize to the fullest extent the great advantages of a wide range of temperature in hydrotherapy. Hydrotherapy properly includes thermic applications at all temperatures and in many forms.

In the treatment of fevers, hydrotherapy is especially helpful. There is no other means or set of means by which a febrile action may be more
quickly or permanently controlled than by the scientific employment of water.

Modern obstetrics owe much to hydrotherapy in a variety of ways. The proper use of water at the lying-in period greatly assists in conducting the perils of this critical period, and quickly restores the patient to a normal condition. We are hardly prepared to adopt the cold sitz-bath immediately after delivery, as recommended by Pingler, but during twenty-five years of practical use of hydrotherapy in obstetrics, we have found it to render invaluable service, especially in the form of the hot vaginal douche, the hot uterine douche, the enema, the daily sitz-bath as a preparatory measure, the neutral bath to relieve nervous irritability and insomnia, both before and after confinement, and the cold sponge or spray as a general tonic as soon as the patient is prepared for such treatment.

Organic degenerations are of course incurable, but by the appropriate use of water their progress may often be greatly delayed, and not a few instances have occurred in which such degeneration as that accompanying locomotor ataxia, general paresis, etc., have been entirely arrested and held in abeyance for years. Whatever develops general vital vigor and resistance must delay the development of degenerative processes, malignant as well as non-malignant.

Atrophied parts are not infrequently stimulated to development, so that functions almost entirely lost have been restored.

Brilliant results could scarcely be expected in cases of hyperplasia or hypertrophy, and yet in these conditions marked improvement has not infrequently been effected.

There is no more useful agent than hydrotherapy in dropsy due to chlorosis, anemia, and other cachexias. When due to disease of the heart or kidneys, hydrotherapeutic applications are still highly useful, but must be employed with the greatest circumspection.
Hemorrhages from the nose, stomach, lungs, or pelvic viscera may be successfully combatted by suitable applications of water, as elsewhere explained. In organic disease of the brain and spinal cord, an arrest of the disease may often be accomplished, and it is rare indeed that some benefit is not obtained. In cases of this sort, it must be remembered that cold applications with percussion must be avoided when acute inflammation is present, as the strong reaction set up by an application of this sort will surely give rise to an exaggeration of the condition.

Very hot applications followed by tepid compresses are more serviceable in cases of this sort.

In gastric disorders, hydrotherapy affords more assistance than any other remedial agent. The cold douche in hypo-pepsia and apopseia, and the hot douche in hyper-pepsia, meet the indications of these morbid conditions in a more effective manner than any other known therapeutic agent, the cold douche increasing the production of HCl on the one hand, while the hot douche diminishes the formation of this acid in cases in which it is already present in excess. The cold douche applied to the abdomen stimulates intestinal peristalsis. The writer has devised a moveable and adjustable circle douche which in practice proves very serviceable in cases of this sort. [

Gastro-urinary and renal disorders present many conditions which are in the highest degree amenable to hydrotherapeutic treatment. The sitz bath, rectal irrigation, the vaginal and uterine douches, and general tonic applications, are invaluable in this class of disorders. It must be remembered, however, that general saline applications must be avoided or greatly modified when acute inflammatory conditions are present in the pelvic organs or any of the viscera, especially when cold.

Pulmonary disorders present a large variety of conditions in which hydrotherapeutic applications are capable of rendering invaluable service. It is important to remember, however, that severe applications must be
carefully avoided in most cases of this sort. For example, in the application of the cold douche in a case of chronic bronchitis or in which there is a tendency to pulmonary hemorrhage, the application should be confined to the feet and legs. A moist pack applied to the chest is an invaluable measure which may be supplemented by cool sponging of the upper parts of the body, followed by vigorous rubbing.

In catarrhal affections of the throat and lungs the heating compress may be applied systematically to great advantage, but care must be taken not to cover it too warmly, so as to produce the effect of a poultice, which is highly sedative and relaxing. It should be remembered that a healthy skin is an indication of a healthy mucous membrane, and disorders of the mucous membranes may not infrequently be caused to disappear by the employment of such tonic means as will bring the skin into a thoroughly healthy condition.

In affections of the skin, warm neutral baths are often of the highest service. In some cases, it is wise to add soda or other alkaline substances to the bath, whereby its curative value is enhanced. The tepid douche may also be employed with advantage in many cases. Skin eruptions are generally due to general toxicemia. The enema and hot water drinking should be freely employed as a means of tissue cleansing. Cold baths must be avoided.

In chronic eczema with thickening of the skin, the daily hot douche to the affected parts has proved in the writer's hands a most effective means of restoring the diseased parts to a normal state.

In cases of skin disease in which a considerable portion of the skin structure is destroyed, as in pemphigus, the prolonged immersion bath can sometimes be employed with great advantage. In some cases of this sort the bath, maintained at a neutral temperature, has been continued consecutively for several months.

The diathesis and cachexia especially require the alternative
and tonic effects of hydrotherapy, yet the lowered vital condition which universally exists in connection with these morbid states renders it important that great care should be exercised in the employment of such powerful agents as the cold douche and other toxic measures.

The three leading diatheses, which are typically represented by chronic rheumatism, obesity, and diabetes, all present as their characteristic feature, deficient oxidation. In the rheumatic diathesis there is a deficient oxidation of the proteid wastes; in diabetes, a deficient oxidation of sugar; and in obesity, an excessive accumulation of hydrocarbons. Residual tissue, nonoxidized fat.

The cold bath excites oxidation, and hence it is especially indicated in these cases; but there is, at the same time, diminished vital resistance, lowered nerve-tone, and lessened ability to react in consequence of the prolonged perversion of nutrition, exposure to the influence of depressing toxic agents and retained excrementitious matters, and hence tonic measures must first be administered with great care. The patient must be gradually trained to react to the contact of cold water. Either one of two methods of training may be adopted. In some cases, it is necessary to apply first one and then the other. These methods are as follows:

1. The method of graduation. If some form of douche is the mode of application selected, the water must be employed at a moderate temperature, as 75° to 80°. The application should be ten to twenty seconds, and should be followed by energetic friction. From day to day, as the patient's nerve-tone rises, the temperature may be gradually lowered until the temperature of 60° to 65° may be reached. As the temperature is lowered, the application should be shortened, until at 60° the time should not be more than six to eight seconds.

In obese persons who still have a moderate amount of energy, a somewhat lower temperature may sometimes be reached after long training. The
same is true in reference to diabetic patients who are still in good
flesh and in whom there is no marked tendency to emaciation. In the
rheumatic diathesis and in cases of great sensitiveness to cold, treat-
ment should begin with the warm douche at 94° to 98°.

In cases in which the percussion effects of the douche are found to
be badly tolerated, non-persacient measures may be at first employed,
such as affusion at 80° to 85°, the wet sheet rub at the same tempera-
ture, the immersion bath at 85° to 90°, the neutral bath with friction,
the sitting shower at 80°, the towel rub, and even the cool or tepid
sponge bath with very feeble patients. It should be remembered that in
beginning a course of treatment, it is better to commence with too mod-
erate than with too severe measures, as otherwise the patient is likely
to be discouraged and to lose confidence. Moderate applications fre-
quently repeated may be made to accomplish the same results as more
severe applications taken less frequently.

2. Preliminary heating of the skin followed by a very short cold
application. This method succeeds in some cases better than the method
of graduation. Reaction as a rule develops more promptly and regularly
after a very short cold application than after a prolonged application or
higher temperature. For many patients also an application at 75° to 80°
is quite as disagreeable as a colder application. It is consequently
advisable in many cases to begin with the application of cold or very
cold water at the outset, but making the application so short in duration
that untoward effects are obviated. The preliminary heating of the skin
greatly diminishes the unpleasant sensation attending the cold applica-
tion, as well as the untoward after-effects which occasionally occur, a
fact which has been frequently pointed out in this work. The hot appli-
cations should be at a high temperature, usually 108° to 110°, and should
continue three to six minutes, or until the patient is so thoroughly
heated that he experiences an intense desire for a deluge of cold water.
This yearning for cold is an evidence that the system has been prepared to receive a cold application with benefit.

The hot douche, the hot immersion bath, the electric light bath, the vapor and hot air baths, are excellent means of preparing the patient for a cold application in cases of diabetes, rheumatism, and obesity. The electric light bath is to be preferred to the other measures mentioned, when it is accessible. Unless patients are quite acclimated, the bath may without injury be carried to the point of slight perspiration, or in cases of obesity and rheumatism, when the patient's general strength is good, profuse perspiration may be produced with injury, and in most cases with benefit, but must not be carried to the point of exhaustion. It should be remembered, also, that the longer the hot application is continued, the longer the time required for removal of the heat communicated to the skin by the bath, hence the cold application must be proportionately longer in duration. The increase in time of the cold application must be measured in seconds while the hot application is measured in minutes. As a rule, a cold or very cold application will be not more than two to four seconds after a hot application of as many minutes, and not to exceed ten to fifteen seconds after a hot application of twenty to thirty minutes. Cool or tepid applications, which are often required in diabetic and rheumatic cases and in chronic Bright's disease and cases of neuralgia, may be continued for one or two minutes in many cases. The required effect must be secured; viz., cooling of the skin to such a degree that proper but not excessive reaction may be secured.

The cold application should follow the hot bath immediately and before there has been the slightest opportunity for cooling of the skin. To accomplish this, the vertical rain-douche or shower bath may be advantageously placed in the same compartment in which the vapor or Russian bath is administered, so that the patient can receive extreme cold water
upon his body without leaving the compartment, thus avoiding the preliminary chill, which greatly lessens the effect desired, and may spoil it altogether. The writer has had constructed for this purpose an electric light bath and douche apparatus combined, in which the electric lamps are protected from the action of the water by an inner lining of plate glass, so that the patient may receive a cold douche while the heat-rays from the incandescent filaments are falling upon the surface of the body with full intensity. By means of this apparatus the applications of heat and cold are really simultaneous, so that there is no possibility of chilling the surface by evaporation.

The cold application should at first be of extremely short duration, not more than one or two seconds at the beginning, or as short as possible. In very sensitive cases, the douche should not be applied to the whole surface. The stream of water should be at first directed upon the feet and legs from the knees down. At each succeeding application, the amount of surface is increased until the whole body may be subjected to the influence of cold water. The applications should be made with great rapidity, however, and should not last more than two to five seconds.

In cases of rheumatism with very painful joints, care should be taken to avoid allowing the stream of cold water to fall upon those joints which are sensitive, otherwise the thermic reaction set up may increase the irritation and congestion of the joints and consequently aggravate the pain and discourage the patient.

In anemia accompanied by menorrhagia, a condition not uncommon, the cold douche should be preceded by a very short cold bath or a fomentation to the spine, or both, and in the application of the douche care should be taken to avoid the lumbar and abdominal regions. In anemia withamenorrhea, a general cold douche may be administered, but should be preceded by a hot douche to the hip, thighs, and feet, or a short hot sitz and hot foot bath; or, hot foot bath and hot circle.
It sometimes happens that the prolonged use of tonic measures results in a condition of nervous weakness following a period of apparent marked improvement. In such a case, the treatment should be at once suspended or modified, but the same measures should be again employed as soon as the evidences of therapeutic overwork have passed away. Generally patients feel so much improved when such a suspension of treatment takes place, that they imagine that the treatment is doing them harm, and that they are better off without the treatment than with it. They should be made to understand that the improvement experienced after the suspension of treatment is the legitimate result of the treatment, and that it is simply a fair test of the greater improvement and permanent benefit which they will experience later as the result of the internal vital work which it is the purpose of the treatment to organize and to maintain, and which, though more or less productive of present inconvenience, is nevertheless laying a broad and solid foundation for future health and vigor.

Incurable maladies.—Even in disorders which are not curable, as in cancer of the stomach accompanied by vomiting; uterine tumor or cancer, giving rise to hemorrhage; advanced locomotor ataxia accompanied by lightning pains; and a variety of other symptoms connected with disorders which cannot be readily cured, much can be done for the patient by the palliation of the most distressing symptoms. The vomiting of cancer may be checked and a very considerable degree of improvement secured. Often the consumptive's cough may be controlled, and if the patient can be so situated as to enjoy the advantages of a climatic change at an elevation of about five thousand feet, while at the same time receiving intelligent hydropathic treatment, a cure can be effected in the great majority of cases. Night sweats, fever, and other symptoms of consumption can be to a remarkable extent mitigated by suitable measures which are elsewhere pointed out.

By the prolonged hot douche or the revulsive douche, the lightning
CRANES

NINE

1897
pains of locomotor ataxia may often be relieved with a promptness which seems truly magical, and in scores of cases of locomotor ataxia which have been under the writer's care within the last twenty years, recovery from nearly all the symptoms present has been seen in a considerable number of cases, and great improvement in nearly all.

It may be properly said that no case of chronic disease, no matter how inveterate or hopeless in its nature, should be abandoned as incurable without giving to hydrotherapy, with the accompanying regimen of diet and exercise, active or passive, an intelligent and persevering trial.

Untoward Effects of Hydrotherapy. — There is no remedy, no matter how valuable it may be, which is not capable of misapplication or abuse. That untoward effects sometimes result from applications of water is consequently not an objection to its use, but is rather an argument for its scientific employment, and suggests the necessity of giving the same attention to the study of this important therapeutic agent that is given to the study of the various remedial agents enumerated in the materia medica, and elucidated in a systematic treatise upon therapeutics.

We are glad to note that the Medical Department of the Imperial and Royal University of Austria, located at Vienna, has established a chair of hydrotherapy, which is occupied by the distinguished Professor Winternitz, who has doubtless accomplished more than any other living man toward the establishment of modern hydrotherapy upon a sound scientific basis.

It is to be hoped that the time will come when every medical school in the United States and in every other country will be provided not only with a chair of hydrotherapeutics, but with a laboratory in which students of medicine may by practical demonstration, and experience, become familiar with the magic-working powers of this most remarkable of all therapeutic agents.
1897
ALL LINEN

CRANE'S
Headache.-- Perhaps the most common of the unpleasant effects which sometimes follow remedial applications of water is headache in some form. The pain is most commonly located in the forehead, but the top of the head, the back of the head, or the whole head may be involved. When present, headache indicates a too strong application of either cold or hot water.

Headache more commonly follows the cold plunge, the cold douche, or a hot bath of some sort, than any other form of application. Some patients are so susceptible, indeed, that placing the foot in very hot water will induce a severe headache. In others, strong reaction induced by any form of cold bath will occasion headache. In some instances, the headache thus occasioned is extremely violent and may last for several hours.

Explanations of this.

Hydrotherapists

The cause of headache occurring in hydrotherapy are various: some writers contend that it is always congestive, others that it is always anemic. The writer's view is that the headaches following hydrotherapeutic applications are sometimes congestive, sometimes anemic, and sometimes purely reflex or sympathetic in character, due to overstimulation of the sympathetic centers.

When headache occurs immediately or soon after a cold bath, the indication is that the bath was too cold, too prolonged, administered with too much percussion, or that reaction has failed, or that it has been too intense. Headache may be due to any one of these causes. If headache following a hot bath is due to congestion of the brain from overstimulation of the heart and the employment of too high a temperature. Applications which produce headache should be at once modified, as definite and serious injury may result from the prolonged employment of measures which induce an unpleasant symptom of this sort. If Vertigo and sweating sometimes occur either in connection with headache or without.

Vertigo is due to the same causes as have already been mentioned as
that the application has been too
and in temperature, either too
heat or too cold. (b) too long in duration.
(c) (d that the reaction has been excessive,
and incomplete.

CRANE'S
productive of headache. Sweating of the head indicates too strong reaction to the head.

The three symptoms above named indicate the necessity, modification of the measures employed; as, for example, a towel rub or wet sheet rub, an effusion at 80° or a short full bath at 85° to 90° may be substituted for the horizontal jet or other exciting measures. Too strong reaction at the head may also be obviated by wetting the face, neck, and head just before the application of the bath, by the application of a cold compress about the neck, to the head, or to the back of the neck, and by the hot foot bath just before, during, or after the bath.

Insomnia, nervousness, wandering pains, palpitation, fidgets, uneasiness, and indefinable but unpleasant sensations following a bath indicate the necessity for the employment of less strongly exciting measures. The Scotch douche should be substituted for the cold douche, and it may be necessary to suspend the douche altogether, employing instead the rubbing wet sheet, towel, rub, or the neutral bath. The last named measure is one of the best of all known measures in insomnia. In cases in which strongly tonic treatment is necessary, these applications should not be made in the evening, but in the forenoon. If there is a disposition to insomnia, this may be combated by a neutral bath taken just before retiring at night.

Insomnia, or a persistent sensation of fatigue occurring after three or four weeks' treatment, indicates a necessity for the substitution of dry friction, short electric light baths, the wet sheet rub, and similar measures in the place of strongly exciting treatment, so that the central nervous system may have an opportunity to recuperate the energy which has been expended in reaction and reparative work.

Headache or toothache is not an uncommon symptom, especially in persons who have previously suffered from these disorders. In cases of this sort, do not apply the cold douche or other cold applications above
the level of the shoulders.

In neurasthenics, and in many cases of hysteria, in which pain is generally chiefly expressed at certain points, care should be taken to avoid exciting or tonic applications to these points. This is sometimes not easy to accomplish, nevertheless it is necessary to exercise the greatest care to avoid the so-called hysterogenous zones, and especially to avoid the abdomen in cases in which the patient complains of decided pain or tenderness in this region.

Varicose Veins. -- When enlarged or ruptured veins are found upon the surface, as they are likely to be, percussive applications should be carefully avoided. The towel rub, affusion, and immersion baths should be used instead. The application of cold water will sometimes precipitate an attack. In such cases, hot and cold applications to the spine will give temporary relief from an attack, and the neutral bath may be employed daily for a few days until the peculiar susceptibility of the nervous system is somewhat modified. In such cases, the patient must be carefully trained to endure cold applications, the first attempts being made with water at a temperature of 75° to 80°, the temperature being systematically lowered from day to day.

Tendency to Take Cold. -- At the beginning of a course of hydropathic treatment, the patient not infrequently complains of an increase in susceptibility to changes of temperature. This susceptibility passes off, however, in a short time, for the continued use of cold water hardens the skin and increases its resistance. Great care must be taken to thoroughly dry the skin after baths of all sorts, not only by removing all sensible moisture from the surface, but by removal of the moisture which has been imbibed by the skin and which by subsequent evaporation may produce chill.

Rheumatic Pains, which not infrequently follow hydrotherapeutic application, are not due to taking cold, as is often feared, but to in-
1899
ALL LINEN

CRANE'S
complete reaction or to the setting free of uric acid and the consequent excess of this irritating substance in the blood. Colds, sore throats, and catarrh of the nose and throat are usually due to neglect of the patient or the attendant to completely dry the skin, thus exposing the secondary chill and resulting in cases of this sort, the cold applications should be preceded by a hot Scotch douche, an electric bath, or some other form of sweating bath.

Chronic skin disease sometimes presents a serious obstacle to the employment of hydrotherapy. If suppurating pimplies or furuncles, erythemas or acute eczemas appear, the indication is that cold baths should be suspended and that neutral baths should be employed. Zinc ointment may be advantageously applied after each bath to the affected surfaces.

Crisis or Fever of Reaction. Priessnitz and the early water-cure doctors made much of so-called "crises," but modern study of hydrotherapy has shown that the "crises" are the result of too violent measures or of strong measures employed for too great a length of time. The principal symptoms mentioned in connection with crises are fever, boils, suppurating eruptions, salivation, hemorrhoids, diarrhea, and vomiting. The application of too strong measures to the surface give rise to eruptions and irritation of various sorts, boils, etc.; while excessive water drinking give rise to the intestinal disturbances.

There are no salutary effects arising from crises which cannot be obtained by far better means. The practice of producing crises was based upon the supposition that all disease is due to impurities, and that these impurities may be gotten rid of by means of purulent discharges from the skin, artificially created. No one at all familiar with modern medical ideas can for a moment entertain faith in the antiquated, inconvenient, and (we are glad to say) obsolete measure.

Slight symptoms of fever accompanied by indigestion, headache, weak-
1907

Manual of Hydrotherapy

Kellogg
BRIEF HISTORY OF HYDROTHERAPY

Practical hydrotherapy is as old as the race. Water was undoubtedly the first remedy used for the relief of the sick. It is the most universal and the most widely applicable of all curative agents. More or less knowledge of its use is possessed by savages and even by lower animals living in a wild state. Its uses were known from the most ancient times, as shown by numerous historical documents. It was much used among the Egyptians and the ancient Hebrews.

Hippocrates, the learned Greek physician who flourished in the fourth century B.C., gave in his works most excellent practical directions respecting the use of water. In the time of the Caesars water was the most popular remedy for both chronic and acute disorders. Celsus elaborated a medical system which consisted exclusively of water, friction and exercise. Galen wrote learnedly of its use, and the directions which he gave are still followed by the native practitioners of the Orient. The Arabian physicians of the Middle Ages who were the learned men of their time, strongly advocated the use of water and used it largely in their practice. For eight hundred years water has been largely employed by the native physicians of Japan.

For at least two centuries the use of hot and cold water both internally and externally has been current among the peasantry of both England and Germany. John Wesley, the founder of Methodism, in his little work, "Primitive Physick," published in 1747, recommends fomentations, water drinking, cold compresses, cold baths, sweating bals, the hot and cold power and other practical hydriatic methods for a variety of ailments, having found these remedies in successful use among the common people, though not at that time recognized by the medical profession.

At the beginning of the last century an English physician, Currie, made a scientific study of the use of water in fever, and showed its great value as a
febriugue; but unfortunately the value of his work was not recognized and it was lost sight of.

It is probable that the world is more indebted to Vincenz Priessnitz than to any other person for the exact and systematic methods of using water now generally employed. Priessnitz was an uneducated peasant, a native of Austrian Silesia. As assistant to a veterinary he learned something of disease and made use of water in the treatment of horses, pigs, and cattle. His successes led him to experiment upon himself and his sick neighbors. His patients increased in number, and before he was forty years of age he had become world-famous, and was constantly surrounded with hundreds of patients gathered from all the civilized countries of the world. Among his visitors were not a few physicians, medical men of the highest standing, some of whom were patients, others students eagerly studying the methods which restored to health those whom their remedies had failed to cure and who were regarded as incurable.

The methods of Priessnitz were, of course, empirical, for he had no scientific training, and he made many serious blunders; but his inspired genius enabled him by devising, improving and adapting methods of using water, to elaborate so perfect a system that comparatively little improvement has been possible. Said one of the best known and ablest scientific practitioners of hydrotherapy in Europe to the writer a few years ago, "I follow Priessnitz;" and every practitioner of scientific hydrotherapy does the same, whether aware of the fact or not.

Priessnitz was an empiric not not a charlatan. He was an humble, earnest seeker after truth, a man of remarkable tact and natural sagacity which enabled him to succeed in spite of his lack of scientific knowledge, and so such an extent that he commanded the respect of the ablest scientific men of his time and received official recognition and royal authority to conduct his work.

Hydrotherapy began with Currie, but chief credit for further development must be given to Professor Wilhelm W. Winternitz, of Vienna, Fleury of France,
Beni-Barde, Bettey, Bouchard, Dujardin-Beaumetz, d'Arsonval, and in recent
times Brieger, Strasser, Duxbaum, Hirsch, and many others who have made important
contributions to this branch of physiologic therapeutics.

In this country, Barlow has been most
active in calling the attention of the medical
profession to the therapeutic value of water.
The water was actively engaged in
the scientific and practical practice of hydro-
therapy for her since 1873, and since 1876, as
superintendent of the Battle Creek
Sanitarium, has done what he could in the
for the improvement of the technique and
the therapeutic practical therapy of
this valuable physiologic agent, and has especially labored sought to
perfection a systematic method of correlating
the use of water with other natural
therapeutic agents in a complete
and rational system of physiotherapy.
THE PHYSIOLOGIC EFFECTS OF WATER.

Until within recent times the use of water both by the physicians and by the laity has been almost wholly empirical. This cannot be regarded, however, as a special reproach, for the same may be said of remedial measures of almost every sort. Within the last half century the marvelous results of laboratory research and experimental medicine have added to the art curative the science of therapeutics, and has transformed the empirical hydropathy of Fra Bernardo, Floyer, and Priessnitz into rational and scientific hydrotherapy.

In the scientific use of water as a curative agent every prescription is based upon the physiologic effects of the hydriatic measures designated. For example, if relief of pain is the object sought, the measure prescribed must be such an one as is known to have the effect when applied to a healthy person of lessening nerve sensibility. If the purpose is to lower temperature, then the application must be of such a nature as has been shown experimentally to be capable of lessening heat production or increasing heat elimination, or both.

It is evident, then, that a proper understanding of the therapeutic uses of water requires an accurate knowledge of the effects produced by various hydriatic measures when applied to the healthy person, the so-called physiologic effects of water.

The physiologic effects of water are based upon:

1. The physical properties of this agent, namely (a) its solvent properties; (b) its qualities as a thermic agent by which it may communicate to or withdraw from objects in contact with it, heat; and the peculiar mechanical effects connected with certain modes of application;

2. The reactions of the living body to the chemical, thermic, and mechanical stimulation arising from the contact with the body of various forms of applications at various temperatures and under varying conditions.
Water is a universal solvent. It is the vehicle which conveys into the body the energy-laden material which it needs to maintain its structures intact, and to replenish its constantly wasting energies; and passing out of the body conveys with it the debris of tissue disintegration and the residues of materials which, having yielded up their store of energy to the body are of no further service. Water is absorbed both by the mucous membrane and the skin. It is introduced through water drinking, the enema, the prolonged immersion bath, and the subdermic injection.

Thermic applications of water may be made by means of immersion baths, by cloths saturated with water, or by single or multiplied streams of water directed against the surface with varying degrees of force.

To the thermic effects produced by water at varying temperatures may be added mechanical effects by the various forms of the douche, by friction with the hand or other means in connection with the application of water, and by movements of the body when immersed in water.

Effects kindred to those which are produced by applications of water may be secured by means of other thermic agents, such as hot water, hot vapor, various cold or hot objects, such as ice, ice bags, hot-water bags, heated bricks, etc., and by sunlight and the various forms of the electric light.

Mechanical effects similar to those produced by water may also be produced by friction or percussion with the hand or other objects, by mechanical vibration and in other ways.

Chemical and electric thermophores.
THE PHYSIOLOGIC EFFECTS OF WATER DRINKING.—Claude Bernard called attention to the fact that "life exists only as a liquid medium," comparing the cells of the human tissues to infusoria. Like infusoria the living tissues absorb nutriment from the liquid medium with which they are bathed, of which water is the chief constituent. The same liquid medium cleanses the tissues of the poisons which they generate and conveys them away to the proper excretories. The absorption of water takes place chiefly from the intestine. The stomach absorbs little. The presence of CO₂ stimulates the absorption of water, while the presence of mineral salts hinders absorption.

After free water-drinking absorption takes place with so great rapidity that the proportion of water in the blood may be increased six per cent., the blood-volume being increased to nearly the same amount (Schults). This increase is very temporary, however. Half an hour after very copious water-drinking the blood contains a smaller proportion of water than before, even less than when water has been withheld for twenty-four hours (Böcker).

After free water-drinking the ability of the blood to absorb oxygen is improved (Böcker).

The activity of the kidneys and the skin is greatly increased after copious water drinking. There is also an increase in the amount of urea excreted, both through the urine and the perspiration. The amount of chlorid of sodium removed by the perspiration is so great that the amount excreted through the kidneys is diminished (Fleming).

All the metabolic activities of the body are encouraged by free water-drinking. This is especially true of constructive metabolism; hence the free use of water tends to increase bodily weight, especially in this subjects (Liebig).

By the free use of water the volume of blood is increased and the blood-pressure raised. The effect of this is to increase the strength and slow the rate of the pulse, to accelerate general blood-movement, to improve oxidation of tissue wastes, to encourage secretion and elimination, to raise the standard of vital activity, and to increase vital resistance.
Copious drinking of cold water produces a marked effect in slowing the heart beat, and increasing its force. It also tends to lower temperature. The drinking of hot water excites the heart and slightly raises the general temperature. The free drinking of hot water quickly produces free perspiration.

By the introduction of water either hot or cold into the rectum and its retention, effects are produced which are practically identical with those which result from water drinking.
THE EFFECTS OF COLD APPLICATIONS

The following summary is a brief presentation of the essential facts which have been demonstrated by experiment upon human beings and animals, and verified in clinical experience:

GENERAL EFFECTS OF COLD

1. Primarily depressant.
2. Secondarily excitant.
3. Short cold application causes contraction followed by dilatation.
4. Prolonged, moderately cold application causes prolonged internal contraction of vessels, internal as well as external.

EFFECTS OF COLD ON THE SKIN

1. Diminishes, then increases perspiration.
2. Causes pallor followed by flushing.
3. Contraction of muscular and connective tissues.
4. Lessening of sensibility and diminished reflexes.
5. Mucous membrane reacts the same as the skin, though less sensitive.

EFFECTS OF COLD ON THE CIRCULATION

1. General applications quicken, then slow, heart beat, and raise blood pressure.
2. Increases blood-pressure.
3. Over artery, causes distal contraction.
4. Continuous over the heart, depresses its action, and lowers tension.
5. Short over heart, increases force and action, then slows rate and raises tension.
6. Short cold applications anywhere increase pulse rate.
7. Cold applied to one hand contracts the vessels of the other hand.

EFFECTS OF COLD ON RESPIRATION.

1. General douche causes quick, gasping respiration.
2. Cold, non-punctiform, causes deep and slow respiration.
3. Cold increases oxidation and elimination of CO₂.

EFFECTS OF COLD ON THE MUSCLES.

1. Prolonged cold lessens muscular irritability and energy of strained muscles.
2. Short cold increases irritability and energy of strained muscles.
3. Cold excites smooth fibers.
4. Cold to small area produces general goose-flesh and shivering.
5. Cold, general or local, causes shivering.

EFFECTS OF COLD ON THE NERVOUS SYSTEM.

1. Applied to nerve trunk, paralyzes the parts.
2. Lessens rate of transmission.
3. Prolonged cold to head lessens and may suspend mental activity.
4. Short cold to the head excites mental activity.
5. Short general applications of cold produce general excitation of the nervous system.

REFLEX EFFECTS OF COLD.

1. Short, very cold with high pressure causes reflex vasodilation.
2. Long, non-punctiform cold causes reflex vasoconstriction.
3. Short cold to face and neck excites brain and heart.
4. Short cold douche to chest excites, then slows pulse.
5. Long immersion of hands in cold produces contraction of the vessels of the brain, nose, and lungs.
6. Short, very cold to hands causes uterine contraction.
7. Short, very cold douche, with high pressure, to the feet, causes dilatation of the uterine vessels.
8. Immersion of the legs in cold water contracts the vessels of the lungs and kidneys.
9. Short cold to mammary glands causes contraction of the uterine muscles.
10. Short, very cold to abdomen, hands and feet produces contraction
of the bladder, bowels, and uterus.

11. Prolonged cold to the upper dorsal region contracts the vessels of
the nose, throat, and lungs.

12. Ice-bag to the dorsal region contracts the vessels of the stomach.

13. Douche, lumbar region, moderate pressure (15 to 45 seconds), contracts
uterine vessels.

14. Very short, cold douche to the lumbar region, with strong pressure,
dilates the uterine vessels.

15. Short cold douche to the thighs causes dilatation of the uterine
vessels.

16. Short cold douche to the lower sternal region excites renal activity.

EFFECTS OF COLD ON THE BLOOD.

1. Short cold application increases blood-count.
2. Short cold increases oxygen absorption and gaseous exchange.
3. Short cold increases viscosity of the blood.
4. Short cold increases blood alkalinity.
5. Short cold promotes hematogenesis.

EFFECTS OF COLD ON ABSORPTION, SECRETION, AND NUTRITION.

1. General short cold applications increase intestinal absorption.
2. Short cold increases activity of all secreting glands.
3. Prolonged local applications at high pressure increase activity
of related secreting glands.
4. Short general cold quickens all vital functions and raises vital
resistance

EFFECT OF COLD ON ANIMAL HEAT AND TEMPERATURE.

1. General cold applications diminish surface temperature and the
general temperature.
2. Cold spray to the soles of the feet lowers general temperature.
3. Prolonged cold to head lowers general temperature by depressing
the thermogenic centers.

4. Cold to surface increases thermo electro electrical phenomena.
5. Short cold increases heat production.
6. Prolonged cold decreases, then decreases, heat production.
7. Cold produces circulatory reaction by lowering the temperature
   of the skin and blood.
8. Cold produces circulatory reaction by reflex influence upon the
   vasomotor centers and perhaps also by direct action upon the visceral-
   sympathetic ganglia of the blood-vessels.

EFFECTS OF HEAT

GENERAL EFFECTS OF HEAT.

1. Primary-excitant.
2. Secondary-depressant.
4. Long applications, vasodilatation, revulsion, excitation, exhaustion.

EFFECTS OF HEAT ON THE SKIN.

1. Contracts yellow elastic fibers, and relaxes white fibers.
2. Contracts smooth muscle fibers—goose-flesh.
3. Short, 110° to 130°, vasoconstriction followed by vasodilatation.
4. Long, extreme vasodilatation; later, after application, vasoconstriction
5. Increase of perspiration and skin respiration.
6. Sensibility increased at 98°, decreased at 113°, extinct at 130°.
7. Increased heat elimination; a. vasodilatation; b. increased movement
   of blood; c. increased evaporation; d. increased conductivity.
8. Prepares skin for cold application.

EFFECTS OF HEAT ON THE CIRCULATION.

1. First slows, then quickens pulse. (Pulse slowed and tension lowered
   after perspiration begins)
2. Percutient applications raise blood-pressure.
3. Very hot immersion baths raise blood-pressure.
4. Warm general applications lower blood-pressure.

EFFECTS OF HEAT ON RESPIRATION.
1. Moist, warm air increases rate and ease of respiration.
2. Hot, dry air hinders respiration.
3. Respiration slower and more superficial after hot applications.
4. CO₂ elimination increased by atmospheric temperatures below 40° and about 50°.

EFFECTS OF HEAT ON THE MUSCLES.
1. Short, hot applications increase muscular energy and excitability, and lessen fatigue effects.
2. Prolonged heat lessens energy and excitability.
3. Very hot applications excite involuntary muscles.
4. Long, warm, and hot applications relax involuntary muscles.

EFFECTS OF HEAT ON THE NERVOUS SYSTEM.
1. Short, very hot applications produce tonic effects, exciting brain and nerve centers.
2. Prolonged very hot applications cause general nervous excitement, followed by exhaustion.
3. Prolonged very hot applications produce toxic effects (heat stroke).
4. Local, very hot applications lessen nervous irritability and inhibit pain.

EFFECTS OF HEAT ON THE BLOOD.
1. General applications diminish blood-count.
2. Diminish leukocytosis.
3. Diminish alkalinity.
4. Diminish viscosity.
5. Diminish hematogenesis.
EFFECTS OF HEAT ON ABSORPTION AND METABOLISM.

1. Sweating baths promote absorption from alimentary canal.
2. Excite general catabolic activity.
3. Increase \( CO_2 \) production.
4. Increase nitrogen oxidation and urea.
5. Neutral baths promote ameborism.

EFFECTS OF HEAT ON THE VISCERA.

1. Short, percipient local applications lessen gland activity.
2. Prolonged local applications increase glandular activity.
3. General sweating diminishes HCl.
4. Local hot applications to abdomen diminish motility of stomach and intestines.
5. Prolonged heat to abdomen congests splanchnic urea.

EFFECTS OF HEAT ON HEAT PRODUCTION AND TEMPERATURE.

Prolonged general hot applications
1. Raise temperature of skin and blood, and increase heat production.
2. General applications followed by lowered temperature.
3. Short, very hot applications diminish heat production.
4. Atmospheric temperature above 70\(^\circ\) and below 40\(^\circ\) increases heat production.

(At 104\(^\circ\) in dogs, heat production increased 350\%.)
GENERAL EFFECTS OF COLD APPLICATIONS.

When water, cold air, or any cold object, is brought into contact with the surface of the body, the cold nerves of the thermic sense recognize the lower temperature and transmit inward to the vasomotor and other centers an excitatory impulse, the result of which is felt throughout the entire body. The brain, the lungs, the heart, every blood-vessel, every tissue, feels a thrill of this impulse. The whole system is roused to resist the influence of the cold, which the body recognizes as a deadly enemy.

The effect of stimulation of the vasomotor centers is to cause instant contraction of all the blood-vessels of the body. This contraction continues for some time at the surface of the body, but is very transient in the interior when the cold application is general in character. The cause of the quick disappearance of the contraction of the internal vessels is the inrush of blood, or to speak more correctly, retrostasis, which occurs as the result of contraction of the superficial vessels; that is, a great volume of the blood is diverted from the surface to the interior of the body to make room for which the internal vessels are mechanically dilated.

It thus appears that there are these two distinct general effects produced by a general cold application. The first is reflex, the second is mechanical. Both these effects must be borne in mind and given due consideration in all general applications, whether hot or cold, since cases are frequently encountered in which, while the reflex effects of the general cold application may be very desirable, the mechanical effects may be very undesirable, or even in the highest degree dangerous, as in cases of cardiac dilatation, pulmonary congestion, arteriosclerosis, and other conditions, as will be pointed out later.
The direct effect of cold upon tissues, the temperature of which is lowered, is uniformly depressant. When a general cold application is continued for a sufficient length of time to lower the temperature of the blood, all the functions of the body are depressed. This fact is the basis of the sedative effects of cold water.

Short cold applications are excitant in the reaction which quickly follows; the activity of all the vital functions is increased. This fact is the basis of the tonic effects of cold water.

In all applications of cold water the effects are of course more or less mixed. In prolonged applications the depressant effects predominate. In short applications the excitant effects are dominant.

By the terms long or prolonged is meant two minutes to four minutes, or longer, and by the term short is meant four to thirty seconds.

EFFECTS OF COLD UPON THE SKIN.

A cold application instantly checks perspiration. If the application is brief, perspiration either sensible or insensible returns with the succeeding reaction.

The blanching of the skin which follows a short cold application is due to contraction of the arterioles and capillaries of the skin. The bright scarlet hue which the skin assumes after a short cold application is evidence of the accelerated amount of blood through the actively dilating vessels.

When a cold application is prolonged, the skin acquires a mottled bluish appearance. This is due to the intense spasm of the small vessels as a result of which the blood remains so long in the arterioles that its oxygen is completely absorbed. So long as the skin is maintained in this condition all its activities are practically suspended.

The goose-flesh appearance produced by a cold application to the skin is due to a contraction of its muscular tissues.
Cold lessens cutaneous sensibility and to a corresponding degree lessens reflex activity when the application is very intense or prolonged more than twenty or thirty minutes. This is the basis for the rule to remove a cold application at the end of twenty or thirty minutes for five minutes, to allow recovery of the nerves of the skin when reflex effects are desired, and to make the cold application continuous when it is desired to suppress reflex effects.

Effects similar to those above described are produced by applications of cold to the mucous membrane of the stomach or the lower bowel, though these parts are less sensitive to cold than is the skin.

THE EFFECTS OF COLD UPON THE HEART AND BLOOD-VESSELS.

A general cold application first quickens then slows the heart by increasing the force of the heart.

Cold applications when not greatly prolonged raise blood-pressure to millimeters.

A cold application made over an artery causes a contraction of the distal branches of the artery.

A short cold application over the heart increases the rate and force of the heart-beat, and raises the arterial tension. As the tension rises the pulse rate is lessened.

A continuous cold application over the heart depresses its action, and lowers the tension. A short cold application to any part of the body has the effect to increase pulse rate.

Cold applied to one end contracts the vessels of the other end.

A short cold application at first lessens the blood-supply of the parts to which the application is made, and also of the internal related parts, but only so long as the contraction of the small vessels continues. As soon as
this contraction gives way to dilatation in the reaction which occurs after withdrawal of the cold applications, the movement of the blood is increased through the stimulation of the peripheral heart, the so-called skin heart (Schiff). This effect of cold upon the small blood-vessels is highly important, as it provides means by which either the general or the local movement of the blood may be controlled—diminished or accelerated. This principle is utilized with most admirable effect in the treatment of chronic visceral congestion, dilatation of the heart, and whenever there is need of either the general or local reinforcement of the circulation. By the aid of this principle, local blood-supply can be regulated to a nicety.

Prolonged moderately cold applications cause prolonged contraction of the vessels or internal associated vascular areas. This principle is one of the highest practical value, as will be seen later in the consideration of local cold applications.

THE EFFECTS OF COLD ON RESPIRATION.

A short cold douche of cold water upon any part of the body, particularly upon the chest, causes quick, deep, gasping respiration.

A moderately prolonged non-percutient application (cool or cold immersion bath) deepens and slows respiratory movements, and thus permits thorough aeration of the lungs and emptying of the portal circulation by the full descent of the diaphragm.

A general cold application when not prolonged sufficiently to lower the temperature of the blood, increases the tissue conditions, and the production and elimination of $\text{CO}_2$. 
THE EFFECTS OF COLD UPON THE MUSCLES.

Short cold applications increase the excitability and force of voluntary or striated muscles.

Prolonged cold applications lessen the irritability and the energy of the voluntary muscles.

Cold applications excite the smooth muscular fibers.

The goose-flesh and shivering produced by cold applications are due to automatic action of both voluntary and involuntary muscles under the exciting influence of cold. By the contraction of the involuntary muscular fibers of the skin the blood-vessels are compressed, the movement of blood through the skin is lessened, and the escape of heat through this channel is diminished; while by the rythmic contraction of the voluntary muscles heat is generated and thus the temperature of the body is maintained.

THE EFFECTS OF COLD UPON THE BLOOD.

A short cold application followed by good reaction increases the blood count within half an hour. The increase may amount to more than 25 per cent.

Short cold applications increase the absorption of oxygen and the amount of oxygen stored in the body.

Short cold applications increase the viscosity of the blood, and thereby tend to raise the blood-pressure.

Short cold applications increase the alkalinity of the blood by rendering more complete the oxidation of the acid tissue residues. This fact is of the highest importance, as vital resistance rises and falls with the alkalinity of the blood (Charrin).

Cold applications encourage blood formation.

Cold applications as recently shown by Wright raise the tuberculo-opsonic index and so increase the resistance of the body against the tubercle
bacillus.

THE EFFECT OF COLD UPON THE DIGESTIVE ORGANS AND OTHER VISCERA.

General cold applications increase absorption by the intestinal mucous membrane, and thus promote nutrition. This fact is associated with improvement of the appetite under the influence of cold air as well as under the influence of cold water. Short cold applications increase the activity of the gastric and other digestive glands. Cold applications produce a notable increase in the amount of gastric acid \( (HCl) \).

Prolonged cold applications diminish the activity of the digestive glands.

Short cold applications increase the motility or peristaltic activity of the stomach and intestines.

Prolonged cold applications to the hips and abdomen lessen peristaltic activity and diminish portal congestion.

THE EFFECTS OF COLD UPON METABOLISM.

Short cold applications incite general metabolic activity.

Cold applications prolonged until the temperature of the blood is lowered lessen metabolism and all vital functions.

Short cold applications increase the activity of all secreting and excreting structures.

A short cold douche at high pressure over the liver or stomach promotes glandular secretion in these organs.

THE EFFECTS OF COLD ON HEAT PRODUCTION AND BODY TEMPERATURE.

General cold applications diminish surface temperature and if continued reduce the general body temperature. This effect is much more pronounced when
the temperature is above normal than in a healthy person.

A bath at 73° F. for one hour lowered the temperature of a healthy man
one and a half degree (Draper). (Should have new experiment here)

A prolonged cold spray to the soles of the feet lowers the general
temperature slightly.

Prolonged cold applications to the head lowered the general temperature
of the body by depressing the thermogenic centers.

A short or moderately prolonged general cold application increases
heat production. This increase may amount to two hundred or three hundred
per cent.

When a cold bath is continued a sufficient length of time to produce
shivering, this is an indication of the lowering of the blood temperature and
the beginning of increased heat production through the action of the muscles.

Prolonged cold applications first increase and then decrease heat
production. The decrease of heat production is produced by lowering of the
temperature of the blood, which cools the thermogenic tissues in the muscles,
and thus lessens the activity of the oxidizing processes by which bodily heat
is produced.

An atmospheric temperature below 40° F. increases heat production
to a marked degree.

EFFECTS OF COLD UPON THE NERVOUS SYSTEM.

Cold applied to the sensory nerve trunk produces numbness and allays
all sensation in the parts to which the nerve is distributed. When the cold
is applied to the motor or mixed nerve muscular paralysis is also produced.

Cold applied to a nerve greatly slows the rate of transmission of
nerve impulses.

A short application of cold to the head stimulates mental activity.
A prolonged application of cold to the head lessens mental activity, and may produce unconsciousness.

A short general application of cold produces general excitation of the nervous system with a feeling of exhilaration and general well-being.

THE REFLEX EFFECTS OF COLD.

Every internal organ of the body is in close nervous relation with some special area of the skin surface. This relationship is based upon the anatomical fact that the nerve trunks which supply internal parts are each directly connected either through a common trunk or a common nerve center with external branches which are distributed to the skin and other external parts. The accompanying diagrams show the principal skin areas which are connected with important internal parts.

Some organs are related with several areas. The brain, the heart, the lungs, and the great splanchnic area (portal system), are reflexly influenced by the entire skin surface. This is particularly true of the area supplied by the great splanchnic nerve, which is the most important of all the vasomotor nerves in the body, responding quickly and constantly to all forms of sensory irritation.

The following is a summary of the special effects produced upon important viscera by cold applications to the several reflex areas.

Short, very cold applications at high pressure influence vasodilatation in the internally related parts.

Long, non-percutent, moderately cold applications cause reflex vasoconstriction of internally related parts.

Short cold applications to the face and neck excite the brain and heart.

A short cold douche to the chest first excites then slows the pulse.
Prolonged cold immersion of the hands produces contraction of the brain, nose, and lungs.

Short, very cold applications to the hands excite uterine contractions.

A short, very cold douche at high pressure applied to the feet causes dilatation of the uterine vessels.

Immersion of the legs in cold water contracts the vessels of the lungs and kidneys.

Short cold applications to the mammary glands excite contractions of the uterus.

Short, very cold applications to the abdomen, the hands, and the feet, cause contraction of the bowels, bladder, and uterus.

Prolonged cold applications to the upper dorsal region cause contraction of the nasal and pulmonary vessels.

An ice-bag applied between the shoulders cause contraction of the vessels of the stomach.

A cold douche applied to the lumbar region with moderate pressure (duration, 15 to 45 seconds) excites contraction of the uterine vessels.

A very short, moderately cold douche to the lumbar region with strong pressure dilates the uterine vessels.

A short, cold douche to the thighs causes dilatation of the uterine vessels.

A short cold douche to the lower sternal region excites the activity of the kidneys.

Short, very cold applications over the stomach or the spine opposite dilate the gastric vessels, and promote the secretion of hydrochloric acid.

Prolonged, moderately cold applications at moderate pressure over the stomach or the spine opposite produce contractions of the gastric vessels and lessen secretion.

A short cold application over the liver causes contraction with a diminution in size.
A short cold application over the spine, especially when enlarged, causes contraction of the organ.

A cold application over the heart increases the force of the heart-beat and diminishes its size if dilated.

A prolonged cold application to the face and neck, particularly the eyes and the ears, diminishes the blood-supply of the brain.

The practical importance of the above facts, which have been verified by numerous experiments upon men and animals, and by abundant clinical experiments, cannot be over-estimated. From these facts it clearly appears that the surface of the body is a sort of key-board upon which the physician, skilled in the use of hydrotherapy, may produce almost any desired therapeutic effect.

By suitable applications the blood-supply of any organ, or the movement of blood through any internal organ, no matter how remote from the surface, may be increased or diminished at will.

It is important to know the fact that all of the various spinal centers are represented in the skin of the back. This is due to the fact that the external branches of the spinal nerves, the main trunks of which pass forward for distribution to the lateral and anterior portions of the body, give off small posterior branches which are distributed to the over-lying skin of the back. So the dorsal surface of the trunk is a sort of miniature key-board, by applications to which all the internal viscera may be influenced. This fact explains the great value of the dorsal douche, the Chapman bags, alternate hot and cold applications, and doubtless also the remarkable effects which may often be produced by simple rubbing or friction of the back, and the good effects of mechanical vibration applied to the dorsal region.
THE PHYSIOLOGICAL EFFECTS OF HEAT.

Heat is primarily an excitant agent. If the temperature of an organ or tissue is elevated slightly above its normal temperature, its activity is thereby increased, just as its functional activity is diminished when its temperature falls below normal. A very high temperature is excitant through the sensory stimulation which it induces. In this regard it resembles other irritants.

The secondary, reflex effects of heat are depressant, and its application is followed by an atonic reaction.

A general hot application stimulates the thermic nerves, which send inward to the great nerve centers of the body impulses which exercise a marked depressant or inhibitory influence upon the general bodily functions.

The activity of the sweat glands is increased by the direct stimulation of the heat, an important protective measure for cooling the body by evaporation. Heat production is enormously increased through the raising of the temperature of the blood, almost the only example of increased functional activity in internal parts as the result of the application of heat.

THE EFFECTS OF HEAT UPON THE SKIN.

Heat contracts the yellow elastic fibers and relaxes the white fibers of connective tissue.

Very hot water applied to the skin produces goose-flesh, the same as does cold water, through contraction of the smooth muscular fibers of the skin.

Short, very hot applications, 110--130° F., cause vasoconstriction, quickly followed by vasodilatation, with dusky redness of the skin.

Long hot applications produce extreme vasodilatation. Subsequently, after removal of the heat, vasoconstriction occurs.
Hot applications increase perspiration, sometimes to more than twenty times the normal amount.

Cutaneous respiration is also increased.

Tactile sensibility is increased at 98° F., decreased at 113° F., and becomes extinct at 130° F., at which temperature pain is produced.

Hot applications increase heat elimination by dilating the surface vessels, by increasing the movement of blood through the skin, by increasing evaporation from the skin, and by increasing the conductivity of the skin.

Hot applications prepare the skin to react to cold applications by raising the zero of the temperature sense, storing heat and blood in the skin, and rousing the cutaneous nerves to a high degree of activity.

THE EFFECTS OF HEAT UPON THE HEART AND BLOOD-VESSELS.

A general hot application first slows then quickens the pulse.

In the hot air bath the pulse is first quickened and the tension raised. The pulse is slowed and tension lowered after perspiration begins. (Have these experiments repeated.)

A general hot douche with considerable pressure raises blood-pressure, as does also the very hot immersion bath and the hot enema.

General hot applications lower blood-pressure by dilating the vessels without exciting the heart.

Short warm and hot applications produce vasodilatation with revulsion to the surface.

Prolonged general hot applications produce great vasodilatation, with stasis of blood in the skin.

THE EFFECTS OF HEAT UPON RESPIRATION.

Warm moist air increases the rate and the ease of respiration.

Hot dry air hinders respiration.
After a general hot application respiration is slower, but more superficial than normal.

An air temperature above 70° F. increases C O₂ elimination.

THE EFFECTS OF HEAT UPON THE MUSCLES.

Short, very hot applications increase muscular excitability and energy, and lessen fatigue effects. This fact explains the restorative effect of a short, hot bath in cases of fatigue after great muscular exertion.

Prolonged general hot applications lessen muscular energy and excitability. A hot bath continued for thirty minutes made a strong man so weak that he could not stand erect without assistance. He was instantly restored, however, by a cold shower bath, showing that the effect was purely reflex.

Very hot applications excite contraction of involuntary muscles. This is seen in the goose-flesh appearance produced by hot applications to the skin, and in the stimulating effect of hot liquids upon the stomach and bowels.

Prolonged hot and warm applications relax both voluntary and involuntary muscles.

THE EFFECTS OF HEAT UPON THE BLOOD.

General hot applications diminish the blood count. This is one of the ways in which injury is produced by excessive hot bathing, and shows the importance of exercising great care in the use of hot baths.

Prolonged hot baths diminish leukocytosis, and thus lessen the ability of the body to resist the attacks of microbes.

Hot baths diminish the alkalinity of the blood and so diminish vital resistance.

Hot baths diminish the viscosity of the blood, thereby tending to lower blood-pressure.
Hot baths diminish blood formation.

The above facts emphasize the necessity for exercising great care in the use of hot baths. It is easily possible to do great harm by subjecting a patient to repeated general hot applications.

THE EFFECTS OF HEAT UPON METABOLISM.

The elevation of the blood temperature produced by a general hot bath excites general destructive metabolism.

General hot baths increase \( \text{CO}_2 \) production. The oxidation of nitrogen is especially promoted by hot baths when sufficiently prolonged to elevate the temperature of the blood one or two degrees.

The production of urea is increased by hot baths.

The neutral bath (92--96° F.) promotes tissue building, and hence is conducive to increase of weight, especially in emaciated persons.

THE EFFECTS OF HEAT UPON THE DIGESTIVE ORGANS AND OTHER VISCERA.

Sweating baths promote absorption from the intestinal tract. On this account they have a tendency to cause constipation by producing an excessive dryness of the alimentary residue.

A short hot douche over the stomach lessens gastric secretion and hydrochloric acid formation.

A prolonged hot application over the stomach produces increased gastric secretion.

Sweating baths diminish hydrochloric acid formation by diverting blood to the surface of the body and by eliminating large quantities of sodium chlorid.

Local hot applications to the abdomen diminish motility of the stomach and intestines.

Prolonged warm applications to the abdomen dilate the portal vessels and may possibly be dangerous.
and congest the splanchnic area.

THE EFFECTS OF HEAT PRODUCTION AND BODY TEMPERATURE.

General hot applications raise both the temperature of the skin and the body temperature.

Short general applications are followed by a lowering of the body temperature.

Short, very hot applications diminish heat production.

An atmospheric temperature above 70° F. increases heat production to the amount of 300 per cent. or more.

THE EFFECTS OF HEAT UPON THE NERVOUS SYSTEM.

Short, very hot applications produce an excitant effect upon the brain and nerve centers.

Prolonged, very hot applications produce general nervous excitation, followed by exhaustion.

Prolonged, very hot general applications may produce toxic effects (heat stroke).

Local, very hot applications lessen nervous irritability and inhibited pain.

REFLEX EFFECTS OF HEAT.
REACTION

One of the most interesting of the physiologic phenomena observed in connection with hydriatic applications is known as reaction. This is particularly marked after cold applications, although reaction occurs after all applications at a temperature considerably removed from the normal bodily temperature.

The application of cold water to the general surface of the body produces a general perturbation of the whole system. The contact of the cold water with the millions of thermic nerve endings distributed in the skin produces a most profound impression upon every tissue and function of the entire body. The sudden contraction of the small vessels throughout the whole body, comprising not only those of the skin, but also of the internal vessels, and especially the vessels of the great splanchnic area, forces suddenly forward a great quantity of blood into the veins, accelerating blood movement throughout the body, and quickening every vital activity. In the reaction which follows, the small vessels are dilated so as to permit the ready passage of the accelerated blood current.

This dilatation is not passive, however. The muscular walls of the small arteries are excited to rapid, rhythmic activity by the stimulating influences received from the vasomotor centers in response to the reflex excitation communicated to them from the surface.

The following comparative table shows the several primary effects produced by a short, general cold application and the reaction effects which follow:

<table>
<thead>
<tr>
<th>Primary Effects</th>
<th>Reaction Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Skin rough from goose-flesh.</td>
<td>2. Skin smooth, soft, supple.</td>
</tr>
<tr>
<td>3. Skin pale.</td>
<td>3. Skin red.</td>
</tr>
</tbody>
</table>
5. Unpleasant sensations of constriction, shivering, discomfort.
6. Respiration quick, deep, gasping.
7. Pulse quickened, blood-pressure raised.
8. Skin temperature lowered, internal temperature raised.
9. Insensible perspiration checked.

Primary Effects

5. Sensations of comfort and well-being.
6. Respiration easy, slow, deep.
7. Pulse slow, blood-pressure raised.
8. Skin temperature raised, internal temperature lowered.
9. Insensible perspiration increased.

Reactions Effects.

Ability to react varies very greatly with different persons and under different conditions, both in health and disease. Prompt reaction depends primarily upon vigorous action of the spinal centers. When these centers are exhausted as the result of exertion, as in fatigue, or as the result of disease, reaction may be difficult or even impossible. Hence it is highly important to study carefully the conditions which permit and which hinder reaction.

In a vigorous healthy person reaction appears immediately after a short cold application, especially when administered in the form of a douche, as indicated by reddening of the surface. Under these conditions reaction may even begin during the application.

If after the first reaction a second cold application is made, a second reaction appears, but with less vigor and promptness. In a healthy person reaction may thus occur several times, but each time less quickly and with less intensity.

This is what happens in the cold immersion bath. The chill which is felt on first entering the bath quickly disappears, giving place to a sensation of warmth. But if the bath is greatly prolonged for a time a second chilliness is felt which is likely to be accompanied by shivering. This is an indication that the limit of the person's ability to react has been reached.

In therapeutics cold applications are never carried so far as this, except when employed in fevers for the reduction of temperature.

A long application of cold suppresses reaction by tiring out the nerve centers. How easily this may be accomplished will be appreciated only when one considers the enormous expenditure of energy which must be required to set into vigorous activity every involuntary muscle in the body, and in extreme cases bringing
into automatic action the entire voluntary muscular system.

In general the aim should be to promote prompt reaction by the most effective means, and at the least vital expense to the body.

Of the measures which promote reaction, some are employed before the bath in preparation for it. Others pertain to the bath, and still others follow the application. These three classes of measures may be briefly enumerated as follows:

I. Conditions and preparatory measures which promote reaction—

1. Youth, general health, and vigor.

2. Dry, warm skin.

3. Exercises stopping short of fatigue.


5. Friction of the skin.

6. Warm clothing, or warming in bed.

7. A warm room.

8. Hot water drinking, or a hot enema.

II. Conditions pertaining to the bath, which promote reaction—

1. Very cold water.

2. Short, sudden application.

3. Strong pressure, if the douche is employed.

4. Friction and rubbing in the bath.

5. Alternation with heat and cold, as the hot water or vapor douche, with the cold douche or cold effusion.

III. Conditions and measures which promote reaction subsequent to the bath—

1. Exercises immediately following the bath.

2. Quick drying and vigorous rubbing of the skin.

3. Heat in the form of dry, hot air, warm clothing, or if necessary, hot water drinking.

Exercises and friction are much the better means of encouraging reaction. The application of heat is very likely to result in a loss more or
less complete of the tonic effects produced by the cold application, through the development of depressing effects.

CONDITIONS WHICH RENDER VIGOROUS REACTION DIFFICULT OR IMPOSSIBLE.

It is very important to recognize and bear in mind the fact that under certain conditions reaction is likely to follow, either in part or wholly, thus rendering cold applications hazardous, and in some cases requiring their interdiction. The principal conditions which discourage reaction are:

1. Excitation from any cause whatever, especially over-exertion, loss of sleep, or starvation.

2. Extreme old age.
3. Infancy.
4. Arteriosclerosis.
5. Chilliness.
6. Profuse perspiration with fatigue.
7. Uric acid diathesis in extreme degree.
8. Great nervous irritability.
9. Cachexia, with dry, inactive skin.
10. Extreme obesity.
12. Extreme aversion to cold.

Priessnitz always took care to test the ability of his patients to react before marking out a course of treatment. For this purpose he was always present at the administration of the first bath, so that he might note the appearance of the skin, to which he gave great attention.

The reactive ability of the patient may be tested by immersing the arm in ice cold water for half a minute, then carefully drying it, noting the length
of time before the normal temperature is restored; or by applying a towel wrung out of cold water to the inner surface of the forearm for ten seconds, then drying gently and noting the length of time which elapses before the surface is reddened. Immediate reddening indicates excellent ability to react.

If general chilliness is produced by such an application, the patient's nerves are extremely irritable, and very cold applications must be given with the greatest care. If the surface becomes blue and remains so for some little length of time, the indication is ominous. The nerve centers are so exceedingly irritable that they may be easily stimulated and brought into a state of collapse, in which there will be loss of control of the great splanchnic area, and overflow of blood into the dilated portal circulation.

REACTION AFTER A HOT APPLICATION.

While the reaction phenomena following a hot bath are less striking than those which occur after a cold bath, and are chiefly negative in character, they are nevertheless sufficiently distinct to be recognized worthy of brief consideration. These effects, which the author believes he was the first to recognize and classify and to distinguish from the tonic reaction of cold as the atonic reaction of heat, may be tabulated as follows:

<table>
<thead>
<tr>
<th>Primary (action) effects</th>
<th>Reaction effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Brief contraction, then dilatation of the cutaneous vessels, especially the veins.</td>
<td>1. Constriction of the cutaneous vessels.</td>
</tr>
<tr>
<td>2. Skin, dusky red in color.</td>
<td>2. Skin pale.</td>
</tr>
<tr>
<td>4. Respiration frequent.</td>
<td>4. Respiration frequent, easy, superficial.</td>
</tr>
<tr>
<td>5. Pulse quickened, blood-pressure increased.</td>
<td>5. Pulse frequent, blood-pressure lowered.</td>
</tr>
<tr>
<td>6. Perspiration increased.</td>
<td>6. Perspiration lessened.</td>
</tr>
<tr>
<td>7. Heating of skin, with rise of internal temperature.</td>
<td>7. Cooling of skin, with depression of internal temperature.</td>
</tr>
</tbody>
</table>
In the employment of hot baths it is highly important to keep in mind the above atonic and depressant effects which almost invariably accompany prolonged or frequently repeated hot baths, when these effects are not antidoted by a cold bath of some sort administered immediately at the conclusion of the hot bath. Fortunately, nearly all the depressant effects which result from hot applications may be instantly removed by suitable cold applications, provided the cold application is made immediately in connection with the heating measure. There are, of course, occasional cases in which sedative or depressant effects are desired, but these cases are comparatively rare.

The comfort which the patients experience during the warm bath, especially those who are suffering from neuralgic or rheumatic pains, often lead to excess in their use, with the result that the patients become depressed, lose their appetite, and in the end actually experience an aggravation of their maladies. By careful management a cool application of some sort may be made in almost every case, and thus the tonic effects desired may be secured if sufficient skill is exercised without the loss of the sedative or pain inhibiting action which is secured by means of the hot bath.

THE NEUTRAL BATH.

Strictly speaking, there is no such thing as an absolutely neutral bath. The so-called neutral bath is a bath the temperature of which is a few degrees below that of the body. The difference between the bath and the body temperature is just sufficient to permit the elimination of the body heat as rapidly as it is formed, thus preventing the rise of the temperature. The temperature of the neutral bath is 92° to 96° F. A bath at this temperature does not produce a sensation of chilliness, and so thoroughly protects the body from external impressions that the nervous system is put at rest.

The bath is not strictly neutral, however, in its effects upon the body, for it has quite a decided physiologic action. The temperature of the bath

...
being below that of the body, absorption of water takes place, and as a result the kidneys are stimulated to increased activity. Through the absorption of water by the cutaneous nerves, their irritability is lessened, and thus the body is maintained in a state of quiet and rest.

INTERNAL REACTIONS.

In making hydriatic applications it is highly important to bear in mind the fact that reaction effects are not confined to the surface. This is especially true in relation to regulated or partial applications. When a cold application is made over the liver, for example, changes, first contraction then dilatation, occur not only in the cutaneous vessels, but also in the vessels of the liver. Whenever a cold application is made to the surface of the body, changes corresponding to those which occur in the skin occur in some internally related parts.

The internal reaction which may be thus produced by external applications constitute one of the most valuable resources of the hydriatic system, but one which is utilized less frequently and less effectively than it should be on account of the general lack of understanding of the governing principles.

The internal reaction may be rendered more or less intense by the suitable modifications of the measures by which it is induced. In general, the more intense the external application, if of short duration, the more intense will be the internal reaction; that is, the lower the temperature and the greater force with which the application is made, the duration being not more than a few seconds, the greater will be the resulting dilatation of the blood-vessels of the internally related parts.

If it is desirable to lessen the intensity of the internal reaction, the external application should be only moderately cold, and it should be of considerable duration (10 to 30 minutes). The application should be made
without force; that is, not in the form of a douche, but in the form of a gentle pour, a compress, or pack, or coil filled with cold water.

The intensity of the internal reaction may also be modified by graduating the temperature of the application; that is, beginning with a temperature near that of the body and gradually lowering to the desired degree.

By making alternate hot and cold applications to the surface, rapid circulatory changes may be effected in internally related parts, the vessels contracting with each cold application, and dilating when the hot application is made. By continuing these alternate applications a sort of pumping process may be operated in relation to any desired internal part and for any desirable length of time.

When it is desired to produce most powerful general, internal reactions, the temperature of the skin is raised by a general hot application, and this application is immediately followed by a very short, very cold application, administered with considerable force, if in the form of a douche, or with vigorous rubbing if in the form of a wet sheet or shallow bath.

If, on the other hand, it is desirable to diminish general reactionary effects, a prolonged graduated bath is administered, avoiding a low temperature. The graduated immersion bath and the graduated shower bath are particularly serviceable for this purpose.

COLLATERAL ANEMIA AND HYPEREMIA

Every important internal organ is anatomically related to the surface of the body, not only through the nerves, but also through the blood-vessels, both arteries and veins. For example, the same artery which through its deep branches supplies a muscle and its underlying bone, also supplies by its superficial branches the overlying skin and subcutaneous structures. If, through any cause, the deep lying branches of the artery become dilated, they will receive more than their due proportion of blood, and as a result the superficial
vessels will receive less than the usual amount of blood. The deep vessels will then be in the condition known as collateral hyperemia, while the superficial vessels are in a state of collateral anemia.

By suitable hydriatic applications these conditions may be induced at will and in any part of the body, superficial or deep. Cold applications when applied to the surface contract the superficial vessels, and induce collateral hyperemia in the deeper, underlying parts. It should be remembered, however, that when cold applications are greatly prolonged the cooling effects may extend to the deeper parts and by affecting the main arterial trunks may diminish the circulation in the entire area supplied, thereby, deeper as well as superficial.

Hot applications, on the other hand, dilate the superficial vessels, and thus produce collateral anemia in the related deep parts. If, however, the hot application is so long continued that the heating extends to the deeper structures, the main arterial trunks may be dilated and thus hyperemia may be produced in the entire area supplied thereby.

This principle may be operated not only in related parts which lie close together, but to remote parts as well, provided the proper vascular connection exists. For example, a hot application applied to the arms by dilating the vessels of the arms, will diminish the amount of blood passing to the brain through the carotids. A hot application to the feet and legs or the lower half of the body produces a still more marked effect upon the blood-supply of the brain. In like manner, the circulation of every organ of the body may be influenced.

**FLUXION**

By this term is designated the change in the distribution of the blood, whereby the amount of blood in any part, or the amount of blood passing through
any part may be increased or diminished by an opposite condition induced in some other parts. Four different modifications of the blood-supply of individual parts or organs are possible:

1. An increase of the volume.
2. A decrease of the volume.
3. An increased rate of blood movement.
4. A decreased rate of blood movement.

These several changes may be effected by inducing suitable reflex effects, or by induced collateral anemia or hyperemia, as may be required, or by combinations of the two methods. For example, if it is desired to diminish the volume of blood in any abdominal or pelvic viscus: (1) the vessels of the part may be reflexly contracted by a suitable cold application to the related skin surface; or (2) the volume of blood may be diminished by a hot application made over a part, the efficiency of which may be increased by extending it to the whole lower half of the body; or (3) both measures may be set in operation at the same time. A small cold application, as an ice bag, may be placed over the part, while a large hot application is made to the whole lower part of the trunk and legs.

The principle of fluxion is one of very great practical importance, and should be thoroughly mastered, as it renders the very greatest possible service in the treatment of acute visceral inflammations of all sorts, and the chronic passive visceral congestions which are so prominently present in various chronic disorders.
The areas which may be most effectively utilized for producing reflex effects have already been designated, and are shown in figures and .

The areas which may be usefully employed for producing fluxion effects from collateral anemia or hyperemia, are shown in figures and .

The most important vascular relations which may be utilized in practice are the following, the skin areas simply being so related to the vascular supply of the several organs named that induced hyperemia therein will lessen the volume of blood entering the deeper parts:

The brain. The skin of the face. The heating application must be short, and must avoid the neck, or an ice compress may be at the same time applied to the neck.

The eye-ball. The skin of the eye lids and the forehead.

The middle ear. The side of the head and face.

The internal ear. Heat to the arms with cold to the back of the neck.

Nasal cavity. The skin of the face and the sides of the head.

The pharynx. The skin of the face lying above the lower border of the inferior maxillary bone.

The application of heat to the neck must be carefully avoided when the purpose is to relieve congestion in any part of the head, for the reason that any such application dilates the large vessels of the neck which lie near the surface, and thus increase the blood-supply to the head.

The lar ynx. The over-lying skin, the arms, and the shoulders.

The lungs. The skin of the chest and the arms.

The kidneys. The loins.

The bladder. The sacrum, buttocks, lower abdomen, and thighs.

The rectum. The buttocks.

The stomach. The anterior surface of the trunk, extending from the middle of the sternum to the umbilicus, or two-thirds of the circumference of the body.
The intestines. The lower two-thirds of the trunk.
The portal circulation. The lower two-thirds of the trunk, the thighs, and the buttocks.

Any organ of the trunk or upper portion of the body. The entire surface below the umbilicus.
HYDRIATIC ANTAGONISMS.

The careful student of hydrotherapy soon becomes aware of the fact that every hydriatic application produces two opposite effects. This antagonism is the necessary result of the fact that the direct effects produced by a hydriatic application and the reflex effects are opposite in character.

For example, when a cold application is made over a viscus, the reflex effect is to contract the vessels and lessen the volume of blood contained in it; at the same time the cold application by contracting the blood-vessels of the surface, produces more or less retrostasis, and thereby tends to increase the volume of blood in all the internal parts. When a hot application is made for the purpose of producing collateral hyperemia of the skin and thus lessening the volume of blood in the related internal parts, there is at the same time a reflex dilatation of the vessels of the organ whereby the desired fluxion effect is antagonized.

The skilled hydriatic physician endeavors to mitigate these antagonisms in a variety of ways. In making a cold application for the purpose of producing reflex contracting of the vessels in the internal parts, care is taken to confine the application to the reflex area exclusively, and to make it as small as possible while accomplishing the desired purpose. Note is made also of the fact that a cold application to the surface not infrequently induces contraction not only of the vessels of that portion of the skin with which it is in contact, but in a much larger area, sometimes extending over nearly the entire surface of the body. Hence, care must be taken to keep the rest of the surface well warmed whenever a local cold application is made for the purpose of inducing internal reflex effects.

When, on the other hand, a hot application is made for the purpose of producing collateral hyperemia of the skin, thus lessening blood-volume in some
internal part, a very large application is made. Thus the drainage area is made sufficiently great to more than counter-balance whatever antagonistic effect may be induced by the reflex dilatation of the internal vessels.

The only method by which these antagonisms may be completely obliterated however, is by the simultaneous application of heat and cold by a method which was first described by the writer in his work on "Rational Hydrotherapy." In this method the reflex area related to the internal part which it is desired to influence, is covered by a cold application (ice-bag, ice compress, or cooling coil), while a hot blanket pack or some other hot application is made to the lower half of the trunk and the legs. By this means the beneficial effects of both methods may be set in operation at the same time, each assisting the other. The extensive hot application effectually prevents retrostasis and induces extensive collateral hyperemia, while the intense cold application causes vigorous contraction of the vessels of the internal part.

Antagonistic effects also arise in connection with applications for the modification of body temperature, general nervous irritability, and for producing various other effects. When, for example, a cold bath is administered for the purpose of lessening body temperature, while the cold medium lowers temperature by the abstraction of heat, it at the same time tends to raise the temperature by reflexly exciting heat production. The colder the application and the briefer its duration, the more intense is the effect in increasing heat production. Here again the skill and experience of the hydropathic physician is tested. By increasing the duration of the bath, by avoiding too low a temperature, the necessary amount of heat may be abstracted without great increase of heat production, and finally by lowering the temperature of the blood, heat production may be actually decreased.

In the employment of hot baths the opposite antagonism exists. While the reflex effect of the hot application is to diminish heat production, a long-continued hot bath by raising the temperature of the blood excites the activity of the thermogenic processes, and thus increases heat formation. Consequently
the hydriatic physician who wishes to avoid increasing the body temperature by a hot bath, takes care to make the bath of very brief duration, and to make the temperature high as the patient will bear, so as to intensify the reflex effect.

While these physiologic antagonisms may at first thought appear troublesome, yet careful study of the subject shows them to be most beneficent and necessary. A little calculation, for example, will show that if in perspiration heat production were not increased, the loss of heat by the evaporation of moisture from the surface of the body would be so great that the temperature of the body would quickly fall to a dangerous point. The opposing effects which are set up by the action of external stimuli render possible a nice balancing of the bodily forces whereby physiologic equilibrium is maintained.
HYDRIATIC TECHNIC.

In the therapeutic application of water it is of the highest importance that an exact, accurate, and so far as possible uniform technic should be followed. When employed in a desultory way or without attention to nicety of details, which to the novice might seem altogether unimportant, the effects are likely to be most disappointing. Excellent results may be obtained with the most simple appliances, and there is no remedy which so well adapts itself to emergency methods as does water. Nevertheless, for the attainment of the most highly satisfactory results, the most appropriate means and an exact method must be utilized. In harmony with the general principles of this work we shall not undertake in this section to describe all known, or even all useful, applications of water, but to present a careful description of those representative and important measures which are essential to constitute an efficient and complete hydriatic system.

Most hydriatic measures may be included in two general classes; first, those which produce purely thermic effects, and second, those which combine with thermic effects certain mechanical effects.

The first class comprises chiefly compresses, packs, and immersion baths. The second class includes douches of all sorts, and baths in which after the water application is added rubbing movements, either with the hand alone, or with a moist cloth in some form.

There may be said to be four complete sets or systems of hydriatic measures:

1. Immersion baths in which either the entire body or some part of it is immersed in water at varying temperatures.

2. Douches, in which water is applied to the body in the form of a jet, or a series of jets, or streams having greater or less force.

3. A variety of measures in which the water is brought in contact
with the body by means of wet cloths or other equivalent vehicle. This class includes packs, compresses, towel rubs, mitten frictions, sheet rubs.

4. Thermotherapy, comprising a variety of means whereby heat is communicated to the body—hot air, hot vapor, sunlight, electric light, etc.

There are a few miscellaneous measures which are not included in the above general classes, such as water drinking, the enema, and various allied applications comprising some of the procedures of massage and combinations of hydriatic and electrical procedures.

The above classification will be followed in describing the individual measures which are dealt with in this work.
THE COLD PLUNGE.

For best effects a roomy tank should be provided, filled with water to the depth of about five feet. The temperature should be 60° F. to 70° F. Lower temperatures are sometimes employed. In an establishment it is desirable to have two tanks, one at a temperature of about 60° F. and the other from 75° F. to 80° F. A useful modified plunge bath may be administered in the ordinary bath tub.

Method.—The patient, having been previously warmed by exercise or a warm bath, enters the plunge quickly, completely submerging the whole body, including the head. The submergence is repeated two or three times. In the intervals the patient rubs himself vigorously.

Duration: two or three seconds if the water is very cold; two or three minutes to twenty minutes if the water is above 75° F.

On emerging from the bath the patient should be quickly dried and vigorously rubbed. He should dress promptly and exercise vigorously for half an hour to promote good reaction.

Physiologic effects.—Powerful thermic reaction, exciting heat production and stimulating every vital function; raises blood-pressure; slows and energizes the heart; eases peripheral circulation and fixes blood in the skin; promotes leucocytosis and raises the opsonic index of the blood; increases blood count; raises the alkalinity of the blood; deepens respiration; increases the activity of the liver and kidneys; and causes contraction of the hollow viscera—bladder, bowels, stomach.

Therapeutic applications.—The short cold plunge bath (two seconds to 30 seconds) is a powerful tonic measure. It may be employed daily on rising by robust young or middle aged adults as a hygienic means. It is especially advantageous for persons whose employments are sedentary. It promotes appetite, and mental and muscular activity.

A prolonged cold plunge bath (5 minutes to 20 minutes) is of special
service in the treatment of obesity and in diabetics who are strong and little reduced in weight. The short cool plunge may be used as a means of cooling off after the electric light bath, the vapor bath, the Turkish bath, the sweating pack, or any other heating procedure.

A very short plunge (2 to 5 seconds) renders excellent service in neurasthenics in whom the skin is too sensitive to permit the use of the cold douche.

Cautions and contraindications.—The cold douche should never be administered without full knowledge of the patient’s condition. It should be avoided in cases of cardiac disease, diseases of the kidneys, arteriosclerosis, a recent history of pulmonary, gastric, or intestinal hemorrhage, and aneurism. It is also contraindicated in cases in which there is marked weakness, exhaustion, grave anemia, emaciation, posterior spinal sclerosis, and hepatic sclerosis. The cold plunge bath must always be avoided in cases of visceral inflammation, particularly inflammatory diseases of the liver, bladder, uterus, ovaries, fallopian tubes, or prostate gland, and in cases of acute or irritable skin eruptions. The very cold plunge bath is very likely to awaken neuralgic and rheumatic pains.

A cold bath should never be administered when the skin is cold, when sweating after violent exercise, or when the patient feels very great repugnance to contact with cold water.
THE IMMERSION OR FULL BATH.

This is one of the most ancient forms of bath. It was employed by Hippocrates. Antonius Musa cured the Emperor Augustus of chronic nasal catarrh by means of the cold bath. Dr. James Currie, of Liverpool, friend of the poet Burns, first made a scientific study of this bath in the latter part of the eighteenth century. He found it of such value in the treatment of fever, especially intermittent fevers, that he recommended it as superior to all other remedies.

Method.—Use an ordinary full bath tub. The length of the tub should be sufficient to permit the patient to lie with the limbs extended. If necessary a portable tub may be employed, but a tub may be constructed of wood, calking the seams with calk; a substitute for a tub may be improvised by means of a wooden frame supporting large pieces of rubber sheeting attached to the frame in such a way that the dependent portion rests upon the floor. Heavy ducking, oiled or painted, may be used as a substitute for rubber sheeting.

Temperature.—The temperature of the bath may be hot, cold, or neutral; or it may be gradually changed from hot to cold, or in the opposite direction. The temperatures most commonly employed are for the cold bath 80° F. to 68° F.; the neutral bath, 97° F. to 92° F.; the hot bath, 102° F. to 110° F.; the graduated bath 100° F. to 70° F.

There are several points to which special attention should be given:

1. The patient must be made comfortable in the bath by means of an air pillow for the head, and a pillow or a folded sheet or blanket beneath the shoulders, especially if the patient is emaciated. Ordinary hot water bags filled with air or with water may be used in place of the air pillow.

2. The amount of water should be sufficient to cover the entire body, including the shoulders. Any exposed portion will be chilled by evaporation, thus disturbing the effect of the bath.
THE COLD FULL BATH—BRAND BATH.

This bath differs from the plunge bath in that it is prolonged and the body is immersed only to the neck. This bath was employed by Currie in the treatment of fevers in the year 1797. He considered it the only treatment necessary in infectious fevers. Priestnits and his followers later employed the bath.

Method.—See directions for the immersion bath. The head, neck, face, and chest should be well bathed with very cold water, which should be applied to each surface several times during every half minute before entering the bath. The bath should be entered quickly and the patient should be vigorously rubbed during the entire time he is in the water, and if able, he should himself assist in the rubbing. It is well in this bath to have an extra attendant to assist in the rubbing.

A cold compress should be applied to the head during the entire bath, and should be frequently rewetted if the bath is prolonged. This is necessary to protect the brain from the powerful retrostasis or inward fluxion of the blood which is necessarily produced by this bath. In Germany it is a common practice to administer a few ounces of wine, or half an ounce to an ounce of brandy, a few minutes before giving the cold bath. This practice is pernicious and in no way contributes to the beneficial effects of this application. If the patient requires any preparation for the cold bath the best measure is a short application of heat to the surface by means of a hot sheet, or rapid hot sponge, or an affusion of hot water (102° F. to 106° F. over the whole surface of the body, just before entering the cold bath. Alcohol taken internally weakens the heart, lessens the tone of the vessels, adds to the work of the liver and kidneys, which are already overtaxed in cases of fever, hinders oxygenation and oxidation, lessens the energy of the nerve centers, and lowers vital resistance. Its effect is altogether evil and antagonistic to the
beneficial effects of the bath. Hence its use cannot be too strongly condemned. It is true that alcohol lessens the unpleasant impressions made upon the skin of the patient by the cold bath, but this is only at the expense of lowering nervous sensibility and activity, which is one of the pernicious effects produced by the fever itself, and to antagonize which the cold bath is administered. Hence the use of alcohol is most undesirable.

Temperature.—The temperature of the cold bath may be varied between 85° F. and 68° F. It is rarely necessary to employ a lower temperature than the last named. The higher temperature is used in fever patients and those who are not accustomed to cold water, and when purely sedative effects are desired without marked exciting effects. The temperature of the sea during the bathing season is often five or ten degrees less, and in some places rarely exceeds 75° F. Mention of this fact to patients helps to remove their prejudice to the bath.

Duration.—The duration of the bath may be five to ten seconds when purely tonic effects are desired, or ten to twenty seconds when strong sedative effects or decided nutritive changes are the effects sought, as when used to reduce temperature in fevers, to reduce flesh in obesity, or to stimulate the oxidation of sugar in diabetes.

Brand introduced the bath into hospital practice at Stettin during the Franco-Prussian war, since which time its use has rapidly extended. It is now recognized throughout the world as one of the most rational and efficient means of treating fevers, especially fevers of an infectious type. In many hospitals it is practically the only remedy used in the treatment of typhoid fever.

In the use of the cold Brand bath, there are certain modifications which should be mentioned. The chief of these are the following:

1. While care is taken to see that the patient's shoulders are
submerged, the patient is made to sit up in the bath every two or three minutes, or at least three times during the bath, at the beginning and the end and at the middle of the application, and while sitting up an attendant pours upon his head one to three quarts of cold water. The wet compress placed upon the head is arranged in such a way as to afford a sort of trough whereby the water will be drawn backward over the neck and spine. It is well also to dash a little cold water upon the front of the chest.

2. The bath is usually continued for ten to fifteen minutes, and is repeated every two or three hours, or as often as the patient’s temperature exceeds 101.5° F.

3. It is often advantageous to graduate the temperature of a series of baths by giving the first bath at a temperature of 85° F. and lowering the temperature a degree or two at each bath until a temperature of 70° F. or even 65° F. is reached. It is not necessary to give a bath at a lower temperature than 65° F. in order to produce all the antipyretic effects desired.

Physiological effects.—A short cold bath produces powerful thermic reaction; that is, it stimulates heat production. When the duration of the bath is not more than three to five seconds, the patient, unless very feeble, quickly becomes very warm by reaction, and if covered up is likely to perspire freely. It is possible by repeating the bath very frequently and prolonging it somewhat to produce a rise of temperature and conditions simulating fever. So it may be easily over-done. There is marked exhilaration and greatly increased muscular energy and capacity. A very prolonged cold bath causes a marked diminution of muscular excitability and energy. LeÀpine showed long ago that the cold bath increases the production of urea. Strasser has shown that the alkalinity of the blood, and hence vital resistance, are increased with the cold bath; and Wright has recently demonstrated that the opsonic index is raised by repeated cold baths.
The physiologic effects of the Brand bath, the most efficient form of the cold full bath, may be summed up as follows:

1. Increased activity of liver, kidneys, and skin.
2. Increased absorption of oxygen and increased elimination of CO₂.
3. Increased activity and energy of the brain and spinal centers.
4. Increased muscle tone and energy.
5. Improved blood formation and increased blood count, especially of white cells.
6. Increased alkalinity of the blood, and raised opsonic index.
7. Increase of blood-pressure, with slowing of the pulse and increased energy of the heart.
8. Increased heat elimination with increased heat production when the bath is continued sufficiently long to lower the blood temperature, which is necessary to produce decided antipyretic effects.

Following the example of Currie, Wright, and others, who one hundred years previously made use of the cold bath in the treatment of typhoid and other infectious fevers, Brand systematized and established this method in hospital practice at a military hospital at Stettin during the Franco-Prussian war, since which time its use has greatly extended, until now it has come to be universally recognized as one of the most efficient and successful methods of treating typhoid and other fevers due to infection.

It will be readily seen how that each of the physiologic effects produced by this bath may be utilized to the greatest possible advantage in the treatment of these acute febrile infections in which there is always lowered vital resistance, diminished alkalinity of the blood, lowered opsonic index, diminished blood-pressure, and a weak heart, often a greatly depressed condition of the nerves, with general weakness through lowered nervous and muscular tone and energy. Since the symptoms of these infectious disorders are chiefly due to the toxins which are produced by the specific organisms which are the
Note. Most of this about the treatment of fevers should be transferred to the chapter on fevers in the closing section of the book.
Immediate cause of maladies of this class, the use of a remedy which not only aids the elimination of these toxins but greatly increases the power of the body to destroy them, must be capable of rendering very great service.

In the employment of the Brand bath great care should be taken to disturb the patient as little as possible. He should be lifted from the bed into the bath and from the bath back to the cot or bed. The patient should never be allowed to walk, unless perhaps at the very beginning of the disease when his strength is still considerable.

The cold full bath (temperature 75° F. to 85° F.) may be employed in place of swimming and other hydriatic measures in the treatment of obesity and diabetes. It is of special value in the first named disease. When employed for reducing flesh the patient should sit up in the bath, rubbing himself vigorously over all parts of the body in rapid succession, lying down to rest occasionally for a few seconds. The muscles of the abdomen and limbs should be made tense. The patient should practise deep breathing in connection with the bath. The temperature of the bath should be lowered from day to day. It is advantageous to add two or three pints of salt to the water to increase the stimulation of the surface circulation, and to thus increase the tolerance of the patient for the cold bath.

When used for the reduction of flesh, two baths may be taken daily, preferably preceded by sweating bath of some sort. The duration of the bath should be fifteen to thirty minutes. It should be followed by exercise, preferably walking, in the open air from half an hour to an hour.

The use of this bath in diabetes should be confined to robust patients who are not much reduced in flesh. It should not be employed more than once daily, and the duration should not exceed ten or fifteen minutes.

The cold bath has been in favor among the peasantry of Europe for hundreds of years as a remedy for rickets in children. An ancient medical work recommends that rickety children should be dipped in cold water immediately
Add to the cold bath: A short cold bath is an excellent antidote for acute alcoholism. A bath of thirty to sixty seconds, accompanied by vigorous rubbing, will temporarily antedote the effects of alcohol intoxication to a remarkable degree. Sailors who fall overboard in a state of intoxication are sobered up at once.
In writing about fevers refer to the use of cold enemas by Jacques. See page 592 of Hydrotherapy, also Currie’s Epidemic of Typhus, page 530 of Hydrotherapy.
en being taken from the bed in the morning, and afterwards vigorously rubbed, and "now dipped every morning for a year." Aside from proper regulation of the diet and an outdoor life, no more efficient measure can be named than the cold bath, but when used for young children the temperature should not be lower than 75° F., and the bath should begin with a temperature of about 80° F.

Cautions and contraindications.—There are several important contraindications to which attention must always be given in the use of the cold bath. It should not be given to very young children nor to very aged persons. It is also contraindicated in great exhaustion, arteriosclerosis; when acute inflammation of any abdominal organ is present; in inflammation of the kidneys, either acute or chronic; painful disease of the bladder; cases of recent or threatened hemorrhage from the lungs, stomach, or bowels; valvular disease of the heart, myocarditis, cardiac edema, or other indications of cardiac weakness; acute or irritable cutaneous disorders; in hematuria; sweating and shivering; also in fevers when the patient is in a state of collapse with cold skin, or when a serious complication of any sort is present.
THE GRADUATED BATH.

This bath differs from the cold bath in that it begins at a temperature not much below that of the body and is gradually lowered until the minimum temperature is reached. It has been especially recommended by Ziemssen and Bouchard, who preferred it to the Brand bath in the treatment of fevers.

Method.—The preparation and general rules are the same as for the immersion bath. The initial temperature of the bath may be anywhere from 90° F. to 100° F., the temperature of the bath being lowered at the rate of one to two degrees a minute until 77° F. is reached, the patient being rubbed vigorously in the meantime. After the minimum temperature is reached the bath is continued for ten to fifteen, or even twenty minutes, until slight shivering begins.

This bath has some advantages over the Brand bath, chief of which are:

1. It does not produce sudden fluxion of the blood toward the interior of the body. Thus it is safer when there is danger of hemorrhage from sudden congestion of internal organs.

2. The blood pressure is not raised.

3. The discomfort to the patient is much less than in the Brand bath.

4. The lowering of the patient's temperature is as great and in some cases even greater than with the Brand bath. Cases are sometimes met in which the temperature seems to be little influenced by the Brand bath, but which yield to the graduated bath.

In certain cases the temperature of the graduated bath may be held at 85° F. to 88° F., instead of descending to a minimum temperature. But at this temperature the bath may be prolonged for an hour or more with most excellent effects in cases where the temperature cannot be otherwise controlled.

Physiologic effects.—The effects of the graduated bath are, the
lowering of bodily temperature; the promotion of activity of the skin, kidneys, heart, lungs, and other vital organs to raise vital resistance and to produce the general good effects which follow the use of the cold bath which have been elsewhere described. It is less exciting, however, has less effect in increasing heat production, and proves to be even more efficient than the Brand bath in lowering temperature. The average duration for producing these effects is about thirty minutes as compared with ten minutes by the Brand bath.

Therapeutic applications.—The graduated bath is almost exclusively employed in the treatment of fevers. Its range of application is wider than that of the Brand bath. It is more easily managed, more readily tolerated by patients, more efficient in reducing temperature, and is almost wholly exempt from the dangers which accompany the use of the very cold bath.

When it is desired to increase the exciting or invigorating effect of this bath this may be accomplished easily by employing a cold affusion with water at 60° F. or 70° F. just at the close of the bath. The patient should be at once put in bed, rubbed vigorously until warmed, and wrapped in blankets until full reaction occurs.

Cautions and contraindications.—The graduated bath is so moderate and safe a measure that it may be used in many cases in which a cold bath is contraindicated. In general, it may be said that the same cautions and contraindications mentioned in connection with the cold bath are required in the use of the graduated bath, but that the liability to injury is very greatly lessened by the graduated character of the bath, and only becomes prominent when other temperatures are employed at the conclusion of the bath.
The use of alcohol in connection with the cold bath.—In Europe many physicians recommend the giving of half a glass of brandy or half a glass of wine a few minutes before placing a patient in a general cold bath. Nothing could be more thoroughly unscientific than this practice, and it is to be hoped that this fact will be speedily recognized, and that the practice will be discontinued. Alcohol is the direct antagonist of cold water. There is no affinity whatever between the two agents. At the present time it is universally admitted that one of the most certain and uniform effects of alcohol is the lowering of blood-pressure. The conditions which demand the use of the cold bath are almost universally accompanied by low blood-pressure. One of the chief purposes of the cold bath is to raise blood-pressure by energizing the heart and by contracting the peripheral vessels. The action of alcohol is both to weaken the heart and to relax the small arteries. Hence, its effect is just opposite that of the cold bath, and when it is given the corrective effect obtained is in no way helped by the alcohol, but is hindered and depreciated by it.

Again, attention should be called to the fact that the most common use of the cold bath is for the lowering of temperature in typhoid and other infectious fevers. In such cases the body is already struggling against the influence of toxins generated by invading bacteria. Alcohol is a toxin produced by various microorganisms. When it is administered it adds to the embarrassment against which the vital forces are already struggling and in no way aids the body in its battle against the causes of disease. It is evident then that the use of alcohol is unwise, and that it should never be employed in connection with the full bath.

Feeble patients, who are thought by some authorities to need the use of alcohol may be prepared for the bath by a short hot application, which may consist of a hot enema, hot fomentation to the spine, a fomentation over the
abdomen, gentle, rapid hot sponge, or a short hot blanket pack. After the hot application the patient should be placed instantly in the cold bath before there has been time for cooling of the body by evaporation.
THE HOT IMMERSION BATH.

Though the importance of the hot bath has been long known, its exact value and its precise effects and limitations, have not been understood until within recent times. Within the last half century this interesting therapeutic measure has been carefully studied and its use has been widely extended. The ancient Romans made great use of the hot bath, probably more as a luxury than as a therapeutic measure. However more agreeable than the cold bath, a lack of knowledge of how to avoid certain inconveniences which are likely to follow its improper use, has created even among primitive peoples, a well-founded prejudice against it.

Method.—The requisites are the same as for the cold immersion bath, with a few additions. An abundant supply of hot water is needed so that if necessary the temperature of the bath may be raised by the addition of hot water after the patient enters it. Provision must always be made, also, for the application of a cooling measure of some sort at the close of the bath. With very few exceptions a cold application of some sort must be made after every hot bath, and occasions for the quick application of cooling measures may arise in any case.

When it is intended that the patient should perspire, a glass of water should be taken before the bath and half a glass of water should be given every five or ten minutes during the bath.

Immediately after the patient enters the bath a towel well saturated with cold water should be applied to the head and face. In cases in which there is a tendency to cerebral congestion, or in which it is especially important that the brain should be protected, ice cold water should be applied over the eyes with a compress and an ice collar should be applied about the neck. The compress should be frequently changed so as to maintain the cooling effect.
Ice bags should be kept over the heart when the patient is feeble. This is always a wise measure in cases in which the bath is frequently repeated, as it prevents the depressing effect of the hot bath upon the heart.

Temperature.—A bath at a temperature of $98^\circ$ to $104^\circ$ F. is designated simply as a hot bath. A bath above $104^\circ$ F. is called a very hot bath. The maximum temperature of the bath is rarely greater than $106^\circ$ F. or $110^\circ$ F., though a temperature of $112^\circ$ F. to $114^\circ$ F. may be tolerated for a few minutes and is sometimes indicated. The native Japanese, who employ the hot bath almost daily, tolerate a temperature of $115^\circ$ F., and even higher temperatures, apparently without injury.

In giving a very hot bath the patient should enter the bath at a temperature two or three degrees above that of the body—$100^\circ$ F. to $104^\circ$ F. By the addition of hot water the temperature of the bath should then be raised until it is as hot as can be borne without discomfort. After one or two minutes a still higher temperature will be tolerated. At intervals of one to two minutes the temperature of the bath may be still further raised by the addition of hot water until the desired temperature is reached. When it is desired to induce sweating the temperature may be first raised, then lowered a little, always maintaining a temperature above that of the body. When perspiration is once started it may be continued at a temperature only slightly above that of the body, and thus the effects of over-heating the blood may be avoided.

A general full bath at $120^\circ$ F. is dangerous to life. Such very high temperatures should never be employed except under the supervision of a physician, and cooling measures should be ready at hand for immediate application if required.

Duration.—The duration of the hot bath depends upon the effects desired. In general, hot baths must be of short duration. Very hot baths must never be prolonged more than three to eight minutes.
Physiologic effects.—The hot full bath is strongly exciting. The nervous system, and through it the heart and blood-vessels, and most of the bodily functions, are powerfully excited by the contact of the hot water with the whole surface of the body. The elimination of heat is of course prevented and hence there is a rapid rise in the body temperature. The heating of the blood leads to increased heat production, and excited general cellular activity, increasing the production of urea through the oxidation of albumin. The small vessels of the skin and the skin itself are greatly relaxed. The perspiratory glands are excited to activity; blood-pressure is lowered; there is a strong fluxion of blood toward the skin, which is capable of holding two-thirds of all the blood in the body; and the volume of blood circulating to the brain, lungs, liver, and other internal parts is very considerably diminished.

When the temperature of the bath is raised to 112° F. or 113° F. or even higher, there is a marked diminution in cutaneous sensibility.

The pulse rate is always increased during a general hot bath. The rate lowers a little after perspiration begins. A short hot bath relieves the sensation of fatigue, and increases muscular contractility and energy.

A prolonged very hot bath lessens muscular contractility and energy, and produces great exhaustion. Frequently repeated and prolonged hot baths tend to produce exhaustion, weakness, loss of appetite, anemia, and loss of flesh. The formation of hydrochloric acid by the glands of the stomach is diminished; the volume of urine is decreased, and the stools are rendered more solid, and may become so dry as to produce constipation through the increased absorption of water by the intestinal mucous membranes.

When the hot immersion bath cannot be administered practically identical effects may be obtained by giving a hot blanket pack, a hot sitz bath combined with a hot foot bath, large fomentations to the abdomen or back, and by copious water drinking combined with the dry pack.
Therapeutic effects.—The short hot immersion bath may be employed as a preparation for a tonic application of cold water, but the vapor bath, the electric light bath, the wet sheet pack, the hot shower, or some other heating measure is more generally employed for this purpose. When used as a preliminary heating measure, the duration should be such as to produce a general sensation of warmth without inducing perspiration. The best effects are obtained by allowing the water to run into the tub until the temperature is as great as the patient can comfortably bear, taking care to keep the water in the tub in constant motion so that the hot water will be constantly distributed. A cold application should be made immediately on removing the patient from the bath, so that the skin shall not be chilled by evaporation.

A hot bath is one of the best of all known means of relieving visceral pains. It succeeds in many cases in which fomentations and other local applications fail. Hence it should be tried in all suitable cases before resorting to the use of a narcotic. This bath is a veritable hydriatic analgesic. It acts by inhibiting pain, and since the application involves almost the entire surface of the body, a great multitude of pain inhibiting impulses are sent in through the thermic nerves. The pain of pleurisy, gastric ulcer, gall stones, biliary gall stones, inflammation of the gall bladder, renal colic, intestinal neuralgia, chronic inflammation and neuralgia of the bladder, ovarian neuralgia, general neuritis, lumbago, and sciatica, rarely fail to yield to the hot immersion bath. When necessary the bath may be repeated three or four times a day. Following the bath a large, well covered heating compress may be applied over the seat of pain. For the best effects the bath should be of rather brief duration, two to six minutes, and the temperature should be as high as the patient can bear. Great care should be taken to protect the head during the bath.

The short hot full bath is an excellent means of relieving the intense
itching of the skin which accompanies jaundice. The bath should be short, and the temperature as high as the patient can bear. The higher the temperature the better the effect. This bath is also of service in all forms of pruritis unattended by eruption of the skin. It may be usefully employed in cases of eczema, in which there is considerable burning and itching, with dryness and thickening of the skin. The hot bath should not be employed when the diseased surface is moist or oozing. When used for this purpose the bath should not be followed by a cold application, but if a cold application is necessary, care should be taken to avoid the affected parts when the whole skin surface is not involved. When the whole skin is involved, the patient may be cooled off by wrapping in a light blanket, or by applying dilute alcohol or some other evaporating lotion.

The hot bath is of great service in acute rheumatism, both muscular and articular. In these cases the bath should be prolonged sufficiently to produce perspiration, and after the bath the patient should be placed in bed, wrapped in blankets, and allowed to perspire freely for an hour or two, or even longer. The skin is a most important channel for the elimination of the lactic or sarcolic acid which is produced in excessive quantities in this disease. It is now generally conceded that salicylic acid and the salicylates and allied drugs accomplish nothing more in these cases than to relieve pain. The hot bath generally affords greater relief than do the salicylates, and in addition greatly assist the body in its defensive efforts. If it is ever necessary to employ salicylates or pain relieving drugs of any sort, a hot bath should not be omitted. Their systematic use modifies the intensity of the disease in a most marked degree, cuts short its duration, and renders the patient so comfortable that if drugs are required at all the amount and frequency of the doses are greatly diminished.

Acute nephritis is another common malady in which this bath renders great service. It is especially useful in the nephritis which often
complicates scarlet fever. The patient should be placed in the bath a few
minutes then transferred to the bed, wrapped in blankets, and made to perspire
for several hours continuously. Perspiration must be encouraged by water
drinking, and by the use of the enema.

Renal dropsy affords an excellent opportunity for utilizing the
eliminative properties of the hot full bath. Modern researches have shown that
in this condition there is a retention of chlorid of sodium. The crippled
kidneys are unable to remove the sodium chlorid from the blood in the proper
amount, and it is forced out into the tissues. The retention of salt
occasions also retention of water. By inducing vigorous perspiration both
salt and water may be removed from the tissues, and thus the dropsy will be
relieved.

It is important, of course, in this condition as well as in acute
nephritis, to withdraw as speedily as possible sodium chlorid from the dietary.
The patient should be fed buttermilk, fruit juices, water gruels and other
liquids from which salt is carefully excluded.

In all cases of renal dropsy with chronic weakness, the hot full bath
can be used. Partial heating measures are necessary to avoid depression of
the heart.

Very short, very hot baths, followed by cold rubs, afford wonderful
relief in chronic bronchitis. The bath should never be prolonged to the
sweating stage. Tonic and derivative effects are desired rather than the
eliminative effects. In acute bronchitis and common "cold," also incipient
influenza, or grip, the hot full bath carried to the sweating stage is a most
effective means of cutting short the disease. The bath should be followed by
a cold affusion of 80° F. to 75° F.

The hot immersion bath renders valuable service in infantile convul-
sions. The infant should be immersed in the bath for a minute or two, or
until the skin is well reddened. Then it should be held up while a quart or two of water at 80° F. is dashed over it.

In cerebro-spinal meningitis the hot bath renders better service than perhaps any other measure. The bath should be administered several times a day at a temperature of 100° F. to 102° F., so as to produce strong fluxion to the skin. Ice bags should be applied to the head and neck during the bath. The duration of the bath should be eight to fifteen minutes. After the application the patient should be quickly transferred to the bed, care being taken to avoid chilling, and heating compresses should be applied to the legs and trunk so as to continue the derivative effect produced by the bath. The compresses should be employed continuously during the interval between baths.

The hot bath at a temperature of 99° F. to 102° F. is a useful means of relaxing the tissues in strangulated hernia. While the patient lies in the bath with the legs well drawn up and the head supported, the usual manipulations are often successful in replacing the intestine so that operation may be postponed until the patient can be properly prepared.

In cases in which the abdominal muscles are abnormally tense, the hot bath facilitates the examination of the abdominal contents. Not infrequently it is possible to detect a distended gall bladder and small gastric tumor and intussusception, or other abnormality of the intestinal tract by manipulations practised with the patient in the hot bath. Without the assistance thus rendered no abnormality could be discerned.

Eminent French obstetricians recommend the hot bath (100° F. to 104° F) as a means of relieving pains, or profuse discharge which sometimes follows child birth in feeble women. In these cases the bath should be followed by a cold mitten friction, or a cold towel rub.

A very short hot bath (temperature 104° F. to 108° F., duration twenty to sixty seconds) may be advantageously used in certain highly sensitive neurasthenics with whom cold water cannot be employed. Administered in this
way the bath is tonic in its effects, for this purpose it is inferior in most
cases to the hot douche, the tonic effects of which are much more pronounced.
It is to be used for tonic effects only when the hot douche is not available
for some reason contraindicated.

Cautions and contraindications.—The most important contraindication
of the hot bath is cardiac weakness. It must always be avoided in cases of
broken compensation, indicated by great shortness of breath or swelling of the
feet.

Anuria and marked arteriosclerosis, indicated by hardening of the
arteries or extremely high blood-pressure, are also contraindications for the
hot full bath. In such cases general heating to the amount needed, as a
preparation for the cold bath, may be secured by such local applications as
the hot full bath, fomentations to the spine, and hot sponging. The
general hot bath must be avoided.

The general hot bath is also contraindicated in cases of cerebral
appoplexy, also in cases in which the patient has recently suffered from
pulmonary hemorrhage.

In general, this bath is contraindicated in chronic disorders of
the brain and spinal cord, and in cases of pernicious anemia, and as a system
of treatment in chronic rheumatism, or arthritis deformans.

When employed in cases of acute nephritis, the duration of the bath
should not be prolonged (not more than three to eight minutes), and extreme
care should be taken to prevent chilling of the skin by evaporation when
removing the patient from the bath to his bed.

General cold applications being contraindicated, the patient must be
allowed to cool by evaporation while lightly covered with a blanket or by
applying gentle rubbing with dilute alcohol or some other evaporating lotion.
THE NEUTRAL IMMERSION BATH.

This bath derives its name from the fact that its temperature is very near that of the body. It was first systematically used by Currie, who gives an excellent description of the bath in his "Medical Reports."

Method.—The same preparations are needed as for any immersion bath. The special aim of the bath is to submerge the patient in water at a temperature so near the ordinary skin temperature that he will receive no impression, either of hot or cold. As the purpose of the bath is usually to produce a quieting effect, rubbing should be avoided, and the patient should be kept as quiet as possible. Hence it is important that he should be made as comfortable as possible in the bath. This requires that he should be properly supported with air pillows or water bags, so placed that the patient will be perfectly at rest. Absolute quiet should be observed. The patient should be asked to keep his eyes closed, and a napkin should be placed across the forehead so as to shield the eyes from light. When the head is hot the napkin should be moistened in cool, not cold, water.

Temperature.—The temperature of this bath has a very narrow range, from $92^\circ$ F. to $97^\circ$ F. The temperature should not fall below $92^\circ$ F., but it is sometimes advantageous to begin the bath at a temperature of $100^\circ$ F., so as to prevent even the slightest chill on first contact of the water with the skin. After fifteen or twenty seconds the temperature may be gradually lowered to $94^\circ$ F. or $95^\circ$ F., which is the average temperature at which the bath should be given. Emaciated and feeble patients usually require a higher temperature than those who are robust and fleshy. A patient who feels chilly when the clothing is first removed will require a bath at a slightly higher temperature ($95^\circ$ F. to $97^\circ$ F.), while one whose skin is hot and who feels feverish will require a temperature of $92^\circ$ F. or $93^\circ$ F. This bath requires very exact adjustment of temperature to individual cases. A difference of one or two degrees will
often determines success or failure.

Duration.—In general the bath is considerably prolonged. The duration may vary from fifteen to thirty minutes or several hours, or even a number of days, weeks, or months.

Special care should be taken to keep the entire body submerged. Any exposed surface will chill by evaporation. It is especially important that the shoulders shall be covered.

Extraordinary care must be taken that the patient is not chilled when removed from the bath by evaporation of moisture from the skin. He should be taken out quickly and instantly wrapped snugly with a Turkish sheet. The sheet should be tucked closely around the sides, limbs, neck, and feet, so as to touch the surface everywhere, and exclude the air. If the room is cool a woolen blanket should be thrown over the patient, but care should be taken to avoid over-heating. In drying the patient gentle patting movements should be employed rather than slapping or vigorous friction. When the bath is given for insomnia the patient should be got to bed as quickly as possible.

When the bath is considerably prolonged care must be taken to consult the bath thermometer frequently so that the temperature of the bath shall not vary more than a degree. The temperature of the ordinary bath, forty gallons of water, may be lowered one degree by the addition of five quarts of water at ordinary pipe temperature (60° F.). Two quarts of boiling water will raise the temperature one degree. In adjusting the temperature of the bath, great care must be taken to avoid exceeding the limits of the neutral zone.

Physiologic effects.—The temperature of the bath is so near that of the body that the abstraction of heat is only sufficient to keep pace with the normal heat production. Hence the temperature of the body is ordinarily not at all affected by the bath.

In cases of fever, however, the situation is different. The skin temperature is higher than the normal, and heat production being increased, the
the bath becomes a valuable means of lowering the temperature.

The absorption of water by the skin lessens the sensibility of the cutaneous nerves, and thus diminishes reflex irritation from the skin. The absorption of water also encourages the action of the kidneys and the elimination of toxins.

Though more than one hundred years have elapsed since Currie pointed out the great value of this bath as a soothing and sedative measure, it is still but little employed. Those who have made use of it and have witnessed its wonderful sedative effects place a higher estimate upon it as a means of relieving nervous irritability, insomnia, and allied conditions, than any sedative or hypnotic drug known.

This bath has recently been adopted in a large number of insane asylums, especially in the treatment of insomnia and acute mania. The extraordinary results obtained have led to the almost total disuse of hypnotics in a number of the largest State hospitals for the insane. The writer believes that he was one of the first in the United States to make use of the bath for this purpose, having employed it in these cases for more than twenty-five years. Not infrequently persons who have not slept for days, and in whom hypnotics have not produced the desired effects, have fallen asleep within a few minutes after being placed in this bath. If sleep does not come quickly, however, the bath may be continued for an hour or several hours without any ill effects whatever, and with the happiest results in the end. But the greatest care must be taken that the patient is not in the slightest degree chilled, and that he is made as comfortable as possible. Too short a bath tub, compelling the patient to lie in a cramped position, may be the cause of failure. This bath was used for inducing sleep by the famous Hippocrates more than twenty-three centuries ago.

When employed to induce sleep the best time for the bath is at bed time. If necessary, it may be repeated several times during the night. Not infrequently the patient falls asleep in the bath. He should not be awakened, but...
should be allowed to sleep as long as possible. No harm will be done if he
remains several hours in the bath. Sleep in the neutral bath is in the highest
degree refreshing. From personal experience the writer has acquired the
impression that an hour’s sleep in the neutral bath is equivalent in recuperative
effects to a sleep of at least twice that duration in bed. The shutting off of
all external impressions, even such as result from contact of the bed with
the skin, places the brain and central nervous system in a state the most
favorable possible for rest and repair.

The neutral bath is also of great value in chronic diarrhea, chronic
auto-intoxication, all forms of organic disease of the brain and spinal cord,
chronic rheumatism, rheumatoid arthritis, and in hypersensitive neurasthenics.
It often relieves pruritus, especially when not attended by an eruption, and is
useful in chronic urticaria.

The bath may be employed as a means of lowering the temperature in
fever when for any reason the general cold bath or the cooling pack are not
desirable. When employed for this purpose the bath should be continued for
from one to several hours, or until the temperature is lowered.

This bath is of great value in chronic arteriosclerosis, in anemia, and
exhaustion. Effects similar to those obtained from the neutral immersion
bath may be obtained by the neutral pack and the neutral shower or douche,
elsewhere described.

Cautions and contraindications.—No reaction follows the neutral bath.
Indeed, great care is taken to avoid producing either circulatory or thermic
reaction, so as to avoid the nervous excitement which necessarily attends
reaction. On this account extraordinary care must be taken to avoid chilling
the patient by evaporation after the bath. The slightest chill or even the
sensation of cold may be quite sufficient to destroy all the good effects which
have been secured by the bath.

There are very few conditions in which this bath is contraindicated, but
its administration requires the greatest skill and care. The ability to give a good neutral bath is the highest test of the technical ability of a nurse trained in hydriatic procedures.
THE CONTINUOUS BATH.

This bath is a neutral bath, the duration of which is greatly extended. Constant immersion of the body at a neutral temperature may be safely prolonged for an indefinite period. On visiting the great skin hospital in Vienna in 1883 the writer found a patient under the care of the renowned dermatologist Hebra, lying in a continuous bath in which he had been immersed for thirteen months. He had nearly recovered from a terrible burn which involved a large portion of his skin.

Method.—The bath tub should be sufficiently long so that the patient can lie at full length with the shoulders immersed. If the tub is too long for the patient a proper support may be introduced at the foot of the tub against which the feet may rest. It is necessary that every means shall be adopted to make the patient comfortable.

A pair of large pillows or water bags filled with water at the temperature of the body, may be placed around the patient, or he may be supported by sacks filled with excelsior or mattress hair. When the bath is to be continued for a considerable time, a hammock can be constructed with a small piece of ducking. The hammock can be supported in a frame laid over the top of the bath tub and attached to it.

The temperature of the water must be carefully watched, so the patient shall not be chilled or over-heated. Variations should be kept within 93° F. to 96° F. When possible arrangement should be made to secure a constant inflow and outflow of water, so that the skin secretions may be carried away. The bath water should be entirely changed at least every twenty-four hours. The patient should of course be removed from the bath at intervals for evacuation of the bladder and bowels. The skin should be rubbed with vaseline at least once a day to prevent maceration, and a soap shampoo should be administered once a week.
Physiologic effects.—The effects of this bath are the same as those which have been described for the neutral bath. As Claude Bernard, the great French Physiologist, remarked many years ago, "All life is under water." The living tissues and organs of the body all do their work under water. When the body is weakened by contact with water, it is not the water itself which produces the evil effects, but the abstraction of heat from the body by water at a low temperature, or the communication of it by the use of water at a temperature higher than that of the body. Water at a temperature near that of the body cannot possibly produce any deleterious effect whatever.

Therapeutic applications.—The continuous bath has been used with excellent success by Hebra, Kaposi, Passavant, Ries, Dauches, and others, in a great variety of cases, and has proved particularly successful in cases of extensive burns, pemphigus, gangrene of the skin, spinal sclerosis, locomotor ataxia, paraplegia, hemiplegia, apoplexy, chronic sciatica, hyperesthesia of the skin, anemia, delirium, renal dropsy, chronic diarrhea, chronic rheumatism, rheumatoid arthritis, bed sores, neurasthenia, psoriasis, eczema, hysteria.

It is a safe remedy, and it may be employed without fear of any ill consequences. Recently some remarkable results have been reported from the use of this bath in the treatment of the chronic insane. It is probable that in most cases of chronic disease auto-intoxication is the fundamental cause. The continuous bath is beneficial through improving the action of the kidneys and increasing the alkalinity of the blood whereby there is improved destruction and elimination of the mischief making toxins.

In typhoid and other continuous fevers in which the temperature is not controlled by other means the continuous bath must be resorted to with almost certain assurance of success. The writer is able to report admirable results from the prolonged neutral bath in a number of cases of this sort in which the cold bath or cold pack, and even the graduated bath of Bouchard had been employed without marked success.
THE EFFERVESCENT BATH.

This bath is ordinarily administered as a neutral or tepid immersion bath, the ordinary effects of which are reinforced by chemical irritation of the skin by carbonic acid gas and various alkaline salts dissolved in the water.

The special effects of this bath were first studied scientifically by Schott at Nauheim, who especially applied the bath in certain forms of chronic disease. It is now known, however, that precisely the same effects of the baths at Nauheim may be secured anywhere by adding to the water suitable compounds whereby an effervescent solution in every respect similar to Nauheim water may be obtained. The writer has made himself familiar with this bath both at Nauheim and through the use for many years of the artificial bath, and is thoroughly convinced that the natural water has no advantages whatever over the artificial preparation.

Method.—Baths of varying degrees of intensity may be prepared, according to the effect desired. The material necessary for the following simple preparations may be obtained at any drug store:

1. Chlorid of sodium, 4 lbs.; chlorid of calcium, 8 lbs.; sodium bicarbonate, 1/2 lb.; to which is added commercial hydrochloric acid (25 per cent.), 3/4 lb.

2. Chlorid of sodium, 8 lbs.; chlorid of calcium, 12 lbs.; sodium bicarbonate, 1 lb.; commercial hydrochloric acid, 1 1/2 lbs.

3. Chlorid of sodium, 12 lbs.; chlorid of calcium, 20 lbs.; sodium bicarbonate, 2 lbs.; commercial hydrochloric acid, 3 lbs.

When a zinc or copper tub is employed the amount of bicarbonate of soda must be increased one-fourth to one-third, so as to protect the metal from the action of the hydrochloric acid.
In preparing the bath first regulate the temperature of the water, which should be about 92° F. to 86° F., or a little lower than for an ordinary neutral bath. The bicarbonate of soda, the chlorid of sodium, and the chlorid of calcium, should first be dissolved in the water. The hydrochloric acid should then be added. It should be noted that the weight of the hydrochloric acid should always be one and one half times that of the bicarbonate of soda. In adding the hydrochloric acid, invert the bottle containing it and place the mouth of the bottle without removing the stopper just below the surface of the water; then remove the stopper, and rapidly move the bottle back and forth over the entire surface of the bath, taking care to keep the mouth of the bottle always beneath the surface. As the acid is heavier than the water it will run out of the bottle, its place being supplied with water, and so by the method suggested may be evenly distributed throughout the whole bath. The bath will be ready for the patient to enter within five minutes after the hydrochloric acid is added. It should be remember that the patient is not benefited by the carbonic acid gas which bubbles up throughout the water, but rather by that which is dissolved within the water.

There are various other preparations which may be used for producing the effervescent bath. The following is a good formula:

**Formula for one Powder.**

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<table>
<thead>
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<tbody>
<tr>
<td>Sodium carb. (sal-soda)</td>
<td>1 1/2 lbs.</td>
</tr>
<tr>
<td>Sodium bicarb.</td>
<td>1/2 lb.</td>
</tr>
<tr>
<td>Calcium chlorid</td>
<td>3 lbs.</td>
</tr>
<tr>
<td>Sodium chlorid</td>
<td>2 lbs.</td>
</tr>
<tr>
<td>Sodium bisulphate</td>
<td>1 lb.</td>
</tr>
</tbody>
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Mix and dissolve the first four ingredients; then add slowly the sodium bisulphate, which should be kept by itself. It is not desirable to produce very marked effervescence, but rather to secure the saturation of the water of the bath with CO₂. The carbonic acid gas is produced by this formula very slowly, so that it is nearly all absorbed by the water, thus making the method an economical one.
Various excellent preparations for producing the effervescent bath are on the market and are sold by druggists generally.

If the patient is out of breath from exercising, the breathing should become tranquil before the bath is administered. Care should always be taken to rub the chest with cold water before putting the patient in the cold water, and to rub the patient's limbs during the bath. Strong patients may take two or three daily baths in succession, but feeble patients cannot make profitable use of the bath more than two or three times a week. In very feeble patients the temperature of the first baths should be made 94° F. or 95° F. The temperature of each successive bath is made one degree lower.

Duration.—The length of the bath depends upon the strength of the patient, and is usually from five to fifteen minutes. The patient should not become chilled in the bath. He should be rubbed during the bath and at the conclusion of the bath—the skin should be rinsed off by an effusion of water at a temperature of five or ten degrees below that of the bath itself, after which the patient should be wrapped in a Turkish bath sheet and gently rubbed or massaged, and allowed to rest for an hour. The rubbing should be administered carefully so as to avoid over-heating and subsequent chilling.

Physiologic Effects.—The effects of this bath are those of the ordinary water bath of the same temperature and duration, to which are added the reflex vasmotor effects induced by the chemical irritation of the skin. The intensity of the bath depends chiefly on the amount of chloride of calcium present.

The principal advantage of the chemical irritants seems to be that the bath is tolerated at a temperature several degrees lower than other water is employed. Thus more powerful reflex effects are produced than when fresh water is used. Through the stronger reaction resulting, more intense fluxion to the skin is secured, thus affording relief to the over-distended heart in cases of cardiac dilatation. To be able to produce these powerful derivative effects without the application of heat to the surface is of very great advantage.
in cardiac cases.

Therapeutic applications.—The great value of the effervescent bath in carefully selected cardiac cases is now universally recognized. Of course, the same effects may be produced by the rubbing wet sheet, the towel rub, the half sheet rub, the mitten friction, the shallow bath, and the douche, and by judicial management of the measures named one may perhaps accomplish all that can be accomplished by the effervescent bath. Nevertheless, this bath produces characteristic effects which it procures more conveniently and more readily than by other means, and hence it is a valuable addition to the hydriatic method.

Its use is not, however, restricted to cardiac cases. In auto-intoxication with general visceral congestion, in obesity, in pernicious anemia, rheumatoid arthritis, and in hepatic dropsy, it has been of valuable service. It must be admitted, however, that the greatest triumphs of this bath have been secured in cases of cardiac insufficiency.

Cautions and contraindications.—Great care must be taken to avoid over-heating the bath. This measure should rarely be administered more than two or three times a week. It should never be given when the patient is exhausted, or when the breathing is much disturbed. The slightest increase of cyanosis during the bath should lead to the patient's immediate removal. In such cases the patient should be carefully watched to prevent chilling, and the patient's limbs should be well rubbed, taking care not to produce fatigue. If necessary, gentle passive breathing movements may be administered to assist respiration.

The best results from this bath are obtained in connected with a dechlorinated diet; that is, a diet from which ordinary cooking salt is entirely excluded. Careful experiments by numerous prominent investigators have shown in recent years that the food taken in its natural state contains a sufficient amount of sodium chloride, more, in fact, than the body actually requires. So
the addition of sodium chlorid is unnecessary. When the heart and kidneys are crippled there is liable to be retention of sodium chlorid in the tissues, which is the most common form of dropsy.

The oxygen bath.
THE SHALLOW BATH.

This is a partial cold bath in which the patient sits with the limbs extended in cool or cold water, being at the same time vigorously rubbed. This is one of the excellent procedures perfected by Priesmills—utilized wherever scientific hydrotherapy is employed. The so-called Brand bath is really nothing more than a modification of the shallow bath of Priesmills.

Method.—The requisites are a full bath tub, preferably one not too deep, containing about four inches of water at the proper temperature, a Turkish sheet, a blanket, two or three towels, and a large dipper.

Temperature.—The temperature of the bath should ordinarily be 80° F. to 73° F. In well-trained, robust patients, the temperature may be reduced to 65° F., but the duration of the bath should be very short. In beginning a series of baths with a patient who has not had previous training in cold bathing, the higher temperature (80° F.) should be employed. The temperature of the bath may be lowered one or two degrees daily until a temperature of 73° F. or 74° F. is reached. It is not ordinarily necessary to use lower temperatures.

Duration.—When employed as a means of reducing temperature the bath may be continued for ten or fifteen minutes. The most common use of this bath is as a tonic, for which the duration should be short, not more than one to three minutes.

For each minute of the bath the following program should be followed:

While the patient sits upright in the bath the assistant rubs his legs, hips and thighs vigorously for twenty seconds, going rapidly over the entire surface several times during this period. He then rubs the back for ten seconds. He then dips from the tub and pours over the patient's back in quick succession three dipperfuls of water and vigorously rubs the back and shoulders, occupying about ten seconds. He then rubs the sides for ten seconds.
The patient then lies down, and the attendant again rubs the legs for ten seconds. The patient rubs his own arms, chest, and abdomen vigorously during the entire bath, frequently dipping his hands in the water.

If the duration of the bath is to be one minute only the patient is now removed and dried; if not, the same program is repeated: once more if the length of the bath is to be two minutes, or three times for a three-minute bath.

The patient should be prepared for this bath by a hot foot or sits bath, a wet sheet pack, an electric light bath, a fomentation to the spine or abdomen, or by some other heating procedure. Vigorous patients may warm themselves by exercise, but in general a warm bath of some sort is preferable.

After the bath the patient is wrapped in a Turkish sheet and rubbed vigorously, special attention being given to the extremities. Unless feeble the patient should dress quickly and exercise for half an hour so as to promote good reaction. If feeble, the patient is wrapped in blankets for an hour, or until reaction is established. If necessary, hot water bottles may be placed at the extremities. This is rarely needed if the patient has been properly rubbed during and after the bath.

The vigor of the bath may be increased by the employment of two attendants, one rubbing the legs while the other rubs the back and sides. A dash of water ten degrees lower than that of the bath over the shoulders and legs just before the patient enters the bath promotes quick reaction, and adds to the comfort of the patient, as the water of the bath feels very comfortable, being ten degrees higher than that of the affusion.

In the standing shallow bath the patient stands in a tub of water at $75^\circ$ F., while water at a temperature of $80^\circ$ F. to $75^\circ$ F. is poured over his spine, chest and shoulders at intervals of fifteen seconds, two attendants rubbing vigorously in the meantime, one giving attention to the trunk, while the other rubs the legs. At the conclusion of the bath water five degrees
colder than that employed during the bath is poured over the patient, after which he is quickly dried and vigorously rubbed until thorough reaction appears.

Physiologic effects.—This is one of the most powerful of all hydriatic procedures. It is really a very admirable method for which the world is indebted to the genius of Plessmits. The low temperature produces a powerful thermic reaction, while the vigorous rubbing increases circulatory reaction, and thus most vigorous tonic alternative effects are induced. During this bath the force and depth of respiration is greatly increased, the blood-pressure raised, the arteries energized, and the brain and nervous system are powerfully stimulated. There is no other hydriatic measure except the douche which produces more powerful effects, or which accomplishes so much in so short a time.

Therapeutic applications.—The tonic effects of this bath render it extremely useful in nearly all forms of chronic disease. It is especially valuable in Neurasthenia and in chronic dyspepsia. It increases appetite and digestive vigor, and promotes assimilation.

This bath is especially indicated in anemia, chronic auto-intoxication, hepatic and other forms of visceral congestion, chronic bronchitis, constipation, diabetes, obesity, and as a means of cooling the skin after applications of all sorts.

Cautions and contraindications.—This bath is contraindicated in arteriosclerosis, aneurism, organic disease of the heart, congestion of the brain or spinal cord, in acute congestion or inflammation of the pelvic region, sciatica, ovarian neuralgia, menorrhagia, bleeding fibroids, uterine cancer, and all forms of acute visceral inflammation, as of the stomach, liver, kidneys, bowels, bladder, ovaries, fallopian tubes, gall bladder, etc.
THE HALF BATH.

This bath differs from the shallow bath in that the rubbing is omitted and the temperature of the bath is usually above that of the body.

Method.—The requisites are the same as those for the shallow bath, which in general form the bath resembles. The patient sits upright with the limbs extended in a tub containing sufficient water to reach the umbilicus, as the purpose of this bath is usually to produce strong fluxion of the skin of the lower extremities. The water should be at a temperature of 102° F. or more. When given for relief of pain the temperature is raised to 115° F. or even higher.

The chief advantage of this bath over the hot immersion bath is that the patient can safely tolerate a higher temperature when only a portion of the body is immersed than when the whole skin surface is involved.

Duration.—The duration of the bath is three to fifteen minutes, according to the effects required. A very hot bath of two or three minutes is derivative to the lower extremities, and is at the same time tonic in its effects. When the bath is continued more or less depressing effects are likely to follow, and when these effects are undesirable, as is usually the case, the bath may be terminated with an affusion of water at 80° F. poured over the back, shoulders, and hips, while the patient stands in the tub.

Physiologic effects.—This bath is powerfully derivative, producing strong fluxion of the skin of the lower extremities. When properly administered the skin of the legs and hips becomes very deeply reddened. The effect is to drain away a large amount of blood from the pelvic and abdominal viscera, as well as from the upper part of the body. When administered at a very high temperature powerful "anesthetic" effects are produced through the inhibitory action by way of the thermic nerves.

The general effects when the bath is continued more than three or four
minutes are essentially the same as for the hot immersion bath. (see page ).

Therapeutic effects.—This bath is a most valuable means of relieving visceral pain due to chronic or acute congestion. It may be employed in mild cases of visceral inflammation. The applications are in this respect the very opposite of those of the cold shallow bath. This measure finds its most useful application, however, in lumbago and spinal neuralgia. It is, in fact, an excellent application, in almost all cases in which relief from pain is sought when the pain is not due to organic causes. It is, indeed, sometimes useful for giving temporary relief from pain where the cause is such that it cannot be removed. In a case of pain tumor under the writer's care, in which the extraordinarily severe paroxysms of pain occurred at frequent intervals, the hot half bath generally secured almost complete relief for the time being, and gave the patient several hours of comfort.

In sciatica the temperature of the bath is rapidly raised, and the patient should be encouraged to endure as high a temperature as possible. The bath may be repeated every three or four hours, and in acute cases it should be employed three or four times a day. Not infrequently the gratifying result of complete relief from this distressing malady may be obtained within three or four days, sometimes within forty-eight hours.

This bath may be usefully employed as a substitute for the hot sits bath in very fleshy patients. It is an excellent means of relieving chronic pelvic pain, especially the post-operative neuralgia from which patients often suffer. The duration of the bath when used for this purpose should be two to four minutes, and should be followed immediately by a dash of water at 80°F, poured upon the back and shoulders of the patient as he stands erect in the tub, care being taken to avoid direct application to the lower abdominal surface.
THE TONIC COLD SITZ BATH.

The surfaces acted upon in this bath are the lower part of the trunk, the hips, and the feet. It is a very convenient form of bath, and produces many of the effects which pertain to the full bath, and possesses advantages which may be utilized in many cases in which the full bath is not available. It has also characteristic effects of its own. The sits has been in use for a century or two by the peasantry of Germany and Austrian Silesia, but it is only recently that it has been subjected to scientific study; consequently, its value has not been so much appreciated by the medical profession as would otherwise have been the case.

Method.—The requisites are a sits bath tub, a foot bath tub, a Turkish sheet, at least one woolen blanket, several towels, water of the proper temperature for a sits bath and for a foot bath, and a bowl of cold water with which to wet the head.

Special tubs are made for the purpose out of metal, wood, and porcelain. Porcelain tubs are far superior to other sorts. If a tub specially made for the purpose cannot be readily obtained, an ordinary wash tub may be utilized by proping it up on one side.

This bath is always accompanied by a hot foot bath. The patient steps first into the foot bath, the temperature of which should be 102° F. to 104° F. After standing in the hot water for a moment until the feet are well warmed, a general feeling of warmth pervades the body, which greatly lessens the shock ordinarily occasioned by the contact of cold water with sensitive skin surfaces. The parts submerged in cold water should be rubbed continuously during the bath.

The shorter and colder the bath the more vigorous the reaction produced by it. Care should be taken that vigorous rubbing is maintained during the
entire duration of the bath, as otherwise most undesirable effects may result. Care should always be taken to cover the patient with a warm blanket so as to keep the upper part of the body warm. In some cases thorough wetting of the face and head before the bath and the application of a cold head compress are necessary when there is a tendency to cerebral congestion, as shown by a sensation of fulness in the head.

Temperature.—The temperature of this bath may vary from $30^\circ$ F. to $65^\circ$ F., but the temperatures ordinarily employed are $72^\circ$ F. to $78^\circ$ F. The higher temperatures may be employed for the first baths, but the temperature should be lowered one degree each day until a temperature of $72^\circ$ F. to $74^\circ$ F. is reached. A lower temperature ($68^\circ$ F. to $65^\circ$ F. produces more powerful effects, and may be employed after tolerance for cold water has been established.

The temperature of the foot bath should be as high as the patient can bear ($100^\circ$ F. to $114^\circ$ F.).

Duration.—The duration of this bath is one to four minutes. It should never be continued long enough to produce shivering or decided chilly sensations.

At the conclusion of the bath a half bucket full of water ten degrees lower than that of the bath should be dashed over the hips and the feet, a single dash upon the hips, two upon the feet.

The patient is then quickly dried and thoroughly rubbed, vigorous percussion and deep massage of the hips, thighs, and lower back add greatly to the effects of the bath, and should not be omitted. This measure stimulates blood movement through the pelvic organs and at the same time by dilating the surface vessels prevents harmful congestion.

Physiologic effects.—This bath produces a very decided effect upon the pelvic circulation. Indeed, the whole viscer al system is more or less affected by it. The attack of so much skin surface with cold water sets up powerful vasomotor reflexes which are felt in every part of the body. The heart
beats with greater vigor, the pulse is slowed after a brief quickening, and there
is a temporary rise of blood-pressure. The bath is followed by a sensation
of well being, often of exhilaration, which clearly indicates its tonic effects.
A very decided vasomotor reflex effect is impressed upon the viscera of the pelvis
and abdomen. Through the great splanchnic nerve, the most important vasomotor
nerve in the body, the vessels of the abdomen and pelvis, including the
capacious vessels which constitute the portal system, are strongly constricted.
This brief constriction is, of course, shortly afterwards followed by a
reaction in which there is an increased volume of blood in the pelvic and
abdominal vessels, and a greatly increased rate of movement of blood in these
parts. The hot foot bath promotes internal reaction while at the same time
preventing any possible injury from retrostasis during the first moments of
contact of cold water with the skin. The vigorous rubbing which accompanies
the bath, and which must begin the moment the patient enters it and continued
until the patient leaves it, also serves to keep the blood in the skin, and
by thus filling the external branches of the internal iliac vessels, the internal
branches of which supply the uterus and ovaries and other pelvic viscera with
the viscera of the lower abdomen, are to some extent drained or partially
emptied of their blood.

Immediately after the bath vigorous reaction occurs both externally
and internally. The skin of the parts which have been immersed becomes
red through an active dilatation of the surface vessels, and a similar dilatation
and visceral activity is at the same time taking place in the uterus, ovaries,
and other internal parts. To obtain this powerful internal reaction is the
object of this bath, and by its means all the vital activities of the parts
involved are quickened. The improved movement of blood not only secures
improved nutrition, but by bringing in contact with diseased tissues that magical
agent, pure blood, necessary repairs are effected, vital resistance is increased,
leucocytosis is encouraged, the tissues are rendered inhospitable to bacteria,
and a whole series of reparative activities are set up.

The cold sits bath powerfully stimulates the muscular structures of all the hollow viscera of the trunk, and thus encourages the action of the bladder and bowels, when there is muscular weakness of these organs. It increases intra-abdominal tension, thereby unloading the portal circulation, but this effect is only temporary. It also stimulates contraction of the muscular structures of the uterus, fallopian tubes and the various ligamentous structures connected with the uterus.

The final effect of the bath is to increase the amount of blood in the organs of the pelvis and the lower abdomen, and to increase the rate of movement of blood through these parts.

Therapeutic applications.—The therapeutic uses of the tonic cold sits bath may be easily inferred from its physiologic effect. It is useful as a general tonic measure. When employed for this purpose it is well to follow the bath by a tonic spray at a temperature adapted to the patient’s condition.

The tonic sits bath is of the greatest value, perhaps, in the treatment of certain forms of genito-urinary and rectal diseases, both in men and women. It is especially indicated in the treatment of amenorrhea, delayed and scanty menstruation, defective development of the uterus, sterility; for exudates left behind by pelvic inflammation when pain and inflammatory symptoms are no longer present and a condition of anemia has been established; and in all conditions in which it is desirable to increase the supply of blood in the pelvis. In such cases the bath should be preceded by hot vaginal irrigation for two to five minutes.

This bath is of general service in most forms of pelvic disease in women in which acute pain and tenderness are not present, and in which there are no indications of active congestion or inflammation. Hence, it is generally useful in leukorrhea, vaginal or uterine catarrh, subinvolution, and various forms of uterine displacement, and all conditions in which there is relaxation and
passive congestion.

This bath has rendered great service in various forms of sexual weakness in men. It is especially serviceable in true spermatorrhea, impotence, and chronic gleet.

This bath is also of great service in constipation in both sexes when due to excessive dryness of the stool with dilatation of the colon and to a relaxed condition of the abdominal muscles.

The tonic cold sits bath may always be employed with advantage in cases of atony of the bladder in both sexes.

Cautions and contraindications.—This treatment should be avoided in cases of acute inflammation of the pelvic or abdominal viscera, and in painful effusions of the bladder, rectum, testicles or ovaries; also in patients liable to suffer from pulmonary congestion or hemorrhage.
THE RUNNING COLD SITZ BATH.

This bath is administered by means of a bath tub which has been especially constructed for the purpose. The bath tub is made of metal, and is provided with four sets of openings, through which water may be forcibly projected against the body, either singly or simultaneously as follows: a group of openings at the back and upper part of the tub projects a number of fine streams upon the spine; three circles of fine openings around the body of the tub concentrate a great number of streams upon the thighs and trunk as the patient sits in the bath; a single opening or a group of openings plays upon the lower abdomen, and a fourth group of openings in the center of the bottom plays upon the anal region.

The author's running sits bath apparatus is so arranged that water of different temperatures may be played through these different openings. For example, hot water may be played through the circular opening, thus keeping the patient warm while cold water is played upon the spine, the anal region, and the suprapubic region, or any combination which may be desired.

The general method, physiologic effects, and therapeutic indications are the same as for a tonic sits bath. Its effects are more powerful than those of the ordinary tonic sits. Hence the duration may be less. Thirty to sixty seconds is sufficiently long to produce decided effects when the lowest temperature is employed (60° F. to 65° F.). When a higher temperature is used (75° F. to 80° F.) the bath may be prolonged to two or three minutes.

The cold running sits is one of the most powerful therapeutic measures. Its general tonic effects are excellent, and the results following its use are so speedy that patients promptly recognize its great value and are willing to persevere in its use. It should be employed daily for several weeks in
succession to secure the results desired.

When sedative effects are desired, as in the use of the sedative cold sits bath.

(Incomplete. Return to this under the head of "Douches.")
THE SEDATIVE SITZ BATH.

The general technic of this bath is the same as that of the tonic cold sits, with the exception that it is not accompanied by rubbing.

Temperature: 80° F. to 60° F.

Duration, eight minutes to forty minutes.

The bath is accompanied by a warm foot bath, the temperature of which should not exceed 102° F. to 106° F. A very hot foot bath dilates the pelvic vessels, an effect the opposite of that which this measure is intended to produce.

Physiologic effects.—The prolonged cold sits bath produces a prolonged contraction of the vessels of the pelvic region. It restores the tone of these vessels. It stimulates the muscular structures of the bowels, bladder, uterus, and the muscle-ligamentous structures of the pelvis, increases the tone of the abdominal muscles, raises intraabdominal pressure, raises blood-pressure, slightly slows the pulse, gives rise through the intense reaction which occurs some time after the bath to prolonged dilatation of the surface vessels, which exercises a powerful derivative effect in favor of the pelvic viscera.

During the bath the warm foot bath diverts blood to the lower extremities, while the strong impression of cold upon the thermic nerves in relation to the pelvic region, stimulates vasoconstriction of the pelvic vessels. If, however, the water of the foot bath is too hot (108° or above), inhibitory reflexes are brought into play which have the effect to dilate the pelvic vessels, so antagonizing the effect of the bath.

Therapeutic applications.—This bath is useful in all cases in which it is desirable to diminish the volume of blood in the organs of the pelvis or lower abdomen. Preceded by hot vaginal irrigation (five to ten minutes) it is a most valuable means of relieving chronic pelvic congestion. It should generally be employed twice daily, at a temperature of 80° F. to 70° F. for from
twelve to twenty minutes.

In menorrhagia it is employed between the periods, or if the flow is profuse, after the second day.

In metrorrhagia it may be employed at once.

The cold sitz bath also renders great service in the following conditions:

Chronic diarrhea, hemorrhage from the bladder, intestines, urethra, rectum, or in cases of hemorrhoids. When used for the relief of hemorrhage a temperature of 50°F. to 40°F. may be employed.

This measure is also useful in all forms of chronic pelvic inflammation when not accompanied by pain or elevation of temperature, such as chronic metritis, inflammation of the adnexa without suppuration, chronic inflammation of the prostate, chronic colitis and enteritis, with relaxed abdominal muscles. This bath renders very great service in hemorrhoids.

Cautions and contraindications.—This bath is contraindicated in cases of acute pelvic, plain tenesmus of the bladder, neuralgia of the ovaries, bladder, and testicles, in sciatica, in acute inflammation of the pelvic and abdominal viscera, and in cases of arteriosclerosis with very high blood-pressure. This bath should always be avoided in cases of seminal weakness in which nocturnal losses are frequent, as it is very likely to aggravate this symptom. This bath should be avoided in persons who have had an attack of apoplexy, or who have recently suffered from pulmonary hemorrhage.
THE VERY HOT SITZ BATH.

This bath is in many cases an excellent substitute for the full bath. It has an advantage over the full bath in that it can be used at a somewhat higher temperature, and produces somewhat less depressant after effects.

Technic.—The requisites are a suitable sits bath tub, a foot bath tub, a sufficient supply of hot water, a wash bowl with cold water, several towels, a Turkish sheet, a blanket, and proper preparation for cooling the patient at the close of the bath. This may be an affusion, a wet sheet rub, a shower or spray, a towel rub, a half sheet rub, or mitten friction.

Temperature.—For the /very/ hot sits bath the temperature should be 102° F. to 106° F.; for the very hot sits bath, 110° F. to 114° F. In rare cases the temperature may be raised to 118° F. or 120° F.

The temperature of the foot bath should be the same as that of the sits bath or a little hotter.

This bath is nearly always followed by a cooling measure of some sort, which should be adapted to the patient's condition. A convenient method of cooling the patient, especially when the effects of the hot bath itself are the chief effects desired, is to pour over the patient's shoulders while he remains in the bath a pailful of water at a temperature of 80° F.; then have the patient stand while a pailful of water at the same temperature is poured over the hips, legs, and feet.

Duration.—The length of the bath is generally three to five minutes, rarely longer. When greatly prolonged, unpleasant general effects are produced from over-heating of the blood, and the pelvic vessels may be excessively dilated.

Physiologic effects.—The physiologic effects of the hot sits bath are the same as those which have been described for the hot full bath, only less pronounced. To dilatation of the vessels of the skin covering the hips
diverts a large amount of blood away from the organs of the pelvis. The nervous sensibility of these organs is also lessened, giving to this bath remarkable value as a means of relieving pain in this region of the body. While the first effect of the bath is powerfully derivative in favor of the pelvic organs, when not continued it produces passive dilatation of the internal as well as of the external vessels, and thus accumulates blood in this region of the body. It is on this account that the bath should not be too long continued, especially in cases of cases of chronic pelvic congestion.

Therapeutic applications.—The hot sits bath renders great service in most forms of chronic disease. It relieves ovarian pain, neuralgia of the testicles, tenesmus of the bladder, rectum, and vagina, uterine colic, sciatica, renal colic, lumbago, neuralgia of the bladder, kidneys, or intestines, and all other forms of pain not due to acute inflammation. It is of service in pruritis of the anus or vulva, for which purpose it should be employed very hot (108° F. to 114° F.), and should be of short duration (one to two minutes).

When employed for the relief of pain, especially in lumbago and sciatica, it is sometimes best to omit the cold application, wrapping the patient warmly in flannels immediately after the bath, so that the sweating may continue. Or when this is undesirable, the patient may be cooled by means of the alcohol rub.

Cautions and contraindications.—The prolonged hot sits bath must be avoided in cases of high blood-pressure, cases of acute cardiac weakness, and whenever acute inflammatory conditions are present.
THE REVULSIVE SITZ BATH.

The preparations for this bath are essentially the same as for the hot sits bath. Two pailfuls of water should be in readiness, one at a temperature of 85° F. to 90° F., the other at 65° F. to 60° F. Begin at 102° F. to 104° F. and increase by the continuous addition of water to as high a temperature as the patient can bear, or at least 112° F. or 114° F. Some persons are able to tolerate a temperature of 116° F. to 120° F. for a short time.

The duration of the bath should be one to four minutes.

It is undesirable to produce general or profuse perspiration. The effect of this bath and the time for terminating it may be judged from the appearance of the skin, which should be very deeply reddened. At the close of the bath the patient rises, steps out of the foot bath and stands while two pailfuls of cold water are poured over the hips and feet. The colder water is used last. With each pailful of water one dash is poured over each hip and two dashes upon the feet. A sheet is thrown quickly about the patient, so that not the slightest chill can occur. It is well for the patient to lie well wrapped in the blanket for some time, until the skin has returned to its normal condition, as the slightest chill is likely to cause a return of the pain.

Physiologic effects.—The effects of this measure are in general similar to the physiologic effects of the short general hot bath, the principal difference being in the stronger revulsive effects produced by the more intense cooling of the skin surfaces, and the marked inhibitory effect produced by greater raisings of the temperature endurable, whereby its efficiency as a means of relieving pain is considerably increased.

The brevity of the bath also prevents the undesirable general effects which sometimes accompany a prolonged hot bath.

Therapeutic applications.—This bath may be used in almost any case in
which pain exists in the lower part of the trunk. It is one of the most useful of all means of relieving the chronic pelvic pains from which many invalid women suffer, and which often leads to the habitual use of opium, alcohol, and other drugs. Modified in connection with general tonic measures, this bath affords most excellent and satisfactory results in cases of this class. There is no better means for relieving the various neuralgias, hyperesthésias, and discomforts connected with genito-urinary diseases in both sexes.

Cautions and contraindications.—The only contraindications are extremely high blood-pressure, very weak heart, and the presence of acute pelvic inflammation, great exhaustion, or a general elevation of temperature.
THE NEUTRAL SITZ BATH.

In general character this bath resembles the neutral immersion bath, except in the more limited nature of the application.

Technic.—As the purpose of this bath is to produce sedative effects by utilizing the peculiar sedative properties of the neutral zone, care must be taken to avoid chilling the patient and to avoid disturbances of every sort.

Temperature.—For the sits bath, 92° F. to 97° F., or an average temperature of 94° F. or 95° F.; for the foot bath, 100° F.

Duration.—Fifteen minutes to an hour or more.

Cooling measures after the bath are not required. Careful attention should be given to drying the patient, care being taken to avoid patting and vigorous rubbing movements. If feeble, the patient should lie quietly after the bath for an hour or two. In general it is best to administer this bath just before retiring at night. In special cases it may be given two or more times in twenty-four hours.

Physiologic effects.—No marked thermic or circulatory reactions are set up by this bath. Its general effect is quieting. It encourages the action of the kidneys, and soothes the central nervous system, particularly the lower spinal ganglia. It has a special sedative effect upon the genito-urinary centers.

Therapeutic applications.—This bath is useful as a means of relieving general nervous irritability, and especially irritability of the genito-urinary organs. It renders valuable service in cases of nocturnal losses in men, and in the allied condition in women, tenesmus of the bladder, strangulated hemorrhoids, pruritis of the vulva and anus. Certain cases of neuralgia of the testicles, ovaries, and coccyx are more readily relieved by the prolonged neutral
sits than by the hot sits, though generally the latter is more efficacious
in relieving pain.

There is no other remedy so valuable in erotomania and priapism.

It is useful in cases of pelvic pain due to low grade inflammation
in which cold baths are contraindicated. In these cases the bath may be
slightly modified with advantage, beginning at 100° F. and increasing to 102° F.
to 104° F. during two minutes, then cooling down to 90° F. for half a minute, then
returning to 95° F. for ten, fifteen, or twenty minutes. This same modification
may be utilized with advantage in priapism and erotomania. It may be also
advantageously employed in all forms of subacute inflammation of the pelvic
viscera. It is an appropriate measure in acute catarrhal inflammation of the
bladder and urethra. A long neutral sits bath (twenty to thirty minutes)
administered two or three times daily is an excellent measure in gonorrhea.
In such cases, of course, it is important to assign a special tub to each
patient and to employ most thorough-going measures of disinfection so as to avoid
infection of other patients.
THE COLD FOOT BATH.

This powerful revulsive hydriatic measure is less employed than it should be, through lack of general knowledge of its powerful physiologic effects.

Technic.---Temperature: 70° F. to 45° F. Duration: one to five minutes. The lower the temperature employed the more powerful the effects and the shorter the duration.

Any receptacle of suitable size to receive the foot may be employed, but wood or porcelain is preferable. The amount of water should be sufficient to cover the ankles as well as the feet. The feet should be well warmed by exercises, rubbing, dry heat, or a hot bath, and care should be taken to avoid chilling the feet by exposure to the cold air or to a cold floor before placing them in the cold water. During the bath the feet should be continuously and vigorously rubbed by an attendant if possible. In the case of very nervous or sensitive patients the feet may be immersed and rubbed in alternation, one at a time, changing at the end of fifteen or twenty seconds. The patient should be well wrapped to avoid general chilling. When employed for the relief of cerebral congestion the head and face should be well bathed with cold water before the bath. At the close of the bath the feet should be thoroughly dried and rubbed with the dry hands lubricated with vegetable oil, fine vellum, or massage cream. Care should be taken to see that moisture is not retained between the toes.

In general the patient should exercise for twenty to thirty minutes after his bath, preferably by walking in the open air. The muscles of the feet and calf may be brought into vigorous action by an exercise known as heel raising, in which the patient while standing raises and sinks the heels in rapid succession. If the patient is unable to exercise upon the feet resistive movements of the feet and legs may be made by the patient alone or with the assistance of a nurse. If the feet are allowed to become chilled after this
bath its good effects are entirely destroyed, and the patient is likely to experience the ill effects which commonly follow wetting and prolonged chill of the feet.

Physiologic effects.—This very interesting hydriatic measure owes its properties to the rich vasmotor nerve supply of the soles of the feet and the extensive reflex relations which exist between this comparatively small skin service and other parts of the body.

A short cold application to the feet causes a reflex contraction of the muscular walls of the bladder and bowels, and contracts the blood-vessels of the pelvic and abdominal viscera. The circulation of the brain is also influenced in the same way. The vigorous rubbing which accompanies the bath causes strong circulatory reaction in the vessels of the feet and lower legs, and by this means produces a derivative effect. Thus a double influence is brought to bear, whereby the volume of blood in the brain and the pelvic and abdominal viscera is diminished.

The revulsive effect produced by dilatation of the vessels of the feet in this manner is much more durable than when produced by application of heat. When the bath is properly administered the feet tingle and glow from inrush of blood. This effect of cold upon the feet is much appreciated by the lumbermen of the north woods of Maine, who utilize it to warm their feet when threatened with freezing, by pulling off their boots and stockings and rubbing their feet with snow.

Therapeutic applications.—It may be inferred from the above that this bath is an excellent remedy for the habitually cold feet from which many neurasthenics and dyspeptics suffer. It should be taken daily. It is also a valuable remedy in chronic sweating of the feet and chilblains, and can be highly recommended in chronic constipation due to atony of the bowels and in atony of the bladder. Priessnitz used this application with great success in
Acute gout. He made the application very long, sometimes four or five hours, or even longer.

Cautions and contraindications.—This bath must be avoided by women during menstruation, and for a day or two previous. It is also contraindicated in neuralgia of the bladder, ovaries, and bowels; in sciatica and lumbago, and in acute inflammation of the ovaries, bladder, prostate, and bowels; and in tenesmus of the bladder and rectum.
THE RUNNING COLD FOOT BATH.

This is a modification of the ordinary foot bath whereby the reflex effects are greatly intensified.

Technic.—Temperature: 70° F. to 40° F. Duration, one to three minutes.

This bath requires a tub so constructed that the depth of the water will not exceed one-half inch, and permitting a constant stream of water so that the temperature will be maintained constant. Aside from this the method of administering the bath is the same as has been described for the ordinary foot bath. The foot must be constantly rubbed, either by an attendant or the patient himself may rub one foot with the other, alternating every ten or fifteen seconds. The bath should be continued until a thorough reaction is obtained, indicated by redness of the toes.

Physiologic effects.—The physiologic effects of this bath are the same as those which have been described for the ordinary foot bath, but are more intense. The tone of the visceral blood-vessels is increased, and the abdominal muscles and the walls of the hollow viscera are stimulated to contraction.

Therapeutic applications.—This is a most excellent remedy for habitual coldness of the feet. It relieves cerebral and visceral congestion, stimulates the action of the bowels and bladder, and has an excellent tonic effect in neurasthenia.

Cautions and contraindications.—This measure should be avoided in catarrh of the bowels and bladder, neuralgia affecting the organs of the pelvis and abdomen, in Lumbago and sciatica, and when there is pain or tenderness in the joints from gout or rheumatism.
THE COLD LEG BATH.

This bath is similar in character to the foot bath, only involving a larger area of the skin of the lower extremities.

Technic.—Temperature: 70° F. to 50° F. Duration: one to three minutes.

The bath may be given with an ordinary foot bath tub. The amount of water in the tub may be a little greater. The feet and legs should be constantly rubbed during the bath, the water being lifted up and applied to the legs with the hand. The whole area of both legs from the knees to the toes should be rapidly gone over with the two hands, working simultaneously and with firm pressure. Special attention should be given to the calf of the leg. The bath should be followed by exercise, and if the patient is confined to the bed it is well to apply a heating compress well covered with mackintosh and flannel. By this means the derivative effect of the bath can be greatly prolonged.

Physiologic effects.—The physiologic effects of this bath are the same as have been described for the cold foot bath. The derivative effects are somewhat increased on account of the larger area involved.

Therapeutic applications.—This bath is useful for the same purposes as indicated for the cold foot bath.

The contraindications are the same.
THE COLD WALKING LEG BATH.

This interesting modification of the cold leg bath represents the most ancient form in which it was used. The first description of the bath is that by Fra Bernardo, an Italian physician who in 1724 practised in the Island of Malta. He required his patients to walk daily in the wet grass as a "hardening process." A hundred years later Priestnitz of Graefenberg adopted the same procedure. It is at present much used by the followers of Kneipp at Weerishofen. The method is really valuable, being a most effective means of producing very strong reaction, both thermic and circulatory, in the lower extremities. It is not a panacea, however, nor a measure which should be used in a routine way, as it is commonly used by empirics. It also has the inconvenience that it is not utilisable except at certain seasons of the year.

The writer has devised an indoor walking leg bath which can be utilised as an instrument of precision, and with which excellent results are obtained. It consists of a box open at the top, two feet deep, and with a space of twenty inches between the perpendicular sides. Along the sides are placed several rows of double brass wires about eight inches in length covered with braided twine. Along the upper edge of each side runs a pipe perforated at short intervals with small openings, which are directed inward and slightly downward. As the patient walks through this box the twine covered loops of brass wire impinge against the surface and produce a combined percussion and friction effect, while fine streams of water at any desired temperature and pressure constantly play upon the legs as they pass along. The box is about forty feet in length. After passing through the box the patient walks back beside it, giving opportunity for reaction to occur, then again passes through the box and so continues as long a time as is necessary to produce the desired effect.

Technic.—The general precautions to be followed in the application of this bath are the same as have already been described for the cold foot bath.
Physiologic effects.—This bath is perhaps the most effective of all means of producing revulsion to the lower extremities. It is a combined and simultaneous application of the douche, mechanical friction, and massage exercises, so that both thermic and circulatory reaction are excited in the most thoroughgoing manner possible. Powerful reflex effects are produced upon the brain, spinal cord, and the abdominal and pelvic viscera, raising the tone of the blood-vessels, stimulating the nerve centers, and causing contraction of internal muscular structures. It raises blood-pressure more than any other procedure, except the general cold bath, and it places the circulatory system in the best possible condition for promoting general metabolism, since by the exercises involved in the procedure the blood-vessels of the skin necessarily leads to over-accumulation of blood in the viscera and all internal parts. The muscles are contracted and hence cannot accommodate any considerable amount of the blood driven from the skin. This combination of the reflex effects produced by the cold bath to contract the vessels of the viscera, while dilating the vessels of the muscles, gives to this measure peculiar potency and adaptability as a therapeutic means.

Therapeutic applications.—This is perhaps the most valuable of all therapeutic means for balancing the circulation in neurasthenics and chronic dyspeptics who habitually suffer from coldness of the lower extremities. In these cases the deficiency of blood in the feet is due to vasomotor spasm in the extremities, combined with lack of vasomotor tone in the splanchnic area. The abdominal muscles are usually weak in these cases, so that the intraabdominal pressure is diminished. This combined with loss of tone in the vessels promotes an enormous dilatation of both the arteries and veins of the abdomen and pelvis. The chronic congestion of the viscera which necessarily results is responsible for a great number of the distressing symptoms from which
neurasthenics and dyspeptics suffer. The back-ache and dragging sensations so much complained of by invalid women are usually attributable to this same cause. The giddiness, mental confusion, nervousness, irritability, and depression which neurasthenics and dyspeptics suffer are chiefly due to over-accumulation of blood in the abdominal region.

The cold walking leg bath affords relief by reflexly contracting the over-distended vessels. The abdominal muscles are also brought into strong contraction, thus increasing the intraabdominal tension; at the same time the tone of the vessels is improved, and thus an admirable therapeutic effect is produced.

For constipation due to atony of the bowels and in cases of atony of the bladder this bath is also indicated.

The walking leg bath is an admirable general tonic. It stimulates both the brain and spinal cord, and improves the general circulation, and thus fills a very valuable place as an accessory remedy in the treatment of a large proportion of cases of chronic disease in both sexes.

Cautions and contraindications.—The contraindications are very few but very decided. The bath should not be employed in cases of acute inflammation or active congestion of any abdominal or pelvic viscus. It should also be avoided in cases of neuralgia of the lower extremities or the pelvic viscera when there is tenderness of the knee joints or of the joints of the feet.
THE HOT FOOT BATH.

This bath is in such common use it hardly needs description. There are important facts in relation to it, however, which are not generally understood, and which it is important to understand in order to secure the best results and to avoid disappointment.

Technic.—Temperature of the hot foot bath 100° F. to 106° F.; very hot foot bath, 110° F. to 120° F. Duration, five minutes to thirty minutes.

There are several important details to which attention must be given. First, it must be noted that decidedly different effects, in fact, opposite effects, are produced by the hot foot bath and by the very hot foot bath.

The effects of the very short, very hot foot bath are also different from those of the prolonged very hot foot bath. It is also important to note that the general as well as local effects are produced by the hot foot bath. The temperature must be very carefully adjusted to the individual case, as will be indicated later.

At the close of this bath some cooling measure must nearly always be applied. Not infrequently a general cold application of some sort is necessary. This is always the case when perspiration has been induced, or when the bath has been continued so long as to produce weakening or depressant effects.

The best method of cooling the feet is to dash a little cold water upon them just as the patient steps out of the bath. They should then be quickly and thoroughly dried. When a general cold application is required it may be a general affusion, a mitten friction, a wet sheet rub, or cold towel rub.

Physiologic effects.—The physiologic effects of the hot foot bath differ according as the temperature is hot or very hot, and to some degree with the duration. In general, the effects are similar to those of the hot bath,
but the effect upon the general circulation is much less marked; especially the effects upon the heart are less depressant, blood-pressure is lowered, and there is less diversion of blood to the skin, unless the foot bath is continued long enough to produce over-heating and general perspiration. When long continued the foot bath lowers the temperature of the blood, but to a much less degree than does the general hot bath.

There are three classes of effects produced by this bath:

1. A local dilatation of the blood-vessels, indicated by a reddening of the skin of the feet and legs, and by a slight increase in the size of these parts.

2. Reflex effects upon the circulation of remote parts. When a very hot foot bath is given (110° F. to 120° F.) there is at first a contraction of the blood-vessels of the brain, the heart action is slowed and increased in vigor, and there is a slight raise in blood-pressure. When the bath is continued for several minutes blood-pressure falls, the heart action is slowed, and reflex dilatation of the blood-vessels of the pelvic organs and their related regions, occurs.

3. The local dilatation of the vessels is produced the same as with the warm foot bath.

4. A very hot foot bath (110° F.) lessens nervous sensibility, not only in the parts to which the bath is applied, but also in reflexly related parts, comprising in general the lower half of the body. This inhibitory action of heat (the so-called "analgesic" effect) is one of the precious qualities of this bath.

It is important to note that while the hot foot bath at all temperatures diverts blood to the lower extremities, the lower temperature, designated as "hot" (102° F. to 106° F.), produces these derivative effects alone, while higher temperatures, designated as "very hot" (110° F. to 120° F.), produce in addition to the derivative effects reflex contraction in remote parts. When
the application is short with dilatation, and when the application is prolonged
with nervous sensibility. These effects taken together make this an extremely
interesting and valuable procedure.

Therapeutic applications.—From the above it will be readily seen that
nothing should be much more absurd than to prescribe a hot foot bath without
indicating the exact temperatures required, or if the attendant is well trained,
it may be sufficient to designate the bath as hot or very hot. It is certainly
of the highest importance that a clear designation should be made in the
therapeutic application of this bath, between the hot bath and the very hot
bath, since the physiologic effects are so different, as has been pointed out
in the preceding paragraphs.

The hot foot bath (102° F. to 106° F.) is exceedingly valuable as a
derivative. It may be used to relieve congestion of the head, or to divert
blood from the upper part of the body in congestion or hemorrhage of the lungs,
for relief of head-ache and insomnia.

It should be noted that the hot foot bath is useful only in
congestive head-ache, which is usually attended by flushing of the face, throb-
ing of the temples, redness of the eyes, a feeling of fulness in the head,
and other indications of the excessive accumulation of blood in the head.

When the patient is pale and symptoms of cerebral congestion are absent,
the very hot foot bath should be applied, and renders very great service.

The duration of the warm foot bath is generally longer (ten to twenty
minutes or more). It may be continued as long as is desirable without
producing harmful effects, and it is often well to accompany its effects by the
application of a heating compress at the conclusion of the bath. Cold
applications made at the conclusion of the bath should be very short, their
purpose being simply to fix the blood in the skin.

The very hot bath may be very usefully employed in cases in which
the chief objects sought is relief of pain or vascular or muscular spasm of
of contracted vessels. It is a most excellent remedy in all forms of painful local affections of the feet, as rheumatism, gout, and neuralgia. It should generally be avoided in cases of acute inflammation of the joints, but very hot and quite short (one to five minutes' application) are very useful in the treatment of sprains after the first few hours, cold applications being best for immediate application.

Paresthesias as well as neuralgia are relieved by the very hot foot bath. The very hot and somewhat prolonged foot bath (ten to twenty minutes) is very useful in cases of delayed, painful, scanty, or interrupted menstruation. It is of equal service in relieving the pain of intermenstrual. If at any time an application of the very hot foot bath produces menstruation, this ill effect may be immediately corrected by short, hot vaginal irrigation.

Cautions and contraindications.—There are few contraindications for the hot foot bath, but the very hot foot bath, especially if prolonged more than one to three minutes, must be avoided in cases in which there is a tendency to hemorrhage from the uterus, stomach, lungs, or brain. In cases of extremely high blood-pressure this bath must also be avoided. The prolonged, very hot foot bath is contraindicated when an extreme rise of temperature is present.
THE HOT LEG BATH.

The physiologic effects, therapeutic applications, contraindications, mode of application, of the hot leg bath are essentially the same as those of the hot foot bath, the only difference being that the effects rendered are somewhat more intense because of the larger skin area involved. The hot leg bath is less frequently employed than the hot foot bath for the reason that it requires a sitting position, whereas the hot foot bath may easily be given to a bed-ridden patient without fatigue or exposure.
THE ALTERNATE FOOT BATH.

In this form of bath hot and cold water are used in alternation. The effects of this bath may be made to approach closely either those of the hot foot bath or the cold foot bath, according as either the hot or the cold application is made dominant.

Two foot bath tubs are required, one containing hot water and the other one cold. The feet are placed first in the hot water for half a minute then transferred to the cold bath for fifteen seconds. The feet should be rubbed well in the cold bath.

Physiologic effects.—If the purpose of the application is to divert blood to the lower extremities and to relieve pain in the pelvis or abdominal region, then the feet should be held in the hot water for two or three minutes, and the cold application should be very short, not more than five or ten seconds—simply a dash of cold water is generally sufficient. The feet should then be returned to the hot water for another two or three minutes. These alternations may be repeated five to ten times. At the end of the application a heating compress should be applied to the feet and legs. The patient should be kept quiet in bed and warmly wrapped for some hours.

When the purpose of the application is to reduce chronic swelling in the ankle or toe joints, or to relieve eczema or chilblains, the hot and cold applications may be equal in duration, or nearly so—about fifteen seconds each. The hot applications should be just long enough to thoroughly heat the skin, and the temperature should be as hot as can be borne without discomfort.

Therapeutic applications.—The alternating foot bath is useful in almost all cases in which the hot foot bath renders service. Its only advantage over the hot foot bath is that the short cold application produces a refreshing effect which lessens the tendency of the prolonged hot application
to produce depressant effects. The alternating foot bath with equal periods of heat and cold renders great service in improving the circulation, and is indicated in enlargements of the joints from rheumatism or gout. It renders extremely valuable service in promoting the absorption of the exudate which is left behind in the joints of a limb which has just been fractured or has been retained in a splint for a long time without proper movements and manipulations of the joints. It is also very successful in cases of abnormal sweating of the feet, chilblains, and chronic eczema, with thickening of the skin.

Cautions and contraindications.—It is only necessary that great care should be taken to avoid making either the hot or the cold application too prolonged to obviate any possible injury, even in cases where prolonged very hot foot baths or cold foot baths are decidedly contraindicated.
THE HAND BATH.

This bath is simply an immersion of the hands in water at cold, hot, or neutral temperature.

Physiological effects.—Immersion of the hands in cold water contracts the vessels of the hands and at the same time those of the brain and lungs. The pulse is slowed; respiration becomes slower and deeper. The curious fact was observed by Brown-Sequard that when one hand is placed in cold water the temperature of the opposite hand is lowered as well as the hand that is immersed.

Prolonged immersion of the hands in hot water produces effects the opposite of those produced by cold water. Nervous sensibility is diminished, both locally and reflexly.

Therapeutic applications.—The cold hand bath is useful in relieving nose bleed and hemorrhage from the lungs. The temperature should be low, (50° F. to 40° F.), and the duration eight to twelve minutes.

The cold rubbing hand bath is a useful means of relieving vasomotor spasm, which is a common cause of cold hands and feet in neurasthenics.

The very hot hand bath often relieves ovarian and uterine pain and vesical tenesmus. It may be advantageously employed in connection with the hot foot bath. It also renders valuable service in acute rheumatism, swelling of the joints from sprains, stiffness following fractures, neuralgia, carbuncle, ulcer, and chronic eczema with thickening of the skin when affecting the hands.
THE ALTERNATE HAND BATH.

The alternate hand bath, which consists in dipping the hands for fifteen or twenty seconds first in hot water, then in cold water, is useful as a means of relieving the stiffness of the joints which follow fractures and dislocations. The affected joints should be rubbed and flexed during the application.
THE ARM BATH.

This bath requires a specially constructed vessel to receive the arm. It may be best given with the patient in a sitting position, the bath being so placed that the whole forearm is immersed, the arm being flexed at a right angle.

Physiologic effects.—The effects produced by the arm bath are essentially the same as those produced by the hand bath, but are somewhat more pronounced. Priessnitz discovered the interesting fact that immersion of the elbow in cold water contracts the vessels of the forearm, a fact which may be sometimes utilized in the treatment of wounds of the hand, when the effect of the cold water is desired without the inconvenience of wetting the injured parts.

Therapeutic applications.—The cold arm bath is a useful means of relieving pain in cases of violent, recent sprain and in erysipelatous inflammation of the hand.

A short, very hot arm bath (110° F. to 120° F. for three or four minutes) is a useful means of relieving the pain accompanying rheumatic inflammation of the finger and wrist joints. A continuous bath slightly below that of the body (95° F. to 98° F.) is valuable in severe burns of the hand and forearm. The immersion may be continued for several days, or even weeks, care being taken to change the water every few minutes and to maintain a uniform temperature. In gangrene of the fingers the continuous bath at a temperature of 100° F. may be employed with great benefit. Before the discovery of the antiseptic and aseptic methods which are now employed in surgery, Langenbeck, an eminent German surgeon, greatly reduced the mortality following surgical wounds, especially in traumatic cases, by means of the immersion bath. This was applied especially to wounds of the hand and arm.
THE COLD WET SHEET PACK.

This is one of the most important and useful of all hydriatic procedures. The earliest mention of this mode of applying water records its use by Hahn, in 1738. Hogarth, the painter, according to practised wrapping himself in a wet sheet on going to bed at night. The wet sheet pack was in general use among the peasantry of Germany when adopted by Priesnitz, but Priesnitz improved the method of applying the pack and systematized its use. The method employed by Priesnitz is that which is commonly used at the present time by all hydriatic physicians.

Technic.—The requisites are a double woolen blanket, a single blanket, two extra large cotton or linen sheets, a pailful of water at 60° F., a thin cotton or air pillow, a Turkish sheet, and two or three towels. Some practice is required for the skilful administration of the pack, and instruction under a trained hydriatic nurse is highly desirable. For convenience of description, the procedure is divided into the following steps:

1. Lay the pillow at the head of the couch; fold one of the sheets lengthwise and lay it across the couch in such a way that the folded edge will cover the lower part of the pillow.

2. Unfold the double blanket and place one end upon the couch in such a way that the upper edge lies two inches above the upper edge of the sheet and the end falls a couple of feet over the edge of the couch opposite the attendant.

3. Dip the sheet in cold water and wring it as dry as possible. Two persons are required for this, as well as for the thorough execution of several other parts of the procedure. Spread the sheet upon the blanket, letting the upper end fall an inch and a half below the upper edge of the blanket.

4. The patient, who has been undressed and wrapped in a blanket, is
now prepared to enter the pack by thoroughly rubbing his face and neck with cold water, which should be applied two or three times with a saturated towel. The blanket being dropped off the patient lies down upon the sheet, quickly raising his arms above his head, and extending the limbs, separating them slightly. His position in relation to the wet sheet should be such that the tops of the shoulders fall about three inches below the upper edge of the wet sheet, so that the shoulders may be well covered when the sheet is folded.

5. One of the attendants catches the upper end of the side of the sheet next to him, and carries it straight across the patient's body, and draws it close up under the arms and along down the side of the trunk. The lower portion of the sheet is tucked snugly around one leg. The patient now brings his arms down and holds them close to his body, while the attendants draw the other end of the sheet over, tucking the other end over the shoulder and the trunk, while the lower portion is wrapped around the opposite leg. Great care must be taken to make the sheet fit snugly everywhere, so that air will be wholly excluded.

6. The attendants now draw the short end of the blanket across the patient and tuck the edge under with great care. The upper edge must be folded under the patient's shoulder so as to make it fit closely around the neck, as complete exclusion of air is highly important.

7. The long end of the blanket is now passed across the patient in the opposite direction and wound about him like a winding sheet. The tighter the sheet is drawn the better the contact between the wet sheet and the body, and the more prompt and thorough-going the reaction will be.

8. Bring over the two ends of the folded cotton sheet and draw snugly about the neck, folding across over the shoulders in such a way as to make the entrance of air impossible, and to protect the skin and face from contact with the woolen sheet.
9. Fold under the projecting edge of the blanket at the foot, making the body as snug as possible. A hot water bag may be slipped inside the blankets if necessary.

10. The extra blanket folded lengthwise is laid over the patient and tucked under the shoulders and sides. In Germany it is a common custom to lay a feather-bed over the patient.

The whole procedure must be executed with great rapidity. After the patient lies down upon the wet sheet only a few seconds should be occupied in adjusting the wet sheet and in tucking the short end of the woolen blanket about him. Any delay produces chill from evaporation and hinders the development of reaction.

Great care must be taken to see that the patient is thoroughly warmed before the pack is applied. This measure is generally used after some heating procedure, such as electric light bath, hot fomentations to the spine or abdomen, combined with the hot foot bath, or some other equally efficient means. The pack should be applied immediately after the patient leaves the heating procedure, so that there will be no opportunity for chilling. Painful parts, as sensitive ovaries, irritable spine, or a tender joint, may be protected by covering with a single thickness of dry flannel.

If the patient remains long in the pack a towel wrung out of cold water should be applied to the head, but this is not needed at the beginning, and with sensitive patients hinders reaction.

The length of time the patient remains in the pack depends upon the effect desired. If a tonic pack is ordered the patient should remain in the pack until he feels warm and comfortable and for ten or fifteen minutes longer. If strongly exciting effects are desired, the duration of the pack may be extended until perspiration appears upon the patient's forehead. If elimination is sought through the sweating pack, the patient may be left in the
pack for one, two, or three hours, as may be required, and water should be
given at intervals of ten or fifteen minutes. The cooling pack required renewal
of the sweating sheet as soon as it approaches the temperature of the body.

At the close of the pack it is generally necessary to administer some
cooling procedure. This may consist of a wet sheet rub, towel rub, cold mitten
friction, a douche, or a cold plunge. The application should be of short
duration and at a temperature varying from 80°F. to 60°F., according to the
effects desired.

Physiologic effects.—The effects produced by this powerful hydriatic
procedure are very pronounced, and vary according to the duration and the
manner in which the procedure is conducted. The general effects may be
tonic, sedative, alterative, eliminative, or antipyretic, according to the
special way in which the procedure is modified. These effects will be more
fully described under appropriate headings.

The first effect of the application is to produce a general chilliness,
which in a few minutes gives way to a sensation of warmth and well-being as the
reaction makes its appearance. Experiments of Schüller and later experiments
conducted by other investigators have shown that one of the most characteristic
effects of the pack is to lessen the volume of blood in the brain. This is
doubtless due to the dilatation of the vessels of the skin, and the volume of
blood in the liver and other internal organs must have lessened as well as that
of the brain. It thus appears that the pack is a very powerful derivative
procedure.

Therapeutic applications.—Therapeutic applications of the several
modifications of the wet sheet pack are indicated under the several headings
which follow.
THE TONIC PACK.

The special use of this measure is to follow a general hot bath, when it is desired to combine tonic with sedative effects. The technic is the same as has been described for the cold wet sheet pack.

Physiologic effects.—The first contact of cold water with the skin has an invigorating effect upon the central nervous system, while the reaction which quickly follows and which is promoted by the snug covering of the body, produces powerful derivative effects by fixing the blood in the skin. If the bath is too long continued the skin will be over-heated, and the tonic effect will be lost; hence when the tonic effect is desired, the pack must be interrupted within a few minutes after reaction is established and before perspiration begins. The ordinary duration of the pack will be twelve to twenty minutes. The procedure may be followed by a wet hand rub, a cold towel rub, or an affusion at 80° F. to 70° F.

Therapeutic applications.—This measure is used when such strongly excitant and tonic measures as the douche, wet sheet rub, plunge, or shallow bath, cannot be employed. The excellent derivative effects which are produced by it are highly useful in all forms of visceral congestion, especially in chronic enteritis, gastritis, chronic inflammation of the bile passages, chronic pelvic congestion, and any sort of chronic skin disorders, particularly psoriasis and eczema.
THE NEUTRAL PACK.

This is a pack given in the ordinary way, while care is taken to keep the patient in a state of comfort and warmth, taking care to avoid over-heating and perspiration. As soon as thorough-going reaction has occurred and the patient feels warm and comfortable, the extra blanket is removed, a little later the dry sheet which is folded about the neck and shoulders is loosened, and still later the woolen blanket is also loosened, but not sufficient to admit air to the body of the patient, whereby evaporation and chilling may be produced. The patient should at no time feel the slightest chill, as this will entirely vitiate the desired effect. If there is the tendency to overheating, a towel wrung out of cold in very cold water should be applied to the face.

Physiologic effects.—The neutral bath is a highly sedative measure. It diverts blood from the brain, spinal cord and other deep lying parts and at the same time protects the skin in such a way that the effect of the external impressions in stimulating the central nervous system is cut off. The withdrawal of blood from the brain is followed by an inflow of lymph from the great lymph spaces provided for this purpose, and thus the brain structures are put into the very best possible condition for reparative activity. The stimulating effect of an active blood circulation is removed, while external sensory stimuli are suspended, thus establishing conditions most favorable for complete rest, and recuperation of the brain.

Therapeutic applications.—From the above it will appear that the neutral pack is one of the most effective means of combatting insomnia, mania, delirium, and all conditions in which there is an excess of cerebral activity. The magic effect of this measure in securing quiet and sleep in cases of acute mania has led to its adoption as a routine measure in such cases in a number of large State insane asylums. In several instances the writer has had the
Suggestion for page 110

I suggest that you use the two cuts which appeared in the annual report of the Illinois State Board of Charities, complimentary copy of which was sent to Dr. Kellogg. One picture shows straight jackets and similar devices for restraining the insane; the other page shows a number of hydriatic procedures which have displaced these other measures.
pleasure of bringing this important procedure before the notice of superintendents of institutions for the insane, and wherever it has been given a sufficient trial it has displaced to a large extent the hypnotics which had formerly been employed. Further fact upon this important point will be given in a later portion of this work. The neutral pack is a most refreshing measure, while at the same time exercising a highly sedative effect. It relieves nervous irritability, promotes appetite, and induces healthy activity of the skin. It may be employed to great advantage in cardiac and renal cases in which very cold or very hot general applications are undesirable. Care must be taken that prompt and thorough reaction are secured.
THE ALTERNATIVE PACK.

For technique see

Physiologic effects.—If the pack is continued until free perspiration begins, decided effects upon the general tissue changes of the body are produced. The burning up of waste material is rendered more complete, reparative processes are stimulated, general tissue change is accelerated, the circulation is improved, and skin activity increased, and then when properly employed this measure may be a means of securing excellent curative effects.

The bath should be followed by a vigorous tonic application of some sort, as the cold spray, the wet sheet rub, the shallow bath, or plunge.

Therapeutic applications.—There are few chronic diseases in which this procedure may not be properly employed.

About the only contraindication is extreme general weakness, the feebleness of the heart which is indicated by shortness of the breath, or swelling of the limbs, or some active cutaneous affection. It is a simple but effective measure which is well adapted for use in the home. By its use effects may be secured which are almost equivalent to those ordinarily obtained by the use of more elaborate measures, such as the electric light bath, the hot air bath, or similar means.
THE SWEATING PACK.

For technic see

Physiologic effects.—If the patient is left in the pack for a sufficient length of time perspiration always begins through the accumulation of heat. Heat accumulation may be promoted if necessary by applying outside the pack a piece of rubber sheeting sufficiently large to permit the edges to be tucked in snugly on all sides. The patient should be given half a glass of water or lemonade every ten minutes, or until free perspiration begins. Water may then be given less frequently, but the water drinking should be continued as long as the patient remains in the pack. The sweating process may be continued for several hours, and is one of the most effective and convenient methods of inducing prolonged perspiration. The early hydropaths of the Priessnitz school frequently made their patients perspire for ten or twelve hours in succession. Such extreme measures are not to be commended, but there are cases in which perspiration may be continued for one or two hours with very great advantage.

Therapeutic applications.—This procedure is useful in both cardiac and renal dropsy, especially the latter disease, when the heart is not greatly weakened. Profuse perspiration removes from the body a considerable amount of chlorid of sodium and thus relieves the system from the ill effects of the retention of this mineral element, which is now recognised as the most common form of dropsy which accompanies certain forms of disease of the kidneys and heart. The sweating pack may be employed with excellent success in the treatment of pneumonia. Special instructions for its use in this disease will be found elsewhere (page ). It may be used with advantage in acute rheumatism, in which prolonged perspiration is of special service. The procedure is less useful in chronic rheumatism, but may be employed occasionally with benefit.
The sweating pack powerfully stimulates destructive tissue activity, which renders it valuable in obesity. It may be used with equal advantage in cases of dyspepsia, when the patient is not emaciated and if fairly robust.

Cautions and contraindications.--When the pack is followed by nervousness, headache, giddiness, or coldness of the hands and feet, the duration has probably been too great. If repeated, the length of the procedure should be considerably lessened. During the sweating pack the patient's face and scalp should be moistened to avoid over-heating of the head, and if necessary a towel wrung out of cold water may be applied and frequently renewed. Care must be taken, however, to avoid excessive cooling of the head, as by this means perspiration may be checked.
THE COOLING PACK.

For technic see page .

As this application of the pack is always for the purpose of reducing temperature so there is no danger of imperfect reaction, the method may be somewhat simplified. Instead of a long double blanket employ two single blankets. Lay these upon the couch one over the other, and after applying the wet sheet about the patient in the usual way, fold the blankets about the patient one at a time, taking care to tuck in snugly. As soon as this wet sheet becomes warm the blanket should be opened and the wet sheet removed and reapplied. It is well to have two sheets so that the second sheet can be wrung out ready for immediate application as soon as the first sheet is removed. The second sheet when warm should be replaced by a third sheet, and this process is continued until the desired effect has been obtained. Seven or eight, or even ten sheets may be employed if necessary. When the application has been properly made the length of time required for warming the cold sheet will be less with each successive application. The first sheet will usually be warmed in five to seven minutes; the second will require eight to ten minutes; the third twelve to fifteen minutes, etc. The patient's temperature should be taken after each application, and as soon as it reaches 101.5°F. or 101°F. the application should cease.

Ice water should not be employed. The wet sheet should be wrung out of water at 60°F. or 70°F. Ice water produces so intense a reaction that heat production is increased.

If the patient is inclined to chill and shiver with the application of the wet sheet he should be rubbed vigorously for a few seconds outside the sheet before the woolen blankets are applied. It is especially important to rub the legs.

Therapeutic applications.—The cooling pack may be employed in all continuous fevers. It is one of the most effective of all known means of
lowering the temperature. It has the advantage over the brand bath that it is much less violent, less disagreeable to patients, and may be employed without a bath tub or apparatus of any sort. Hence it can be utilized anywhere. The reduction of temperature obtained by it seems to be more durable than that obtained by the cold bath. It is an effective means which can be relied upon to lower the temperature in every case in which it is employed with sufficient thoroughness and continued for a proper length of time.

Cautions and contraindications.—In cases of fever in which the surface is cold, a hot blanket pack or some other heating measure should be applied from three to six minutes before the application of the wet sheet pack, so as to prepare the skin for the contact of cold water. In some cases the hot enema seems to be the most serviceable as a heating procedure. Not infrequently the vasomotor spasm which is the cause of the coldness of the surface may be overcome by a fomentation to the back or to the abdomen.

The dangerous experiment of combining the pack and the evaporating sheet should not be tried. The application owes its efficiency in large part to the reaction which follows the cold application. By this means the blood-vessels of the skin are well filled, circulation through the skin is rendered more active, and thus heat elimination is increased and the temperature lowered. It is for this reason important that the sheet should be snugly wrapped around the body and that it should be kept covered with woolen blankets as in the ordinary pack. Care must always be taken that the patient is not left in the pack so long as to experience a heating effect. The sheet should be changed as soon as it feels appreciably warm to the hand. The temperature of the sheet may be noted by loosening the blankets about the patient and slipping the hand underneath.

In connection with the cooling pack free water drinking and frequent enemas should also be employed. The patient should be made to drink a glass-
ful of water or of weak lemonade every half hour, and copious enemas may be employed three or four times daily. In acute fevers there is always a retention of sodium chlorid in the body through the inability of the kidneys to eliminate this element. It is hence important that salt should be omitted from the dietary.
THE DRY PACK.

This is a very old procedure. It has been in use at least for two or three centuries.

Technic.—The patient is wrapped snugly in woolen blankets after the application of the ordinary wet sheet pack, with the omission of the wet sheet. When the patient's skin is sensitive to the contact of wool, he may be allowed to wear thin under garments and cotton stockings. Bottles or rubber bags filled with hot water should be placed at the feet and the sides of the legs. Half a glassful of hot water should be given just before the patient enters the pack and continued at intervals of ten or fifteen minutes until profuse perspiration is established. The patient may be allowed to perspire two or three hours, or longer if necessary. To prevent extreme over-heating and exhaustion care should be taken to keep the temperature of the room at about 70°F. The face may be bathed occasionally with cold water, a moist napkin may be placed upon the forehead, and cold water instead of hot water may be given the patient to drink.

When available a large electro-thermaphore, in the form of a blanket heated by electricity may be used to very good advantage. It shortens the duration of the application, and greatly lessens its discomforts. In employing the electro-thermaphore the procedure is as follows: a large woolen blanket is spread upon the couch. The thermaphore is laid upon the blanket and another woolen blanket is placed upon the thermaphore. The patient with his clothing removed, or retaining only thin undergarments, is placed upon the couch, and a woolen blanket is wrapped snugly about him, then the thermaphore, and lastly the under blanket. A rubber blanket or mackintosh is placed over all and tucked in at the sides. When administered in this way the effects of the application are equivalent to the hot air bath. When the desired temperature is reached the current may be thrown off in whole or in part, to be turned
on again later if required. This perfect temperature control is a very great convenience.

After the bath a cold application of some sort should be made. In feeble patients this may consist of a cold mitten friction, a cold towel rub, or a cold half sheet rub. Strong patients, and especially those in whom it is desired to reduce flesh, may receive with advantage a vigorous cold douche, a wet sheet rub, a shallow bath, or a plunge. In cases in which rapid loss of flesh is desired, a swimming bath in water at a temperature of 75° F. or 80° F. is most desirable.

Physiologic effects.—This is a very powerful procedure which is nowadays frequently used. Sweating is used in large part by the accumulation of the natural heat of the body. The elimination of heat being interfered with the temperature of the body gradually rises, and when it reaches 0.7° above normal or 99.3° F., perspiration begins. When the bath is long continued the temperature may rise two or three degrees. This is the equivalent of artificial fever. As the temperature rises the patient becomes quite uncomfortable, the skin is hot and dry, the face flushed, and the pulse rapid. When perspiration begins the rate of the pulse diminishes and the patient becomes more comfortable.

The dry pack renders special service in cases of shock or collapse from whatever cause, in the cold stage of intermittent fever and in chronic rheumatism. In these cases it is preferable to avoid applications which involve wetting of the skin. It may also render excellent service in cases of obesity and in cases of dyspepsia in which the patient is fleshy and of good strength.

When employed for relieving shock an ice bag should be placed over the heart, and if the pack is long continued the blanket should be opened at intervals of fifteen or twenty minutes, and cold friction of the limbs should be
should be administered. This prevents the depressing effects of the heat upon
the heart, and aids in raising the blood-pressure.

Cautions and contraindications.—Great care must be taken to watch
the temperature of the patient during this application to avoid an excessive
and harmful accumulation of bodily heat. This is especially important when
the dry pack is used to abort a malarial chill or during a state of collapse or
continuous fever. The dry pack is a highly excitant procedure and must be
employed with great caution. When too long continued it may do great harm
by causing an excessive elevation of body temperature. The temperature of
the patient should be taken before entering the pack and at intervals of fifteen
minutes during the application, and if the temperature rises two degrees above
the normal temperature (that is, to 100.6° F.), the heat should be moderated
or the application should be interrupted.
THE HOT BLANKET PACK.

In this application the patient is enveloped in a blanket wrung out of water as hot as can be borne without discomfort.

Technic.—The requisites are a comfortable couch, a rubber blanket, four or five woolen blankets, a cotton sheet, a small air or cotton pillow, and several hot water bags or bottles or their equivalent.

The cotton sheet folded lengthwise is laid across the couch in such a way that the folded edge light overlaps the pillow. The rubber sheet is laid upon this, the upper edge falling three inches below the cotton sheet. Two dry blankets are spread over the cotton sheet in such a way that the upper edge falls an inch or two below the edge of the rubber sheet. A blanket quickly wrung as dry as possible out of water at 160° F. is spread over the dry blankets, and this is covered with a dry blanket. The patient previously dresses, or wearing only thin cotton underclothes is placed in such a position that the ears are on a level with the upper edge of the rubber sheet. The patient lies with the legs extended close together and the arms extended close to the sides of the trunk. The blankets are one by one brought over and tucked under snugly about the neck and under the sides. The rubber blanket is then folded over so as to completely incase the woolen blankets and to exclude air, particular attention being given to the neck and feet. Lastly, the cotton sheet is drawn snugly about the shoulders and neck to assist in keeping the rubber blanket in place and to protect the face from contact with it.

When given to induce perspiration the duration of the pack should be twenty to thirty minutes. Care should be taken to watch the temperature, which should not be allowed to rise over two degrees above normal.

When used for the relief of pain the application is of short duration, usually not more than five to ten minutes.

When employed to warm the skin in preparation for a cold bath, as in
fever, three to five minutes' duration is usually sufficient.

When employed as a sweating measure the patient should drink water freely, and the head and the hips should be frequently bathed in cold water. When cardiac weakness exists, ice bags may be placed over the heart during the application.

When the electro-thermaphore is available, this may be used with very great advantage. The method is as follows: A rubber sheet is first spread upon the couch. On this is placed the thermaphore. Over it is spread a sheet wrung as dry as possible out of warm or hot water. On this is spread a dry blanket, and on this the patient lies. The patient is first snuggly enveloped in the dry blanket. The moist sheet is then quickly wrapped around him, then the thermaphore blanket, and lastly the rubber blanket. The heat from the thermaphore evaporizes the water in the sheet so that the patient's body is very quickly surrounded by warm vapor, the temperature of which gradually rises. When the temperature reached is as high as the patient can bear, the current can be turned off to be turned on again later if necessary. This procedure has a great advantage over an ordinary hot blanket pack in that the temperature is gradually increased to the maximum, which can be maintained as long as desired, while in the hot blanket pack the maximum temperature is available only at the beginning of the application.

In cases of emergency good effects can be obtained by simply wrapping the patient in a blanket wrung as dry as possible out of very hot water, and retaining the heat by means of two or three dry blankets, with newspapers placed between.

Physiologic effects.—This is a highly excitant procedure. It raises the body temperature, quickens the heart-beat, lowers blood pressure, increases heat production, stimulates the action of the skin, and lessens nerve sensibility. The effects are on the whole essentially the same as those of the vapor bath.

Therapeutic applications.—One of the most important and valuable
applications of the hot blanket pack are for the relief of pain, for which purpose the application should be as hot as can be borne, and the duration five to ten, or at most fifteen, minutes. When employed for this purpose the application may be repeated several times within twenty-four hours if necessary to relieve the pain. A narcotic should never be resorted to until this measure has been tried, unless there are good reasons why it is not applicable, as its use is never followed by ill effects, which invariably follow the use of narcotics. As a means of relieving pain it is indicated in dysmenorrhea, lumbago, sciatica, gall-stone colic, renal colic, gastralgia, enteralgia, and ovarian neuralgia. This is one of the most powerful of all hydriatic methods of subduing pain.

As a heating procedure the hot blanket pack may be used in surgical shock and collapse, in cholera and cholera nostras, duration five to twenty minutes.

It may also be used in heating the skin in typhoid and other fevers when the skin is cold. The duration in such cases should be from three to six minutes.

As a sweating procedure, the hot blanket renders valuable service in acute and subacute rheumatism, in nephritis accompanying scarlet fever, uremic coma, muscular rheumatism, the albuminuria of pregnancy, in obesity, in dyspepsia when the patient is fleshy and robust, in renal dropsy and ascites from cirrhosis of the liver when there is not excessive weakness of the heart. Slight weakness of the heart does not necessarily contraindicate the application, as the heart may be easily protected by placing over it a rubber bag filled with ice, to be retained in place during the application.
THE HOT HIP AND LEG BATH.

This procedure is essentially the same as the hot blanket pack, except that it is confined to the lower half of the body, from the umbilicus down. In certain cases the application may be made to extend to the lower end of the sternum.

Technic.--The requisites are a double woolen blanket, two single blankets, and a rubber sheet. The double blanket is first spread upon the couch. Upon this the rubber sheet is laid in such a position that the upper edge will fall just above the umbilicus when the patient lies down. On this is spread one of the woolen blankets which has been wrung out of water as hot as can be borne, the upper edge falling just below the edge of the rubber sheet. Over this is spread the dry blanket. The patient is then placed in position and enveloped as quickly as possible, first with the dry blanket, then with the wet blankets, then with the rubber sheet, and finally he is completely covered with the double blanket so that no part of the body will be exposed to chill. Hot water bags or bottles may be placed about the hips and legs inside the rubber blanket for additional heat if necessary.

The electro-thermaphore is most convenient in this procedure. In its use an ordinary cotton sheet wrung out of hot water takes the place of the wet blanket, and the thermaphore is placed between the wet sheet and the rubber sheet. A much higher temperature can be secured, and the temperature can be maintained at the maximum as long as may be desired.

The temperature of the patient should be taken before the application and at intervals of ten or fifteen minutes during the application. If the temperature rises two degrees above the normal the current should be turned off or the procedure terminated. Care should be taken to protect the head by bathing it with cold water or by the application of a wet napkin to the face, and if necessary to the face and neck. If the heart is weak or if the
patient has a tendency to faint, an ice bag or a cold compress should be placed over the heart.

In general, a cold application of some sort should be made at the conclusion of the pack. The cold mitten friction, the cold towel rub, or the half sheet rub, is most convenient for this purpose, as the application can be made instantly on throwing aside the blanket and before there has been opportunity for the slightest chill through evaporation while moving about. The cold application should be short and thorough, and when there has been general sweating should include the whole surface of the body. Immediately after the cold application the patient should be quickly wrapped in blankets, and it is generally advantageous to apply a heating compress about each leg from the feet to the thighs. In cases of visceral inflammation a heating compress should also be applied over the inflamed part. If necessary this application may be renewed every three or four hours.

This cold application is essential not only as a means of refreshing the patient, and so preventing the atomie or depressant effect of the hot application, but also for the purpose of fixing the blood in the skin and so maintaining the derivative effect which the hot application has produced. After the cold rubbing a heating compress should be applied to each leg. This should be applied as follows: before the hot blankets have been removed, wring out of water at 60° F. two long linen towels, making them as dry as possible. After removing the wrappings and making the cold application, and with the patient entirely covered with blankets with the exception of one leg, apply a wet towel to the exposed leg, wrapping it around carefully so that it shall lie in snug contact everywhere. The apply a wide roller bandage of mackintosh from the foot to the hips. Cover this with a similar bandage of heavy blanket or with one leg of an old pair of thick, woolen underwear. After making the same application to the other leg both legs are enclosed in a thick woolen blanket, which should extend from the feet to the umbilicus.
If the application has been made for relief of inflammation as soon as
the heating compress has become well warmed up an ice bag should be placed
over the inflamed part. The ice bag should be withdrawn for five minutes,
a hot fomentation being applied in the interim.

Physiologic effects.--The physiologic effects are essentially the
same as those of the general hot blanket pack, but more localised, so that in
addition to the general and local analgesic or pain relieving effect this
measure is powerfully derivative, causing strong fluxion of blood to the lower
half of the body. When continued for a sufficient length of time the
effects which accompany the application of the general hot blanket pack will be
produced.

Therapeutic applications.--This application may be employed when more
convenient than the general hot blanket pack for all the conditions in which
that measure is recommended. It is especially valuable as a means of relieving
pain in sciatica, dysmenorrhea, ovarian neuralgia, and all painful affections of
the pelvis and lower extremities.

Perhaps the most important field of usefulness for the hot hip and leg
pack is in the treatment of visceral inflammations in which it is almost
indispensable, either by itself or in conjunction with other measures, which will
be explained under the succeeding heading.

This measure is indicated in all forms of visceral inflammation,
including pleurisy, pneumonia, inflammations of the liver, gall-bladder, bile
passages, inflammation of the stomach, small or large intestine, appendicitis,
inflammations of the ovaries, tubes, and uterus, in dysentery, inflammation
of the bladder, prostate, urethra, testicles, and in meningeal inflammations
of the brain and spinal cord, and it affords much relief in inflammations of
the upper air passages, and even in acute inflammations of the middle ear and
Eustachian tube.

When employed in connection with acute inflammations the applications
must be short, never of more than ten or fifteen minutes duration and the patient
should not be covered too warmly, as there is a tendency to elevate the body temperature. This tendency is especially marked when the elevation of the temperature already exists.

Cautions and contraindications.--There are few conditions in which this application cannot be employed when necessary for the relief of pain, provided the precautions already mentioned are taken in relation to the excessive elevation of the temperature. In cases of dysmenorrhea, accompanied by excessive flow, a hot water douche should be administered both before and after the application, to prevent increase of the flow.
THE REVULSIVE HIP AND LEG PACK.

A detailed description of this application is not necessary, as the technic is precisely the same as that of the hot hip and leg pack, with the exception of a single step. This, however, is of such great importance that it gives decided character to the application and entitles it to separate designation by a distinct name.

The special modification referred to is the following: after the dry blanket and the hot wet blanket have been brought into position and the corners tucked snugly under the hips, one or more ice bags are slipped under the upper edges of the blanket next to the skin and carefully placed over the inflamed part, for the relief of which the application is made. If the intestine, stomach, liver, or spine is involved, then the blanket should be extended as high up as the lower end of the sternum. In cases of pneumonia, pleurisy or pericarditis the ice bag may lie above the hot blankets, and should be covered by a dry flannel bandage passed about the body.

The general directions given for the hot hip and leg pack should be carefully followed in this procedure, special care being taken to avoid excessive elevation of temperature, as this measure is most frequently employed in connection with visceral inflammation in which there is more or less fever.

Physiologic effects.—The physiologic effects of this procedure are exceedingly interesting. They include the effects produced by the hot hip and leg pack, the general hot blanket pack, supplemented by the powerful reflex effects produced by the action of cold upon the skin surface. A hot application to the hips and legs diverts to the surfaces a large proportion of blood, which passes downward through the descending aorta. The effect of this is to lessen the volume of blood in any inflamed internal part, influencing also in the same way all portions of the upper half of the body. By the application of ice
bags over the inflamed parts, whether it be the liver, bowels, ovaries, appendix, testicles, heart, or lungs, a most powerful influence is brought to bear to lessen the volume of blood in the inflamed part by the contraction of the muscular walls of its vessels.

These two powerful factors are made to co-operate, one mechanically through collateral hyperemia of the skin of the lower extremities, the other reflexly through the stimulation of the vasoconstrictor centers. While the intensive hot application to the hips and legs lessens the volume of blood in all internal parts alike, the application of ice over the inflamed parts concentrates this beneficial application in the particular region where it is most needed. It serves, in other words, to focus the therapeutic energy of the application and to give true aim to our attack upon the morbid processes.

This combined procedure accomplishes more than to simply diminish the volume of blood in the diseased part. The real purpose of the application is to increase the movement of healthy blood through the inflamed part, for it is the blood that heals. Inflammation leads first of all to passive congestion. Stagnating blood is soon deprived of its oxygen, filled with paralyzing toxins, and elevated in temperature by the absorption of heat from the inflamed tissues. The tissues which it bathes thus become asphyxiated by the retention of carbonic acid gas; living cells become paralysed, or may even be destroyed by the accumulation of toxins, the leucocytes become exhausted in their battle with the bacteria or overwhelmed by immense numbers of microbes which they have swallowed or with which they are surrounded. The first requirement, then, is for an increased amount of blood, so that fresh supplies of oxygen and of active, robust leucocytes may be brought to the seat of war to freshen and reinforce the tissues in their battle with the invading bacteria. There is no drug known by which this thing can be accomplished.

Hot applications alone fail to accomplish the desired result for the reason that the general tendency of heat is to increase stasis, especially when
prolonged by still further dilating the relaxed vessels. When local applications of ice or cold compresses are made alone, the general effect is to produce chilliness with contraction of the internal vessels and resulting stasis of the movement of blood toward the interior, whereby the already over-filled vessels are still further distended. This gives rise to increase of pain and other symptoms, so that the application is generally abandoned. For this reason cases are exceptional in which benefit is derived from the use of cold applications alone. After many years of disappointing experiences with hot applications and cold applications employed by themselves, it occurred to the writer some years ago to combine these two measures in the one indicated in this procedure and in various other forms which will be later described. The results obtained were most happy, as has since been demonstrated in many hundreds of cases, not only in the writer's experience, but in the experience of other physicians who have learned and utilized this principle.

Another point of advantage in this procedure is this: cold applications made over an inflamed part, while exercising a beneficial effect by reflexly contracting the over-distended vessels, at the same time do not aggravate the pain by increasing nerve sensibility. Hot applications made over an inflamed part have a tendency to relax the inflamed vessels, so increasing the stasis. But through its admirable inhibitory effect, heat lessens nerve sensibility and so tends to relieve pain. It thus appears that with both the hot and the cold applications, we have a beneficial effect in one and a harmful effect in another. By employing the two applications simultaneously, however, in the manner indicated in this procedure, each applications serves as an antidote for the injurious tendency of the other, while the two applications co-operate to secure the object desired, each enhancing the beneficial effect of the other. These effects are secured by making the hot application to cover a large territory since it is chiefly useful through its derivative effects, while the cold
application should be small, barely sufficient to cover the inflamed part or the reflex area related to the affected organ.

Therapeutic applications.—The revulsive hip and leg pack is a measure of the highest importance for the treatment of visceral inflammation of every sort. As above indicated, it may be employed for relief of every form of internal inflammation involving any part from the head to the rectum. The principle is exceedingly simple: A hot application to the whole lower half of the body combined with an application of ice over the inflamed part. The hot application prevents retrostasis or the inward movement of blood, which the ice bag alone is likely to produce. Hence the hot application should be given first. Then after the heating up of the skin is begun, the ice bag is applied, thus preventing any shock to the patient and the increase of pain, which almost certainly follows the application of the ice bag without the heating application.

This application renders its greatest service perhaps in pelvic inflammations of women. It is almost delightful to note the speedy relief which follows the application in all forms of pelvic inflammation which have not yet reached the suppurative stage. When the inflammation is confined to one side, two ice bags should be applied low down close to the groin on the affected side; when both sides are affected four or five ice bags or a large ice compress should be applied so as to cover the entire hypogastrium. The heating enema and the hot douche should also be employed in connection with the revulsive pack, which may be repeated every three or four hours.

The same plans should be followed in the treatment of acute appendicitis. In general, almost complete relief can be obtained within half an hour or an hour after the application is made. If the temperature falls and all of the symptoms subside, operations may be avoided. If, however, the symptoms are not relieved within two or three hours, the advisability of a surgical operation should be considered.
The application is indicated in inflammation of the testicles, prostate and uterus, in inflammation of the ovaries, and in peritonitis. It is an effective preventive of peritonitis, and for this purpose has for many years been employed by the writer as a routine measure after operations upon the pelvic viscera. Its effect in relieving pain in these cases is so remarkable that the use of a narcotic is seldom ever necessary. The patient frequently falls asleep during the application, and by its aid is usually able to obtain several hours of good sleep even during the first night following most severe operations in the pelvic region.

In inflammations of the prostate and testicles ice bags should be applied to the perineum and groins.

Further indications for the use of this procedure are, enteritis, dysentery, perityphlitis, acute gastritis, inflammations of the gall bladder and bile passages, inflammations of the spinal cord, cerebro-spinal meningitis, acute pleurisy, pneumonia, bronchial pneumonia, pericarditis, inflammation of the larynx and pharynx, and inflammations of the middle ear.

Cautions and contraindications.—Inflammation of the bladder is almost the only form of visceral inflammation in which this procedure is contraindicated. Cold applications over the bladder increase the tenesmus, which accompanies cystitis and aggravates the distress which the patient experiences. On this account the ice bag cannot be employed, and the hot hip and leg pack should be used without the ice bag.

Special care must be taken in applying the cold towel rub or mitten friction following the hot application to avoid producing general chilliness. Great care must also be taken that the heating compresses are kept continuously warm so as to maintain a congested condition of the skin of the lower extremities. If the applications are allowed to become cold an effect the very opposite of that desired will be produced; the patient's pain will be increased and the disease aggravated.
THE HALF PACK.

This application differs from the general wet sheet pack only in the fact that it is confined to the small area extending from the arm pits to the middle of the thighs. When still more limited, extending from the arm pits to the hips only, it is known as the "trunk pack."

Technic.--The requisites are a folded cotton sheet, a rubber sheet, a folded woolen blanket, and a half sheet. These are laid upon the bed in the order named, the half sheet being wrung as dry as possible out of water at 60° F. The wrappings are drawn about the body and tucked in as snugly as possible, the dry cotton sheet being last of all, drawn over and pinned snugly, especially at the upper and lower borders so as to prevent the entrance of air. The entire body of the patient should be wrapped in blankets, and if the feet are cold they should be rubbed and dry heat applied.

The duration of the application should be from thirty or forty minutes to several hours. The average duration should be about one hour, or until the skin becomes thoroughly heated. On removing the pack the parts involved should be vigorously rubbed with cold water, either with the hands with a friction mit, or with a wet towel. After thorough drying massage cream or oil should be applied and the patient should dress quickly and exercise for half an hour.

Physiologic effects.--The half pack has a strong derivative effect in relation to the viscera of the trunk. The first contact with the cold water causes contraction of the surface vessels followed by an intense reaction, in which the surface vessels are widely dilated. The dilatation of the surface vessels is more prominent than that which follows a hot application. This measure improves the function of the liver, stomach, pancreas, and other digestive organs. It promotes gastric and intestinal motility, and stimulates
absorption.

**Therapeutic applications.**—This measure is useful in almost all disorders of the stomach, liver, kidneys, and intestines. It very appropriately follows a hot fomentation over the liver or abdomen. It is especially indicated in hyperpepsia or hyperhydrochloria, in jaundice, gall-bladder diseases, intestinal catarrh, auto-intoxication from infection of the colon, in most forms of chronic dyspepsia, hypochondria, most neurasthenics, whenever there is extreme tenderness of the abdominal sympathetic ganglia, in abdominal dropsy, dyspepsia, and in obesity, affecting chiefly the abdominal region.

There are few if any contraindications.
THE COMPRESS.

This is simply a small pack. It is ordinarily applied by a cloth moistened with water at the desired temperature; but clay, felt, sponge, and various other materials may be employed. Cheese cloth or linen toweling answers very well for the purpose. The best material is perhaps Russian crash, such as is commonly used for dish-cloths.

The compress is usually covered by flannel, and is sometimes reinforced by mackintosh or other impervious material. When it is desired that the original temperature at which the compress was applied should be maintained, rubber bags filled with hot or cold water, or a rubber coil through which hot or cold water is passed may be employed. In case of the hot compress, an electro-thermaphore may be applied over the moist cloth to maintain the necessary heat.

Of the many forms of compress the following will receive special attention: 1, the very hot compress—the fomentation; 2, the dry hot compress; 3, the cold or cooling compress; 4, the alternate compress; 5, the revulsive compress; 6, the simultaneous hot and cold compress; 7, the heating compress; 8, the combined or hot and heating compress; 9, the proximal compress.
THE HOT COMPRESS OR FOMENTATION.

This consists of a cloth or sponge wrung out of hot water and applied to the parts indicated, usually at a temperature as high as can be borne.

Technique.—The requisites are, a fomentation cloth, which may consist of a portion of a woolen bed blanket, or in cases of emergency an undershirt or almost anything else capable of holding a consider amount of water. The size of the cloth is important; it is generally too small. It must be at least three or four times as large as the parts it is desired to influence. For example, to relieve a pain in the stomach the cloth when folded should be two feet in length and one foot in width. In addition to the fomentation cloth, there should be provided a still larger cloth to be placed over the fomentation for the purpose of retaining the heat. It is desirable also to have a piece of mackintosh to place next to the moist cloth. In the absence of mackintosh, however, it is well to employ several thicknesses of newspapers. An ample supply of very hot water must be provided. The nearer the temperature of the water to the boiling point the better.

The patient if possible should be in bed with the ordinary clothing removed. The sleeping gown and bed clothing should be well protected, as if they become wet the patient may by contact with the moist surface afterwards become chilled and thus the effect of the fomentation may become neutralized. If the application is to be made to the trunk care should be taken to see that the feet are warm.

Everything being in readiness, the fomentation cloth is immersed in water and then wrung as dry as possible. A clothes wringer is most convenient for the purpose. A practical method is to fold the cloth in a towel or a piece of muslin of proper size, leaving the ends of the towel long enough so that the fomentation cloth may be immersed without wetting the hands. By twisting the ends of the towel and stretching lengthwise, the fomentation cloth may be well
wrung; or one end of the fomentation cloth may be wet and folded into the dry portion so that in wringing it the hands will be partially protected from contact with the hot water. Still another plan is to employ a sufficiently large fomentation so that it will be necessary to wet only the central portion, leaving the hands dry for wringing. If the water is very hot it is important to wring the fomentation very dry; when the temperature of the water is lower, more water may be left in the cloth. As quickly as possible after wringing, the cloth should be spread out, applied to the part prepared to receive it, and covered at once with the dry flannel or mackintosh and flannel, so as to retain the heat as long as possible. If too hot it may be lifted a little with the hand until it cools slightly and the patient becomes able to bear it. At the end of four or five minutes the application should be renewed. Three applications are ordinarily sufficient. At the end of the application the parts are quickly rubbed with a towel or the hand dipped in cold water. When more intense effects are desired a piece of ice may be rapidly rubbed over the surface.

Great care must be taken to avoid burning the patient. An excellent precaution is to employ next to the skin an extra thickness of dry flannel, so that the fomentation shall not come in actual contact with the skin, but only the warm steam or vapor which emanates from it.

The necessity for renewing the fomentation may be obviated by the application of large water bags filled with hot water next to the wet cloth underneath the dry covering.

A thermo-phore affords a still more efficient and convenient method of maintaining a maximum temperature. This consists of a pad in which are interwoven German silver wires. By passing an electric current through the wires they are heated and by proper adjustment of resistance and current the desired amount of heat may be obtained.
In the use of the thermaphore the following is a most convenient method: lay upon the skin a single thickness of dry flannel. Lay upon this a towel or napkin of proper size wrung out of hot water. Upon this place the thermaphore and over all the mackintosh or several folds of flannel. As soon as the current is turned on warming begins and the temperature gradually rises to the maximum, at which it may be maintained as long as desired. It is now possible to obtain thermaphores of different sizes and shapes adapted to different parts of the body.

In emergency a fomentation may be improvised in a variety of ways. A very quick method is to wet a cloth in cold water, cover it with newspaper and hold it against the side or top of a stove or about a stove pipe for a few minutes. The paper being moistened, it is not burned, and protects the fomentation cloth from being soiled. Another method which has on occasion proved serviceable is to spread the wet cloth over the bottom of an inverted milk pan or sieve, or on a piece of wire netting. By holding this over a kerosene lamp or stove the cloth may be quickly heated.

If more convenience a hot water bag covered with moist cloth furnishes an excellent means for fomenting a small area.

Physiologic effects.—The hot compress as well as the cold compress produces both local and reflex effects. Locally the fomentation excites tissue activity by raising the temperature of the parts with which it is in contact. The blood-vessels are dilated, hence the amount of blood contained in the parts is greatly increased. The sensibility of the nerves is at first increased then diminished. The veins appear to be dilated more than the arteries, which accounts for the dusky red color produced by the fomentation. This is quickly changed, however, to cherry red when the fomentation is immediately followed by a cold application. The reflex effects of the fomentation is to dilate the vessels of the internal parts which are in nervous relation with the skin surface to which the application is made.
One of the most valuable and remarkable effects of the fomentation is the relief of pain which it induces through diminished nervous sensibility. This effect is not confined to the parts in immediate contact with the fomentation but through reflex action is extended to internal parts. This anodyne effect is believed to be produced through the thermic nerves. The fomentation is usually followed by a more or less tonic or depressant effect. In this regard its effects are the opposite of those following a cold application. This observation does not apply, however, to very short, hot applications which appear to be purely stimulant or tonic in their effects, as is the case with short cold applications. When large or prolonged fomentations are employed, considerable systemic effect is commonly produced, as manifest by sweating, increased pulse rate, often flushing of the skin, and a feeling of fulness in the head. These effects must be counteracted by cold applications to the head and by the general cold application following the fomentation.

Experiments have shown that an elevation of temperature is a necessary means of increasing vital resistance in various forms of infection. The elevation of temperature produced by the fomentation is doubtless of service in cases of this sort, especially in carbuncle and in furunculosis. This effect may extend to deeper parts, the temperature of which may be raised by prolonged applications of heat to the overlying parts of the skin.

Therapeutic applications.—The fomentation is nearly always indicated when it is desired to relieve pain, to dissipate an effusion or an exudate, to stimulate tissue change or functional activity in superficial parts, or in reflexly related deep-lying parts.

When employed for the relief of pain the fomentation should be followed by a heating compress protected by a mackintosh.

Powerful revulsive and derivative effects are also produced by the fomentation, whereby internal congestions are removed.

The tension of the abdominal muscles due to internal irritation, congestion, or inflammation, may often be speedily removed by a very hot
fomentation, a fact which affords excellent evidence of the influence of these superficial applications upon deep-lying parts.

A fomentation is always indicated in cases of acute or chronic gastritis, inflammation of the gall-bladder or liver, acute or chronic inflammation of the large or small intestines, the appendix, ovaries, uterus, fallopian tubes, bladder, and other abdominal viscera, as well as in inflammation of the lungs, pleurae and other deep-lying parts.

It affords great relief in the distressing pain of neuritis, in gastric ulcer, gall-stones, and renal colic. While in the last mentioned conditions it rarely affords complete relief, it so modifies the pain that the amount of anodyne required is greatly diminished.

A short fomentation applied an hour after meals greatly relieves the pain due to hyperacidity.

A more prolonged hot application is equally useful in hypoacidity.

For pain in the eye ball, whether or not accompanied by inflammation, a fomentation may be applied to the forehead just above the brow.

For the pain of toothache and earache a fomentation should be applied to the side of the face, avoiding, however, the skin surface below the level of the lower jaw. Hot applications to the neck dilate the carotid vessels and so increase congestion and pain.

Back-ache, pain between the shoulders, pain at the back of the neck, and often vertigo and headache may be relieved by a fomentation to the spine following or preceding a fomentation to the abdomen.

A very hot fomentation to the lower end of the spine and buttocks is an excellent remedy for incontinence.

The fomentation may be used with advantage in typhoid fever, peritonitis and all inflammations of the pelvis and abdomen.

It is equally indicated in the following conditions: diphtheria, tonsilitis, pneumonia, pleurisy, laryngitis, inflammation of the prostate,
inflammation of the bladder, lumbago, sciatica, nervous headache, neuralgia
of the joints, or for boils, carbuncles, acne, dysmenorrhea, chorea, muscular
spasm, corneal ulcer, herpes circinatus, chronic eczema, and in nearly all
painful and inflammatory maladies.

Cautions and contraindications.—Care must be taken to avoid burning
the patient in cases of great feebleness, when the patient is unconscious, or
in cases of paralysis. A temperature which will produce no harmful effect
in a normal person may cause a painful blister in an individual whose resistance
is lowered by disease, especially when the circulation of the blood is feeble.
Care must be taken to antidote the depressant or heating effect of the
fomentation by a suitable cooling application of some sort.

It should be remembered that a very hot application is necessary
for relief of pain; as a rule, the higher the temperature the better.

When raw surfaces are present in the area fomented, they should be
protected by mackintosh or some other impervious material.

When applied to the abdomen during the menstrual period the menstrual
flow may be unduly increased. If the fomentation is undesirable the excessive
flow may be controlled by a hot douche.
THE COLD COMPRESS.

The ordinary form of this compress consists of towels, napkins, or cloths specially prepared for the purpose, folded three or four thicknesses and saturated with water at 60° F. or less. In application care should be taken to renew the compress as soon as it ceases to be cold and before it becomes actually warm. To allow the compress to remain in place until it becomes thoroughly warmed may prevent or actually reverse the desired effect.

For a very cold application the compress is wrung out of water containing ice, the temperature of which should be about 40° F. When the heat of the parts to which the compress is applied is very great, bits of ice may be placed between the folds of the napkin, or in place of the compress a rubber or aluminum coil may be placed next to the skin or over a thin wet cloth lying upon the skin; or if more convenient rubber bags filled with broken ice may be employed.

When ice cannot be obtained water may be cooled by the addition of some chemical substance, as nitrate of ammonia. The addition of eight ounces of nitrate of ammonia to a quart of water at ordinary pipe temperature lowers its temperature twenty-five or thirty degrees. The cooling effect of such a solution may be utilized by placing it in a rubber bag or a bottle. The nitrate of ammonia may be recovered by evaporating the water, and may thus be used repeatedly.

In the use of the cold compress, especially when ice bags or ice water is employed the application should be interrupted for five minutes every half hour to allow the skin to recover its sensibility. The size of the compress must be made commensurate with the effects expected of it. When the purpose is to obtain reflex effects upon some internal part, the compress should cover the portion of the skin which is in special reflex relation with the part interested (see page __). If the purpose is to lower the body temperature...
the size of the compress should be sufficient to cover at least one-fourth of the surface. This requires a compress having an area covering about five square feet for the adultry average size. For a child of ten years with a height probably about fifty-one inches the compress should cover an area of two and one-half square feet.

The ice bag should never be applied directly to the skin. A thin dry flannel cloth should be placed between it and the surface of the body. This precaution is necessary to avoid injury from freezing of the skin. It should be remembered that in conditions of disease the resistance of the tissues is very greatly lowered, so that freezing may occur much more readily than in healthy persons.

Physiologic effects.—A cold compress contracts the vessels of the skin with which it is in contact. When the application is of brief duration this contraction is quickly followed by dilatation of the vessels and reddening of the surface to which the application has been made through the increased blood-supply. After a prolonged cold application contraction is much delayed, but continuous for a longer time than after a short application.

The cold application of course abstracts heat from the tissues with which it is in contact and lessens their vital activity; perspiration is checked; circulation of blood through the parts is diminished, and all functional activity is lessened.

The most remarkable effect connected with the local application of cold is the reflex effect produced in internal parts. This subject has been studied at length also (see page __), so it is only necessary in this connection to recall the fact that when the surface vessels contract, as in a cold application, the vessels of the particular internal part which is in reflex nervous relation with the portion of the skin cooled, are also contracted.

If the application of the compress is brief the internal contraction as well as the external application is also brief and is followed by increased
dilatation of the vessels and increased activity of the circulation. In other words, the same changes in the circulation which occur upon the surface, also occur in the internal parts which are in reflex relation with the particular skin surface involved. When the cold application is prolonged the contraction of the internal vessels as well as of those of the skin is likewise prolonged.

These facts give to the compress great value as a means of controlling the volume and movement of blood in internal as well as external parts, and since the activity of every organ depends upon its blood-supply, it will readily be seen that by this means we may be able to increase or diminish at will not only the amount of blood in any internal part, but the movement of blood through the part, to increase or diminish the activity of its functions, and to a great extent to control all its vital activities, both in health and in disease.

It is important not to forget in making cold applications that the contraction of the vessels of the parts to which the application is made necessarily increases the amount of blood contained in the vessels of other parts, so that not infrequently special precautions are necessary to avoid doing harm by too greatly unbalancing the circulation.

It is important also to recall the fact that the direct effect of cold is to lessen the activity and to diminish nervous sensibility. When ice is employed the nerve endings in the skin may be cooled to such an extent that their function is entirely abolished. When this occurs the normal reflex action is interrupted and the effect produced upon the internally related parts is the opposite of that which is first produced when cold is applied; hence the important rule, observance of which should never be neglected, that very cold applications must be interrupted for at least five minutes at the end of every thirty minutes, to permit the nerves of the skin to recover their normal sensibility. The recovery of the nerves may be facilitated by rubbing, and may be accomplished almost instantaneously by a hot application.

The beneficial effects sought through the application of cold are
generally obtained by means of reflex action, and not by direct cooling. For example, when the ice bag is applied over an inflamed ovary the ovary is not cooled by proximity to the ice bag, but by the emptying out of the too long retained and over-heated blood which results from the contraction of its arteries, and by the increased movement of blood through it whereby the accumulation of heat is prevented. This is, of course, true in relation to all internal parts. It is nevertheless true that cooling of the tissues to a considerable depth may take place beneath the ice bag or the ice compress. The writer has observed a fall of five degrees in the temperature of the skin of the epigastrium as the result of drinking in rapid succession several glasses of lemonade at 58° F. This observation was first made by Dr. F. J. Otis in 1898, then a medical student, while making experimental researches in hydrotherapy under the writer’s direction. By placing a thermometer in the mouth it may easily be shown that the internal temperature is reduced by a piece of ice placed against the cheek.

Special effects are produced by the application of cold to certain parts of the body. Prolonged cold applications over the heart (15 to 30 minutes) slow the pulse and raise blood-pressure. Continuous cold applications depress the energy of the heart. Prolonged cold applications to the head produce lowering of the general temperature and vital depression. When a cold application is made over the trunk of an artery, the artery contracts, together with all its branches, a fact which may be utilized to great advantage in special cases.

Therapeutic applications.—The cold compress is indicated in all forms of acute inflammation, externally and internally. When employed for the relief of internal inflammations, it should generally be combined with some form of hot applications, as the hot hip and leg pack (see page 157). Great care must always be taken to avoid general chilling when used for this purpose,
as the contraction of the surface vessels will necessarily increase the amount of blood in the interior and thus counteract any good which may be accomplished by the external application of cold. The rule should always be that the cold application should be made over the inflamed part, and that it should be large enough to cover the reflex skin area associated with the part. Cold applications are hence usually small, while hot applications on the other hand are almost invariably relatively large. At intervals of half an hour the cold application should be removed and a fomentation applied.

Moderately prolonged cold applications (10 to 20 minutes' duration) are of service in energizing and exciting the activity of internal parts. The ice bag over the heart greatly increases cardiac energy, slowing the pulse rate and raising blood-pressure.

An ice bag over the stomach for fifteen minutes half an hour before meals excites gastric motility and promotes the secretion of gastric juice.

A cold application over the bowels or bladder or to the soles of the feet excites contraction of the bowels and bladder.

A cold compress applied over the chest for fifteen minutes every hour greatly increases the depth and fulness of respiration. Hemorrhage from various parts may often be promptly controlled by the proper cold application: for cerebral hemorrhage ice bags or a cold compress to the back of the neck; in uterine hemorrhage the cold compress to the suprapubic region and to the upper and inner surfaces of the thighs; for intestinal hemorrhage ice bags over the umbilical region; in hemorrhage from the bladder ice bags over the bladder; for bleeding hemorrhoids a cold compress to the buttocks; for hemorrhage from the lungs a cold compress over the chest; for hemorrhage from the kidney, cold to the thighs and sternum; in cases of capillary oozeing from a wound the cold compress may be directly applied to the bleeding parts; nose-bleed may be checked by an ice bag applied to the back of the neck while cloths wet in ice water are applied to the face; hemorrhage from the stomach may be checked by an ice bag
applied to the epigastrium.

In most continuous fevers, especially in typhoid fever, the cold compress may be used with excellent success as a means of lowering the temperature, or perhaps we should more properly say, as an accessory means in connection with the cold bath, the graduated bath, or a cooling pack, as the compress alone is not a sufficiently powerful antipyretic means to control temperature in grave febrile conditions. The proper use of the compress in the intervals between the applications of more vigorous measures. For example, after the Brand bath, or a graduated bath, or a series of cooling packs have been administered, and when reaction is well established, the cold compress may be applied and renders extremely valuable service in maintaining the beneficial effect which has been obtained.

The average size of the compress should be about three feet in length by eighteen inches in width. It should consist of six thicknesses of cheesecloth, or two of ordinary toweling. The temperature of the water should be 60° F. or 70° F., and the compress should be wrung just dry enough so that the bed-clothing will not be wet. The compress should be applied over the whole front of the body, from the arm pits to the thighs, and should be made to fit the surfaces snugly, and should be covered with one thickness of dry flannel. The compress should be allowed to warm up, but it should be removed as soon as it reaches the skin temperature, which will usually require ten to twenty minutes, according to the intensity of the fever. Each time the compress is renewed there is a contraction of the internal vessels, which induces a thorough flushing of the parts with fresh blood and relieves the passive congestion which is constantly present in the great visceræ of the abdomen. A considerable amount of heat is abstracted by the warming up of the compress, as will be seen by a simple computation. Suppose, for example, the compress contains one pound (one pint) of water at 70° F. The raising of this water to the temperature
of the skin, say 100° F., requires thirty heat units. If the compress is changed every ten minutes, or six times an hour, this would amount to 180 heat units every hour, which is nearly half of the total amount of heat normally produced in that time. If we suppose the rate of heat production to be double in fever, it appears that by such a use of the compress one-fourth of the amount of heat generated, or half the surplus produced, may be removed by the assiduous use of the cold compress. This requires, of course, that the compress should be removed as soon as the skin temperature is reached. If the compress is allowed to remain until superheated, or until it becomes dry, as may easily happen if the nurse is ignorant or inattentive, the patient will be damaged instead of benefited.

The cold compress over the heart or anterior portion of the chest is of great service in pneumonia, myocarditis, and in pericarditis. The cold compress should be applied over the heart for fifteen or twenty minutes, at intervals of two or three hours in all cases of continuous fever. This application not only sustains the heart, but in some degree aids in lowering the temperature.

The cold compress can be advantageous in most superficial inflammations, such as erysipelas, inflammations of the eye lids, and in various other forms of dermatitis. In these cases the compress should be allowed to become slightly warmed before removing it, but it should be changed before it reaches the temperature of the skin.

Cautions and contraindications.—Care must always be taken to avoid injuring the skin by excessive or prolonged use of the cold compress, particularly when ice or ice bags are employed. Chilling, or even freezing, of the skin, occurs much more easily in sick or feeble patients than in normal, healthy individuals. Paralysed parts may be easily frozen because of diminished sensibility and deficient circulation.

The efficiency of very cold applications is often increased by a very hot application for one or two minutes at intervals of half an hour. This is
especially true if pain is present.

When used for relief of superficial inflammation cold applications must be withdrawn after the first few hours, or whenever the tissues assume a dusky hue. Short hot applications with the heating compress in the intervals are then to be employed instead of continuous cold.

When pain is increased by a cold application it should be removed or the application should be modified by the employment of heat in conjunction with the cold application, as in the revulsive hip and leg pack. Other combinations may be made, as will be described elsewhere under the heating, "The Hot and Cold Compress" (see page ___).

When employed in fevers to control the temperature the temperature of the water employed should not be below 60° F. Colder water excites heat production and is then injurious.

In some cases of dermatitis, and when employed for cooling the head, a thin compress may be sometimes used to advantage. It should be lifted occasionally so that it may be cooled by evaporation. The evaporating compress should not be used as a means of reducing temperature in fever, as it produces uncertain and often undesirable effects. The moistened hair acts as an evaporating compress, and hence in fever patients the hair should be kept continuously and thoroughly moistened.
THE PROXIMAL COMPRESS.

This compress is the result of the practical application of the fact first utilized by Priessnitz, afterwards scientifically worked out by Brown-Sequard and others, that the application of cold across the trunk of an artery not only contracts the vessel at the point of application, but from that point to its terminus, together with its branches. This measure may often be utilized as a means of controlling inflammation in parts to which the application of the cold compress may be either inconvenient or impossible.

The temperature of the proximal compress should be $60^\circ$ F. to $50^\circ$ F. It should be made continuous, but should be interrupted for four or five minutes every half hour. Hot applications should not be made, however, as these dilate the arteries.

The following are the most practical applications of this measure: an ice compress or ice collar to the neck in congestion or inflammation of the brain; an ice bag to the axilla for the whole arm, or to the bend of the elbow for the hand; the ice bag or cold compress to the groin for the whole leg, or to the bend of the knee for the foot.
THE DRY HEATING COMRESS.

It is sometimes inconvenient or impossible to apply the moist heating compress or the fomentation. In such cases practically the same results may be obtained by the application of the dry compress. For this purpose a great variety of measures may be employed, such as the hot water bag, hot bottles, hot bricks, bags of hot sand or salt, etc.

The most convenient of all means when available is the electro-thermaphore. It consists of a specially woven pad in the meshes of which are interwoven German silver wire. By passing the current of electricity through this wire the pad may be heated and a definite temperature maintained for any desired length of time. In use the skin is covered by a single thickness of dry flannel. The thermaphore is placed on this, and upon this a piece of mackintosh or some other impervious material to prevent the escape of heat. A flannel bandage should be placed over all to hold the thermaphore in place. The maximum heat is quickly attained and may be continued indefinitely. After a short time the skin becomes moistened by perspiration, which being retained by the mackintosh accumulates, so that the actual effect of the application is that of the fomentation, or a local vapor bath.

Physiologic effects.—The physiologic effects of the heating compress are in all respects akin to those of the fomentation, but are sometimes less agreeable on account of the extreme tension of the skin through over-heating before perspiration begins.

Therapeutic applications.—The therapeutic indications of the dry hot compress are the same as those of the fomentation.

The same cautions and contraindications are also applicable.
THE ALTERNATING COMPRESS.

This procedure consists in the alternate application of hot and cold compresses.

Technic.—A very hot fomentation is applied for one half minute. Instantly on its removal a cold compress is applied for fifteen to twenty seconds. When purely revulsive effects are desired the fomentation is continued for three or four minutes and the cold application for ten to twenty seconds only.

Physiologic effects.—The alternate compress when the applications are nearly of equal length is a strongly exciting measure, combining the excitant effects of both heat and cold, since the duration of the application of both the heat and cold is too short to develop sedative effects. When the hot application is continued for three minutes or more, the characteristic sedative effects of heat are developed, and by making the cold application very short, only long enough to remove from the skin the heat which has been stored up in it by the fomentation, no exciting effects are produced, and thus purely sedative effects are secured.

The effects may be somewhat varied by lengthening the relative time of application of the hot and cold. In general, however, the hot applications should be about twice as long as the cold. The application should always begin with hot and end with cold. The temperature of the hot application should be as high as can be borne without injury to the skin, and the cold application should be from 60° F. to 40° F. The greater the difference in temperature the more intense will be the effects produced.

The most intense effects can be secured by substituting for the cold compress rubbing with a piece of ice. The duration of the ice rubbing should not be over five to ten seconds. The duration of the hot application should be at least one half minute. This mode of application is too exciting for very feeble or very nervous patients. It is easily tolerated, however, by patients
who are fairly strong, and especially by those who are accustomed to hydraulic procedures. It is the preferable method when the patient is unconscious or in a state of apathy.

The ordinary duration of the application is ten to fifteen minutes. No harm, however, can result from a more prolonged application.

The most important regions to which this application is made are the spine, the head, over the liver, the spleen, the abdomen, and the chest. Highly exciting and immediate localized effects are produced by applications to the several regions of the spine, especially the neck for the brain, the dorsal region for the heart, lungs and stomach, the lumbar region for the kidneys, bladder and bowels, the sacral region for the bladder and pelvic organs.

Physiologic effects.--The alternate application of heat and cold in rapid succession produces powerful excitant effects upon the central nervous system; the applications being of brief duration, only the excitant effects of heat are produced, and the same is true of the cold applications. Indeed, the excitant effects of both the heat and cold are intensified by the combination, since in one case the skin temperature is raised, while in the other case it is lowered so that each application prepares the skin to receive the most powerful impression possible from the succeeding application. The contraction produced by the cold application is very brief in duration, for the hot application which succeeds it produces complete and instantaneous reaction. All the spinal centers are represented in the skin of the back through the posterior branches of the spinal nerves; hence, by an application to the spine profoundly excitant effects upon all the spinal ganglia may be produced, an effect equal in extent though less in degree to those which might be produced by similar applications to the entire surface of the body. When it is remembered that all the important viscera of the chest and abdominal cavities—heart, lungs, stomach, liver, spleen, pancreas, intestines, and pelvic organs—are all governed in their
functional activities by their respective ganglia in the cord, it will be seen at once that this procedure must be one by means of which most profound effects can be produced in the emunctories, digestive glands, and other important viscera which preside over the great functions of life. The vital changes which occur in the viscera as the result of these applications to the spine have now been pretty well worked out. The following are the chief:

1. Through reflex stimulation the excitation of the gland cells leads to increased secretion. Excitation of the muscular structures, as in the case of the heart, the stomach, and the intestines, leads to increased contractile vigor; the heart is energized, and the motility of the stomach and intestines is increased.

2. Most profound effects are produced upon blood circulation in the related internal organs. These changes correspond to those which are produced in the skin. The hot application which dilates the skin vessels at the same time dilates the vessels of the related viscera. The succeeding cold application which contracts the skin vessels likewise contracts the visceral vessels. Consequently, with each repeated application there is executed in the viscera a movement which is equivalent to a pumping process, whereby its circulation is greatly accelerated. With each hot application the blood-vessels are widely opened up and filled with the inflowing blood from the general blood stream. With each cold application the vessels are made to contract with vigor, emptying the vessels and forcing the blood onwards into the veins. It thus appears that the alternate spinal compress affords a means by which the blood movement of the internal organs may be accelerated to an extreme degree.

In addition to the remarkable physiologic effects above mentioned, which may be considered as the principal and characteristic effects of the alternate compress, this procedure is also to a marked degree revulsive in relation to the blood-supply of the spinal cord. The repeated contraction and dilatation of the vessels of the skin over-lying the spine and the thorough
and repeated reaction effects which are induced in the skin area, finally leaves
the blood-vessels of the skin area in a thoroughly dilated state. This
superficial hyperemia of the skin creates a collateral anemia of the spinal
cord; that is, the over-flowing of the vessels of the skin diverts a considerable
amount of blood from the connecting vessels which supply the spinal cord.

By increasing the supply of fresh blood and then by temporarily slowing
the rate of blood movement during the hot application, leukocytosis is
encouraged; these favorable conditions are established for the accumulation
of the white blood-cells in the tissues of the parts acted upon, both externally
and internally. The value of this principle of the alternate compress cannot
possibly be over-estimated.

Therapeutic applications. -- A comprehension of the physiologic
effects produced by this procedure must at once open up for this measure a large
field of usefulness. There are few invalids in whom it may not be advantage-
ously employed one or more times daily. The great majority of cases of chronic
dyspepsia, neurasthenia, general malnutrition, auto-intoxication, and chronic
constipation, are likely to receive benefit from this procedure. One of the
advantages of this measure if the fact that the patient generally feels an
immediate relieving effect. In the neurasthenic powerful stimulation of the
nervous centers arouses the brain and spinal cord to improved activity; depression
gives place to buoyancy, misery to hope and exhilaration; back-aches, head-aches,
lassitude, ennui, weakness and apathy, disappear often almost as if by magic;
the patient seems lifted into a new world.

This effect of course is temporary, but repeated application in
combination with other appropriately adapted procedures gradually conducts the
patient to permanent improvement. No one who has not made a systematic
application of this procedure can possibly appreciate its great value.
Strychnia, quinin, arsenic, and the whole category of medicinal tonics cannot
possibly compare with this simple procedure in efficiency as a method of producing
immediate effects, and from the standpoint of ultimate cure are left entirely
ought of sight.

In every case of visceral inflammation the alternating compress applied
either to the spine or over the affected part may afford substantial service
by encouraging leukocytosis, one of the most important means of vital defense.
Most visceral inflammations are due to the infection of bacteria. For the
destruction of these invading enemies we are chiefly dependent upon the
white blood-cells. Alternate applications of hot and cold afford most effective,
almost the only efficient, beams by which those marvelous body defenders, the
white blood-cells, may be accumulated in the affected part.

The alternate compress is equally indicated in chronic congestion
(always passive), or so-called chronic inflammation of internal parts.
It is a most efficient means of relieving the thickening which sometimes
remains behind after operations for appendicitis, and may sometimes succeed in
relieving chronic pain in the region of the appendix and thereby obviating
operation, although it cannot be recommended as a panacea in this condition, for
unfortunately in the majority of cases operation is the only means which offers
hope for permanent relief. The chronic pains which sometimes follow operations
upon the pelvic viscera may sometimes be removed by the systematic application
of the alternate compress for a few weeks. The same may be said with
regard to pains and indurations which are left behind by traumatisms of various
sorts, such as fractures of bones, dislocations of joints, and ulcerations and
contusions of soft parts. Alternate applications to the neck are a most
valuable means of relieving neurasthenic headaches. The various forms of
headache yield more readily to the alternate compress or an equivalent
alternate application than to any other procedure. Enlargement of the liver
and enlargement of the spleen yield readily to this measure. The portal
congestion which accompanies most forms of neurasthenia, hypochondria and chronic
Note.

In the second part of this book I want to consider briefly therapeutic principles. I want to compare the various tonic measures—hydriatic and drug tonics, eliminatives, hydriatics, hypnotics, anodynes (25 methods). I want also to write a chapter on hydrotherapy in relation to surgical practice.
dyspepsia, and which is present in most invalid women, is wonderfully relieved by alternate hot and cold applications to the abdomen. In these cases fomentations followed by ice rubbing are most effective. This procedure not only contacts the mesenteric and portal vessels, and thus relieves stagnation of blood which has been well described as the "splanchnic pool," but increases the tone of the abdominal muscles, and thereby raises the intra-abdominal pressure, and so affords the vessels of the abdomen better support, thus relieving the primary cause of the condition present, and dissipating a multitude of most distressing symptoms which these invalids suffer and which have been so well described by Dr. Albert Abrams, of San Francisco, in his entertaining and instructive work, "The Blues."

Perhaps the most striking successes of this procedure are to be seen in the beneficial effects obtained through it in cases of shock and collapse and in cases of poisoning by opium, alcohol, and other narcotics. In these cases alternate hot and cold applications to the spine often produce most extraordinary results, apparently snatching the patient from the very jaws of death. No one who has ever witnessed the effect of the alternate hot and cold applications to the spine thoroughly applied in a case of opium poisoning, can ever doubt the efficiency of this wonderfully simple but potent procedure. The writer has more than once seen a patient who was lying in a most profound stupor, with pulse and respiration slowed almost to the stopping point, so quickly aroused and revived by fomentations to the spine combined with ice rubbing, as to bring forth expressions of amazement from the bystanders, as though a miracle had been wrought.

In chronic pleurisy and pneumonia the alternate compress may be used several times daily with excellent results. It affords a most speedy means of curing chilblains. It aids in restoring the circulation of paralyzed limbs. It is of great value as a local application in scleroderma and Raynaud's disease. Applied directly to parts under pressure and liable to develop bed-sores this most distressing complication may be prevented.
THE REVULSIVE COMPRESS.

This procedure requires only a very brief description, as it is practically the same as the preceding with one exception, but that an important particular which to a considerable degree modifies the character and effects of the application. The revulsive compress differs from the alternating only in the fact that the hot application is considerably longer, while the cold application is even of shorter duration. In the revulsive compress the duration of the hot application is from three to five minutes, the cold from fifteen to thirty seconds, or just sufficient to absorb from the skin the excess of heat which has been communicated to it by the fomentation. The number of alternations is rarely more than three, although in certain cases this number may be exceeded to any extent desirable, without material risk of injury, except through excessively fatiguing the patient.

Physiologic effects.—The alternating compress is primarily an exciting procedure, but is at the same time revulsive. The modification of the alternating compress above described and to which we have applied the term "Revulsive Compress," is essentially revulsive in character, and produces little or no exciting effects. This is due to the fact that the cold application is so timed that it serves merely to withdraw from the skin the heat which has been communicated to it and prepares the nerves for the succeeding application. The cold application is not continued long enough to produce the characteristic effects of cold. The tissues are not chilled, and hence no thermic reaction is produced.

It is very interesting in this connection to watch the change in circulatory reaction from the reaction of heat to the reaction of cold. Under the influence of heat the color of the skin becomes dusky red. Instantly when the cold application is made the dusky red hue gives place to a bright cherry red. This is due to the fact that the hot application in relaxing
the small vessels acts more strongly upon the veins than upon the arteries, so that there is partial stagnation or stasis of blood in the skin. The result is an excessive absorption of oxygen, giving to the skin the color of venous blood. When the cold application is made there is immediate contraction of all the vessels of the skin, causing a forward movement whereby the vessels are emptied and in the resulting reaction there is an active dilatation of the small arteries which gives to the skin the brighter hue of fresh arterial blood. The wider stream and more rapid movement of the muscular walls of the arteries maintain a greater volume of blood in the skin, and the active local congestion thus established lessens the volume of blood in the deep-lying parts, which are supplied by other branches of the common blood-vessels.

This is revulsion pure and simple. The hot application is continued long enough to develop sedative effects of heat, and the cold application is not sufficiently prolonged or intense to develop the excitant effects of cold; hence this procedure is essentially and purely revulsive and sedative.

Therapeutic applications.—The revulsive and sedative character of this procedure renders it most valuable as a means of relieving pain. It is applicable in all forms of neuralgia and painful effusions of every description. It is especially excellent as a means of relieving visceral neuralgias, as gastralgias, enteralgias, ovarian neuralgia, the pain of spinal irritation, intercostal neuralgia, lumbago, neuritis, sciatica, facial neuralgia, migraine; and even the distressing, almost intractable, pains of gastric crises, the shooting pain of locomotor ataxia, and the agonizing pains of gall-stones and renal colic are not infrequently to a wonderful degree mitigated by the thorough application of this procedure. The compresses should be large—the larger the better.

Caution and contraindications.—Great care must be taken to avoid a too intense or prolonged cold application, as this will produce exciting effects, and thus neutralize the analgesic or pain-relieving effect to obtain
which this measure is generally employed. It is possible also that the hot
application may be excessively prolonged. Three to five minutes is the
proper duration.

When this measure is employed to the front of the chest care must be
taken to protect the heart by a piece of mackintosh or rubber cloth, or by a
small ice bag or cold compress laid over the region of the heart, thus protecting
this surface from the effect of the hot application, as otherwise the heart may
be ever-excited.
THE HEATING COMPRESS.

This is an exceedingly old-fashioned hydriatic measure. It was used by the old Romans under the name of epithem. In the form of the clay poultice it has been employed from time immemorial. Friessnits was the first to systematize its use. It is only within comparatively recent times, however, that this measure has been subjected to scientific scrutiny whereby its physiologic effects and therapeutic applications have been clearly defined.

The heating compress is in effect a local pack. It consists of a cloth moistened in cold water, applied to the skin, and covered with dry flannel or other protection. It derives its name from the fact that although applied cold, the compress is quickly warmed by the heat of the body, and thus becomes in effect a heating rather than a cooling measure.

Technic.--The requisites are the following:

1. A piece of coarse linen toweling of proper size--Russian crash, such as is used for dish-cloths, is the best. Ordinary linen toweling may be used instead. Turkish toweling should not be used, as it is too thick and so carries too much water.

Woollen cloths are not adapted to the purpose. Muslin or cheese cloth folded to the proper thickness may be used in the absence of anything better.

2. A piece of flannel large enough so that when folded to three or four thicknesses it will cover the moist cloth with liberal margin on all sides.

3. In certain cases the additional protection of impervious covering of some sort is required. For this purpose mackintosh, rubber sheeting, oiled muslin, or gutta percha tissue, may be used; or in the absence of anything better a newspaper may be made to answer the purpose.

4. A bowl of water having a temperature of 60° F. or less. A higher temperature than 60° F. is not adapted to this purpose. Cold or very cold water is required to produce sufficient stimulation to secure good reaction.

In application the linen cloth should be wet in the cold water and
wrung very dry; the colder the water the dryer the towel should be wrung. It
should be spread out smoothly upon the part to which the treatment is to be
applied, taking care that there are no wringles. The flannel covering should
then be applied in such a way as to extend beyond the moist cloth and couple of
inches on all sides. When possible the flannel covering should extend entirely
around the body or the limb to which the treatment is being applied and drawn
tight so as to secure snug contact. It is necessary to exclude the air entirely
from the moist cloth, for if there is the slightest exposure of the moist cloth
to air continual evaporation will take place, and the chilling thereby induced
will destroy the effects of the application. In cases in which additional
protection is required, impervious material of some sort should be applied over
the moist cloth before the adjustment of the flannel covering. This prevents
evaporation and drying out of the compress and so encourages the accumulation
of heat.

When the skin is cold it should be warmed by means of a fomentation
before the heating compress is applied, or it may be rubbed with the hand until
the surface is warmed and reddened by the improved circulation.

In cases in which reaction is poor, as indicated by the patient's
condition or by previous experience, with the heating compress in which it has
failed to warm up, either one or all of the following precautions may be taken:
1. The parts should be thoroughly rubbed until warm and red before the compress
is applied; 2. The towel should be wrung dryer; 3. Colder water should be
employed; 4. The compress may be smaller in size; 5. Greater care should be
taken to secure snug contact with the skin, to exclude air, and a thicker covering
may be employed.

The duration of the heating compress may be an hour or two, or several
hours. The compress is generally used in connection with the fomentation or
some other form of heating of heating measure, and is employed for the purpose
of maintaining and continuing the effect of a fomentation. If the fomentation
is employed twice in twenty-four hours the heating compress will be employed in
the intervals between the fomentations. A very common custom is to apply
the heating compress at night to be worn during the night.

When the compress is rubbed the parts should be quickly rubbed with
cold water, employing for the purpose simply the hand, a friction mit, or a towel
wet in cold water. Afterwards the parts should be covered with dry flannel
to prevent chilling from evaporation.

For convenience we commonly designate the flannel covered heating
compress as the "tonic heating Compress, the form in which the impervious
covering is used being called the "protected heating compress."

Physiologic effects.—During the first few minutes after the appli-
cation of the heating compress the surface vessels are contracted, and a similar
contraction occurs of course in the internal related parts. As the amount of
water contained in the thin compress is small it is quickly warned by the heat
of the body, reaction occurs, the blood-vessels are dilated so that an increased
quantity of blood is brought to the part, and an accumulation of heat begins.
In a few minutes the normal temperature is restored, and if the impervious
covering is employed the temperature at the end of fifteen or twenty minutes
may be slightly above the ordinary skin temperature. Without the impervious
covering the temperature will usually remain a little below the ordinary skin
temperature in consequence of the continual cooling through evaporation which
progresses very slowly as the watery vapor finds its way through the meshes
of the flannel covering. As the surface warms up the blood-vessels become
more and more relaxed until finally the skin becomes decidedly reddened, and if
the parts have been protected by a mackintosh the appearance of the skin may be
much the same as though a fomentation had been employed, indicating passive
congestion of the surface vessels.

The effects of this application differ considerably according as the
protection consists of flannel only or of flannel reinforced with some pervious
When the temperature remains below the normal temperature of the skin, the effect is tonic, both upon the skin and upon the internal related parts. The stimulating action is chiefly upon the small arteries, the so-called peripheral heart. Increased activity results in the greatly increased movement of blood through the parts, as well as an increased volume of blood. In the internal related parts the same changes are induced through the reflex stimulation of the vasomotor centers. For example, if the flannel covered heating compress is applied over the liver the effect would be to stimulate the movement of blood through the liver and to awaken all its activities through the exciting effects of cold. The bile-making function of the liver would be increased as well as its poison-destroying and other important functions which have been so clearly set forth by Roger, Charrin, and others. The same is true in relation to every other internal organ. If, on the other hand, the compress is protected by an impervious covering so as to prevent evaporation, the temperature of the skin rises above the normal point, producing superheating, passive congestion occurs in the skin, and a similar accumulation of blood through vascular dilatation occurs in the internal parts which are related to the skin area involved.

The effects of both forms of compress during the early stage of the application must be similar and the effects produced must differ very slightly during the first fifteen or twenty minutes, but when the application is continued for several hours a decided difference in effect results for the reasons above given. The flannel protected heating compress exercises a tonic or invigorating effect upon internal parts, whereas when the impervious covering is employed in addition to the flannel, which form we have designated as the "protected heating compress," the effects are sedative and allied to those of the fomentation, causing an accumulation of blood in the parts without marked increase of blood movement, lessening nervous irritability, and tending to promote leukocytosis, to relieve vasomotor spasm when this condition exists,
and the chronic anemia resulting therefrom, and to relieve pain by its analgesic effects.

An effect common to both forms of heating compress is congestion of the skin and consequent drainage of related parts which share a common blood-supply.

Therapeutic applications.—The heating compress may be employed with advantage in nearly all cases of ingestion in chronic constipation, in jaundice, appendicitis, congestion in relaxed abdominal muscles with prolapsed abdominal viscera and in all forms of acute inflammation of the viscera.

In all cases in which the compress is employed when fever is present, the tonic heating compress should be used in preference to the protected form. The impervious application may occasionally be employed in any of the above conditions when the patient is so feeble and bloodless that good reaction cannot otherwise be secured. It is well in such cases, however, to place the impervious covering on the outside of the flannel covering, and to remove it after the first hour when good reaction has been secured.

The protected heating compress is chiefly sedative and congestive. It should be employed when accumulation of blood is required, either in the skin or internal parts, but should never be employed, even for external effects, when the accumulation of blood in the internal related parts, which is certain to occur, is likely to be accompanied by harmful effects. The protected heating compress is especially useful in certain forms of so-called chronic inflammation in which as the result of long continued morbid processes an anemic condition has been induced so that benefit may be derived from increasing the volume of blood in the parts and thereby promoting leukocytosis. On this account this form of compress applied to the chest is indicated in chronic laryngitis, bronchial catarrh, intestinal catarrh, in most cases of chronic tuberculosis accompanied by an irritable cough, and in asthma; applied over the liver in cirrhosis of the liver; over the spleen in cirrhosis of the spleen; over the abdomen in tubercular peritonitis; in chronic interstitial nephritis, or
Bright's disease; in cirrhosis of the kidney; and in arteriosclerosis when blood-pressure is dangerously high (200 millimeters or more).

The protected heating compress to the abdomen renders great service in cases of insomnia due to cerebral congestion by accumulating blood in the abdominal vessels and thus relieving congestion of the brain. The compress acts in these cases in the same way as does taking food at bedtime, but it is quite free from the disadvantages of the last named measure in imposing no work upon the stomach, and so securing more perfect sleep than as possible when the digestive process is in active operation. The protected heating compress should be employed the chief purpose is to relieve pain; hence, this measure should always be used when the heating compress follows a fomentation which has been employed to relieve the pains of neuralgia, neuritis, or any other condition which is not accompanied by an active inflammatory process.

This measure renders excellent service in neuralgia of the bowels, spinal irritation, and in connection with hot applications of various sorts in nearly all forms of neuralgia.

The heating compress may be applied to the head in cases of cerebral anemia, and is a successful means of aborting an acute coryza if resorted to at once. For this purpose the hair is moistened, a wet napkin is placed upon the head covered with a layer of dry flannel, and a lady's rubber swimming cap is placed over all.

Cautions and contraindications.—The hot compress must never be allowed to become cool. Though applied cold it should warm up quickly to secure good effects. Slow warming or failure to warm up is an indication of some defect in the mode of application. When the patient complains that the compress does not warm up an investigation of the cause should be made at once; otherwise very serious injury may result. It is proper to instruct the patient that if the compress does not up within an hour it should be removed.
The heating compress should not become dry. The protected heating compress when properly applied does not dry out, but the ordinary or tonic form of the compress always becomes dry if left in place a sufficient length of time. If this compress is to be employed continuously instructions should be given that it should be used just before it becomes dry. When employed continuously care should be taken to sterilize the compress by boiling daily. The skin should also be sterilized by washing with soap, as the continual contact of the moist compress greatly stimulates the growth of the bacteria of the skin and thus gives rise to infection and eczematous eruptions which sometimes prove very troublesome.

The protected heating compress should never be employed when inflammatory conditions are present, as it will increase the passive congestion which is already present and thus lower vital resistance and thus hinder the body in its defensive work.
The wet girdle is simply a heating compress applied about the waist. The area covered by the application is bound above by the nipples and below by the hip bones. It is intended especially to influence the abdominal viscera. This measure was much employed by Priessnitz. It was a common domestic remedy among the peasantry of German, among whom it was known as "Neptune's girdle."

Technic.—The requisites are:

1. A linen bandage long enough to encircle the body twice. The width should be nine or ten inches. The best material is Russian crash.

2. A bandage of soft flannel a foot in width and long enough to extend twice around the body.

3. A strip of mackintosh or oiled silk, or some other impervious covering the same width as the flannel bandage, and of sufficient length to reach around the body and to overlap a few inches.

One half the linen bandage is dipped in water at 60° F. and wrung out as dry as possible. It is then applied next to the skin, taking pains to make it fit snugly at every point. The ends are fastened and the flannel bandage is next applied, taking pains that the edge of the flannel bandage extends at least an inch beyond the moist bandage above and below. The woolen bandage should be drawn as snug as possible and the ends should be snugly pinned.

When the effects of the protected heating compress are desired the mackintosh is applied next to the linen before the application of the flannel bandage. This is known as the protected wet girdle.

Physiologic effects.—This procedure influences not only the abdominal viscera which underlie the wet girdle, but through effects which are produced upon the circulation and the sympathetic nervous system a decided impression is made upon the body at large.
The tonic wet girdle, that is, the form in which the mackintosh is
emitted, invigorates and increases the functional activity of the viscera,
encouraging the movement of blood through the whole splanchnic area,—the meson-
teric and portal vessels. The tone of the abdominal muscles is improved,
intraabdominal pressure is increased, blood-pressure in the mesenteric vessels
is raised, and thus the volume of blood in this region is decreased, and the
amount of blood in the general arterial circulation is increased, thus raising
general blood-pressure. This effect manifests itself to the patient in the
increased feeling of vigor which is increased under the influence of this
application. There is a decided increase of endurance and feeling of light-
ness in walking and increase of mental vigor and activity, and a feeling of
general well-being, which are the natural result of the improved and accelerated
blood circulation. The active dilatation of the vessels of the abdominal
wall diverts a certain portion of the blood from the portal circulation, and
thus relieves congestion of the liver and portal system.

The protected wet girdle, for which the mackintosh is employed, dilates
the abdominal vessels, and hence promotes the accumulation of blood in this part
of the body, lowers the general blood-pressure, lessens the blood-supply of the
brain and spinal cord, and thus produces a decided sedative effect. The
accumulation of heat acts upon the thoracic nerves to diminish nerve sensibility,
thus producing decided soothing effects.

Therapeutic applications.—The tonic wet girdle is useful whenever an
increase of functional activity is desirable in the abdominal viscera, as in
atony of the stomach and bowels, constipation, dilatation of the stomach,
and colon, enteroptosis, hypochlorhydria and hypopepsia, gastritis, a sensation
of heaviness and general discomfort across the lower abdomen, indicative of
portal congestion, enlargement of the liver or spleen, hemorrhoids, flatulence,
the backaches and other discomforts commonly present in the later months of
pregnancy, gastric neurasthenia, chronic dyspepsia, or whenever acute inflammation
exists in any abdominal organ.

The protected wet girdle is indicated in cases of ascites, with cirrhosis of the liver, in arteriosclerosis with high blood-pressure, in chronic interstitial nephritis, in insomnia, in pain in the stomach, bowels, gall bladder, lumbar ganglia of the sympathetics, in chronic gastric catarrh, chronic enteritis, and chronic appendicitis.

Cautions and contraindications.—The wet girdle should not be allowed to become dry. When used without the mackintosh the bandage should be either removed or renewed when it becomes dry, and it should be sterilized every day to prevent its becoming infected. The skin should be cleansed with soap and anointed with vaseline at least once a day.

The protected wet girdle should be avoided whenever acute inflammation or congestion exists in any of the viscera. In cases in which hemorrhage is likely to occur, as in ulcer of the stomach or duodenum, in hemorrhoids, and in cases of bleeding fibroids of the uterus.
THE SPINAL PACK.

Among the special forms of compress this is one which often renders very valuable service.

Technic.—The requisites are:

1. A linen towel or piece of crash long enough to reach from the neck to the occiput, and at least eight inches in width.

2. A strip of flannel a little more than three times the length of the towel and of sufficient width to cover the back.

3. A piece of mackintosh of sufficient length and width to cover the entire back.

4. A cheesecloth roller bandage ten or twelve inches in width, four thicknesses, and about four yards in length.

The towel is dipped in water at a temperature of 60° F. and wrung as dry as possible. After rubbing the spine with a friction mit or the end of a moist towel, the cold wet towel is applied and at once covered with the flannel, which is then secured in place by the cheesecloth bandage. The cheesecloth bandage should be applied first around the trunk, then over the shoulders and under the arms in the form of a figure-of-eight bandage.

When superheating effects are desired, the mackintosh is applied over the wet towel before the application of the flannel covering.

Physiologic effects.—The first contact of the cold wet towel with the spine produces an excitant effect. This quickly gives way, however, to a marked soothing and sedative effect resulting from the continuous hyperemia through which a considerable amount of blood is diverted from the spinal circulation. The partial emptying of the vessels of the spinal cord leads to an inflow of lymph from the surrounding tissues, which establishes the condition shown by Schüller to be most favorable for repair of brain and nervous tissue. The blood is a natural excitant of the brain and nervous centers; a lessened
supply diminishes excitability, while an increased supply of lymph promotes repair.

The spinal pack has an effect upon the spinal cord similar to that which Guler observed to be induced by the general pack upon the brain. The brain is also influenced to a marked degree by the spinal pack. The reflex irritability of the spine is diminished and thus rest and repair are promoted. This is particularly true of the protected spinal compress, which is the form most commonly used.

Therapeutic applications.—The spinal pack is an excellent means of promoting sleep in insomnia, for which purpose it may replace the general pack. It is sometimes more successful in producing sleep than the general pack. Its application involves less disturbance of the patient, and produces less general excitation. The spinal pack is especially valuable as a sleep promoter in cases of neurasthenics who are kept awake by a fidgeting or twitching of the limbs due to excessive irritability of the spinal centers. A spinal irritation is generally relieved by the spinal pack, and the paresthesias and shooting pains of locomotor ataxia are sometimes favorably influenced.
THE HOT AND COLD COMPRESS.

In the employment of the cold sits bath the feet are usually at the same time placed in hot water. When the hot bath is employed it is customary to apply cold water to the head. Cold applications are often made over the heart in connection with hot baths. Some years ago it occurred to the writer to extend and systematize this principle, and the result was the development of a whole new series of hydriatic measures which have been found to produce very interesting effects and to render valuable service in practical therapeutics.

The hot and cold compress consists, then, in the application of a hot compress and a cold compress simultaneously.

Technic.—The method of applying the cold compress is precisely that which has been elsewhere pointed out. The means employed may be a cold coil, a rubber bag filled with cold water, one or several ice bags, an ice poultice or compress, or a thick compress wrung out of water at 60° F. or 40° F. and renewed before the skin temperature is reached. When the application is continued for more than half an hour the cold compress should be removed for five minutes to allow the nerves of the parts to recover their sensibility.

The hot compress may consist of a fomentation renewed every five or six minutes, a hot water bag, a hot water coil, or better, an electro-thermaphore the temperature of which can be maintained constant for an indefinite length of time. The hot application should not be continuous over thirty minutes without being removed to permit a cold application to be made for fifteen or twenty seconds to prevent over-heating of the tissues.

If the precautions indicated are observed the duration of the application may extend from fifteen or twenty minutes to two or three hours.

The hot and cold compress is not applicable to all parts of the body. It may be most conveniently applied to the head, spine, chest, abdomen, pelvis, and legs. The compresses are not always applied to opposite parts, but should
be applied with reference to the internal parts which it is desired to influence. The proper application of the compresses requires an accurate and definite knowledge of the nerves and vascular relations of the internal parts with the surface. These have been pointed out elsewhere (see page), and should be thoroughly studied by those who undertake to employ this very potent measure.

In general, the cold compress will be relatively small, just sufficient to cover the reflex area of the interested internal part. The hot application will be relatively large.

Physiologic effects.—The simultaneous application of heat and cold offers the most favorable of all known means for modifying the blood volume of internal parts. The measure owes its efficiency to the combination of two principles: first, the vasomotor reflex action whereby the blood-vessels of an internal part may be made to contract by an application of cold to the skin surface in reflex relationship therewith; and second, the principle of collateral fluxion whereby the amount of blood supplied to the part may be diminished by dilating the vessels and thus increasing the blood intake of the related part which receives its blood from the same main arterial trunk. By the combination of the hot and cold compress the blood-vessels of the interested part are made to contract, thus lessening their capacity while at the same time the blood-supply is diminished through diversion into other channels. Thus two powerful forces are made to co-operate in such a manner that each assists the other in accomplishing the objects sought.

Therapeutic applications.—The hot and cold compress should be applicable whenever the cold compress may be advantageously employed, but the nature of the procedure does not permit its use under all conditions for reasons which will readily appear when the several forms of the hot and cold compress are studied. When practically applicable this measure secures success in cases in which both the hot compress and the cold compress have failed
to afford relief.

As has been elsewhere shown, there exists certain physiologic antagonisms which are always brought into play whenever hot and cold applications are utilized, so that the beneficial results from either a hot application or a cold application when employed by itself is simply the difference between the beneficial and the untoward effects which the application produces. That is, when a cold application is made to relieve congestion of an internal part by reflexly contracting its vessels, there is at the same time a contraction of the surface vessels whereby retrostasis or an inward fluxion of blood is produced, thus tending to increase the internal congestion which already exists.

When a hot application is made, on the other hand, for the purpose of diverting blood from an internal part which is congested, the effect of the application is beneficial so far as it dilates the surface vessels and diverts blood from internal parts; but there is produced at the same time a dilatation of vessels of the internal parts which it is desired to relieve, and thus the good accomplished is, as before stated, the difference between the good and the evil effects. What this difference shall be depends in large measure upon the skill of the person making the application, and especially on his knowledge of these facts, and of the methods by which the good effects may be emphasized and the evil effects minimized.

Here is the raison d'être for the hot and cold compress. By the simultaneous application of these two measures the untoward effects of each one are antidoted, while the beneficial effects are doubled through the complementary action of the heat and cold. The several forms of this compress which the writer has found most practical are the following:

The Hot and Cold Gastric-Hepatic Compress.—By this procedure the circulation of the stomach, liver, pancreas and spleen may be readily controlled. The hot application covers the area from the fourth rib to the umbilicus, while
the cold application is made to the dorsal spine.

**Therapeutic applications.**—This procedure is applicable in all cases of acute inflammation of the stomach, liver, pancreas, or spleen.

**The Hot and Cold Chest Compress.**—A fomentation is applied to the dorsal spine while a cold application is applied to the front of the chest, extending from the top of the shoulders to the lowest ribs. The fomentation diverts blood from the bronchial arteries, while the cold application reflexly contracts the same vessels.

**Therapeutic applications.**—This measure secures excellent results in pneumonia, bronchial pneumonia, and acute pulmonary congestion. It is applicable in all cases of pulmonary hemorrhage in which there are frequent attacks of slight bleeding. Excellent results are obtained in cyanosis due to cardiac weakness and in consequence of pulmonary congestion. The cold application stimulates the heart and improves the breathing, while at the same time contracting the bronchial vessels. The hot application aids in relieving the congestion by diverting blood to the surface.

The application of the hot and cold chest compress for half an hour once or twice a day will benefit greatly the pulmonary disorders which result from static congestion in feeble patients, patients confined to the bed after surgical operations, and in typhoid fever. The writer has employed this form of application with excellent success for nearly twenty years. For several years he has employed it systematically either in connection with anesthesia as a means of preventing pulmonary congestion which so commonly results from the use of an anesthetic, and believes that he has thereby succeeded in preventing broncho-pneumonia in cases in which this unfortunate application would otherwise have occurred.

Asthma is sometimes relieved by a reversed form of the hot and cold chest compress, an ice bag to the neck with a short, very hot fomentation over the chest.
**The Hot and Cold Renal Compress.**—An ice bag should be applied to the lower third of the sternum, while a fomentation is applied to the lumbar region. The ice bag reflexly contracts the vessels of the kidney, while the fomentation diverts blood from the kidney to the overlying surfaces.

**Therapeutic applications.**—Acute congestion of the kidneys and relapsing parenchymatous inflammation of the kidneys are suitable cases for the application of this procedure.

**The Hot and Cold Intestinal Compress.**—A hot application is made to the lumbar region extending over to the left side, while a cold application is placed upon the abdomen.

**Therapeutic applications.**—This measure may be employed in chronic enteritis. It is also an excellent means of relieving portal congestion which is present in a large proportion of cases of chronic dyspepsia and neurasthenia.

**The Hot and Cold Pelvic Compress.**—A fomentation is applied to the lower part of the back, while an ice bag or cold compress is applied just above the pubes, or to the right or left ovarian region.

**Therapeutic applications.**—This measure is useful in all forms of pelvic inflammation with the exception of cystitis. In cases of cystitis and in inflammation of the prostate, and testicles, the ice bag may be applied to the perineum with fomentation to the back.
THE COMBINED HOT AND HEATING COMPRESS.

The combined hot and heating compress consists of a very hot application made simultaneously with an ordinary heating compress. The heating compress is relatively large in extent, while the hot application is relatively small. As a general direction it may be stated that the hot application covers the reflex area of the interested organ, while the heating compress extends over the same and much larger area, including those portions of the surface which are vascularly related with the interested part.

Physiologic effects.—The effect of this procedure is essentially sedative. The large territory covered by the heating compress produces a derivative effect upon the interested deep-lying parts, while the very hot application extending over the smaller reflex area lessens nerve sensibility and thus a decided sedative effect is produced. By making the hot application simultaneously with the heating compress the primary exciting effects of the heating compress are practically obliterated. Immediate reaction occurs, superheating begins promptly, and a powerful sedative effect is begun which may last for one or two hours or longer. The hot application is usually withdrawn after the first thirty minutes, the heating compress remaining in position.

The hot application may consist of a bag filled with hot water, a hot water coil, or thermaphore. Either of the means mentioned is placed directly in contact with the wet bandage and beneath the woolen wrappings. At the end of thirty minutes the hot bag, coil, or thermaphore, is removed, the wrappings tightened, and the heating compress retained for an hour or two longer, as the case may require.

The Combined Chest Compress, or the Hot and Heating Chest Pack.—The chest pack is applied in the ordinary way. Before the woolen wrappings are pinned, a spine bag half filled with water as hot as can be borne, or a spinal hot water coil is slipped underneath the dry coverings and applied along
the spine. At the end of half an hour the hot bag is removed, the wrappings are tightened, and the pack remains in place for an hour or two longer.

Therapeutic applications.—This measure is excellent for relieving cough and the congestion of the common cold.

The Combined Abdominal Compress, or the Hot and Heating Abdominal Pack.—The wet girdle is applied in the ordinary way. A hot water bag, coil, or thermaphore, is placed over the epigastrium for half an hour, at the end of which time it should be removed, the wrappings being tightened to retain the accumulated heat. The heating compress remains for an hour or two longer. This measure was first employed by Winternits, of Vienna, who gave the procedure the name, "Combined Compress."

Therapeutic applications.—This is a most useful measure for irritable conditions of the stomach. Both motor and sensory disorders of the stomach usually yield with great promptness to the application of this measure. It is especially valuable in cases of vomiting or pain which occurs soon after eating. In such cases the application is made half an hour before the taking of food. At the end of the half hour the hot bag or coil is removed, the patient is allowed to eat food, and the heating compress is retained for an hour and a half more. Patients who suffer from severe gastric pain after eating, eructations, flatulence, vomiting of food, mucus, or bile, merccum, and aerophagia, or so-called air swallowing, are generally greatly helped and in the majority of cases entirely relieved by this measure. The vomiting of pregnancy often yields to this measure when other means fail. This measure may be used with equal success for relief of the pain of hyper-hydrochloria, pyloric spasm, and the gastric irritability which accompanies chronic gastritis.

The Combined Spinal Compress, or Hot and Heating Spinal Pack.—This is an ordinary trunk pack with a bag filled with hot water applied over the spine next to the moist sheet. The spine bag is removed at the end of half an hour.
Therapeutic applications.—This is a useful means for relieving spinal irritation, a condition commonly present in chronic dyspepsia, neurasthenia, and chronic disorders peculiar to women. This measure affords good results in cases of nocturnal enuresis, or bed wetting. In such cases the application should be applied to the lower end of the spine. The wet bandage need never extend above the umbilicus.

The Pelvic Compress, or Hot and Heating Pelvic Pack.—In connection with the pelvic pack a rubber bag filled with hot water is placed just above the pubes for half an hour. The duration of the application may be from one to two hours. The hot bag which is placed just above the pubes is removed at the end of the first half hour.

Therapeutic applications.—This is a very useful measure in all forms of chronic inflammation of the uterus, ovaries, bladder, and tubes. It relieves the heaviness, backache and other unpleasant symptoms to which sufferers from pelvic disease are such constant martyrs. It should be employed in connection with a hot vaginal douche, the sitz bath, and other measures which may be indicated.
THE CHEST PACK.

This procedure is one of the most valuable applications of the local pack or hot compress. It consists of a moist cloth covering the entire chest, both front and back, including the tops of the shoulders and extending to the lowermost ribs.

Technic.—

The Square Chest Pack.—The requisites are: (1) a linen or cheesecloth bandage fitted to the chest; if linen two thicknesses, if cheesecloth six thicknesses. (2) A heavy woolen bandage likewise fitted to the chest. (3) An impervious bandage of mackintosh or oiled muslin, which may be applied over all in such a manner as to exclude the air, thus insuring quick warming up of the compress and superheating. The accompanying cuts show bandages prepared for putting on, and also the methods of application.

The wet bandage is wrung from water at 60° F. to 40° F., applied quickly to the chest, and then the woolen and mackintosh bandages are applied quickly and snugly so as to prevent chilling and to promote quick reaction. The duration of the application may vary according to the objects sought. It may be one to two hours or several hours. Not infrequently the application is made at bed time to be worn during the night.

The Figure-of-Eight Chest Pack.—The requisites are: (1) a bandage consisting of two thicknesses of linen or four of cheesecloth, eight to ten inches in width, six to eight feet in length. (2) A flannel bandage two inches wider and one foot longer. Both bandages should be rolled. The linen bandage is wet and applied to the chest in the following manner: Place one end of the bandage against the right chest below the arm pit, the patient holding it in place by pressing the arm to the side. The bandage is then carried forward, obliquely upward over the left shoulder, then downward obliquely across the chest.
behind to the right axilla, straight across the chest in front, under the left arm, then obliquely upward over the right shoulder. The end is then tucked down under the transverse portion of the bandage, which is pulled upward and pinned near either shoulder and in the center in such a way as to spread out the various parts of the bandage and cover the chest as completely as possible. The flannel bandage is then applied in precisely the same manner. A mackintosh bandage of the same size as the linen bandage should be applied next to the wet bandage, or a mackintosh may be cut the same as for the square pack and applied over the wet bandage before the application of the flannel.

**The Triangular Chest Pack.** — A very satisfactory chest pack may be applied by means of a woolen blanket and two linen sheets. One of the linen sheets is folded lengthwise twice and placed across the bed in such a way that the upper edge will fall just above the axilla of the patient. Over this lay the woolen blanket cornerwise with the apex downward and the upper border at such an angle as to fall at the patient’s occiput when he lies down. The other sheet should be folded cornerwise, then wrung as dry as possible out of cold water and laid upon the woolen blanket with the apex downward and the base of the triangle parallel with the woolen blanket and an inch and a half below it.

The patient now lies down in such a position that the back of the head rests upon the upper border of the blanket. One of the angles of the wet sheet is now brought across the shoulder of the same side and carried downward across the chest and under the opposite arm. The other angle is disposed in a similar manner. The woolen blanket is adjusted in like manner, care being taken to bring the folds close around the neck and shoulders. The ends of the sheet are now brought across the chest and pinned snugly. One or two pins may be put in the woolen blanket as a protection against the entrance of air about the neck. If an impervious covering is required a triangular piece of mackintosh
or muslin should be applied between the sheet and blanket.

The Towel Chest Pack.—A very simply method of applying a heating compress to the chest as the following: prepare a sheet folded lengthwise and a woolen blanket folded in the form of a triangle, as directed in the preceding paragraphs. In place of the wet sheet employ two good sized towels. Wring the towels as dry as possible from water at 60°F., and apply one over each shoulder, carrying the ends across the chest both in front and behind to the opposite axila. By this means the entire chest and shoulders may be well covered. The other wrappings are then folded in place and pinned as directed for the triangular chest pack.

On removing the chest pack the whole chest should be rubbed quickly with the hand, a friction mit, or a towel dipped in cold water, then dried, and protected by a light woolen bandage. When the pack is used over night or continuously, vaseline must be applied to the skin to prevent excessive maceration. Care must be taken to sterilize the moist bandage daily by boiling.

Physiologic effects.—This excellent procedure produces decided physiologic effects. Through the exciting effects produced by the first contact with the cold water respiration is deepened, the heart's action is energized, and the pulmonary blood-vessels are contracted. The volume of respired air is increased more than one-third. When the heating stage of the pack is reached marked dilatation and sedative effects are produced. This is especially true when an impervious covering is employed.

Therapeutic applications.—The tonic chest pack is an excellent means of relieving passive pulmonary congestion. It is hence indicated in feeble, bed-ridden patients as a means of preventing hypostatic pneumonia. It is highly valuable in pulmonary tuberculosis. It is also useful in the passive congestion present in certain forms of cardiac disease.

The protected chest pack is an excellent sedative measure, and renders
great service in relieving the cough of pulmonary tuberculosis and bronchial
catarrh. It facilitates expectoration, relieves the spasm of asthma, the
pain of pleurisy, promotes the absorption of fluid in pleural dropsy, and is a
very useful application in pneumonia after convalescence is established.
In painful effusions of the chest it is employed in connection with the hot
fomentation, which may be applied several times daily, the pack being worn during
the interval.

Cautions and contraindications.—The protected chest pack is contra-
indicated in acute inflammation of the lungs or heart when cardiac compensation
is broken, in aneurism, and when pulmonary congestion or hemorrhage are to be
feared. In cases of this sort the cold compress or the unprotected chest
pack from thirty to sixth minutes is indicated.

The unprotected or tonic chest pack should never be allowed to become
dry. While the inner bandage is still moist the pack should be renewed or
removed.
THE HIP PACK.

This is similar to the general wet sheet pack, but confined to the middle portion of the body limited above by the umbilicus, below by the middle line of the thighs.

Technic.—The requisites are, a folded linen sheet, and single woolen blanket and a double blanket.

A heating hip pack is administered thus: The double blanket is laid upon the bed. The single woolen blanket is folded lengthwise and laid across the bed in such a position that the upper border will fall just above the umbilicus of the patient when he lies down. The linen sheet is likewise folded lengthwise, wrung as dry as possible out of cold water and laid across the woolen blanket so that the upper and lower edge falls a little within the edges of the blanket. The patient now lies down and as quickly as possible the sheet and folded blanket are brought over and snugly tucked in, the patient being lastly enveloped in the folded blanket.

In giving the hot hip pack the dry folded linen sheet is laid across the double blanket in proper position; one half of the woolen blanket is wrung as dry as possible out of very hot water, then folded and laid upon the woolen sheet in such a way that the moist portion will be upward. The patient lies down and first the woolen blanket and then the woolen sheet are drawn tightly about him and tucked in or pinned so as to exclude air as much as possible. The patient is then well covered with the folded blanket.

As the hot hip pack generally produces perspiration the precaution should be taken to cool the patient by means of a mitten friction, or the mitten friction and cold towel rub, or a half sheet rub. As this measure is usually given for the relief of pain the cooling application should be administered very quickly, care being taken to prevent general chilling of the surface.

Physiologic effects.—The physiologic effects of the heating hip pack
are strongly derivative in relation to the organs of the lower abdomen and pelvis. It stimulates the circulation of these organs, encourages peristalsis, and promotes functional activity of the organs of the lower abdomen and pelvis.

The hot hip pack is a highly sedative procedure. It lessens nervous sensibility, dilates the pelvic vessels, and relaxes the muscular walls of the bladder, uterus, and bowels.

Therapeutic applications.—The heating hip pack is useful in most forms of chronic pelvic disease which are not accompanied by acute inflammation. It should follow a hot application so as to secure prompt and vigorous reaction. It is excellent in constipation, hemorrhoids, prostatic disease; renders service in atony of the bladder; promotes the absorption of chronic exudates.

The hot hip pack is a most valuable means of relieving pelvic pain. It is indicated in ovarian neuralgia, dysmenorrhea whether uterine or ovarian, in coccyalgia, lumbago, sciatica, enteralgia, and pain in the region of the kidney and bladder. The application should be as hot as the patient can bear.

Cautions and contraindications.—The heating pack is contraindicated in cases of vesical tenesmus and in neuralgic affections of the pelvic region.

The hot hip pack should be avoided in cases of menorrhagia, hemorrhage from bleeding fibroids, or hemorrhage from the bladder. The hot hip pack may be used, however, to relieve menstrual pain even when profuse flow is present by taking the precaution to administer a hot douche before or after, or both before and after, the application of the pack.
THE PELVIC PACK.

This procedure is similar in character to the tonic hip pack. It produces the same effects and has the same indications. It is a somewhat more vigorous and effective method of influencing the pelvic circulation.

Technic.—The requisites are, a double woolen blanket, a single woolen sheet, and two cotton or linen sheets.

The double blanket is spread upon the couch. Then fold one of the sheets lengthwise and lay it across the center of the blanket. Fold the woolen sheet cornerwise and lay it upon the linen sheet so that the bases of the triangle will correspond with the upper edge of the sheet. Fold the other sheet cornerwise, wringing it as dry as possible out of cold water and lay it down upon the woolen sheet with the angles corresponding. Place the patient in such a position that the upper border of the wet sheet will fall just below the umbilicus. The legs should be drawn up and the feet and the knees separated. The apex of the wet sheet is now drawn upward until it fits the perineum snugly. With the legs extended and the feet still separated each lateral angle of the wet sheet is brought over and wrapped about the corresponding thigh. Thus the entire skin surface of the abdomen, hips and thighs will be covered. The apex of the blanket triangle is now brought up between the legs as snugly as possible and laid upon the abdomen and each lateral angle is brought over and tucked under the thigh of the opposite side. Last of all, the folded dry sheet is brought over and pinned snugly. Then the patient is enveloped in the folded blanket. If necessary a hot bag should be placed at the sides to promote quick reaction.

The duration of the pack may be from an hour to an hour. The patient should remain in the pack until thorough reaction has occurred. It is not generally desirable to produce perspiration. When the patient is removed from the pack a cooling measure of some sort should be administered, such as the cold
Wet hand rub, mitten friction, towel rub, or half sheet rub.

Physiologic effects.—This is a very powerful means of influencing the pelvic circulation. There is an increased amount of blood and an invigoration of function in all the organs of the lower abdomen and pelvis. When carried to the heating stage a powerful derivative effect is produced in relation to the pelvic viscera, owing to the anatomical fact that the skin and muscles of the hips receive their blood supply chiefly from the internal iliac arteries, which are also the chief source of blood-supply to the organs of the pelvis. The active hyperemia of the skin necessarily diverts a considerable amount of blood from the interior to the surface.

Therapeutic applications.—This procedure is indicated in a large number of pelvic diseases in both men and women, among which may be specially named the following: uterine displacements, subinvolution, atony of the bladder and colon, chronic constipation, amenorrhea and scanty menstruation, sexual weakness in men, chronic prostatitis, chronic gleet, proctitis, sexual neurasthenia.

Cautions and contraindications.—The tonic pelvic pack is contraindicated in acute pulmonary conditions, neuralgia in the pelvis region, acute cystitis, hemorrhage from the bladder, kidneys, or bowels, and in menorrhagia, or metrorrhagia.
THE CARDIAC OR PRECORDIAL COMPRESS.

This consists of a cold compress or an ice bag applied over the heart. The cardiac area extends from the second rib above to the sixth rib below, and from the right border of the sternum to the left nipple.

Technic.—Care must be taken to make the compress large enough to cover the area described. No injury results if a larger area is covered. When the ice bag is used two should be employed if they are small. If the compress is used it should be thick so as not to warm up too quickly, and it should be wrung just dry enough so it will not drip. Great care must be taken to avoid wetting the clothing of the patient or the bed.

The duration of the application is generally fifteen to twenty minutes. When used continuously, which is rarely necessary, the compress should be removed for five minutes at least every half hour so as to allow the surface of the skin to recover their sensibility. Otherwise effects the opposite of those desired will be produced. When an ice bag is employed for more than a few minutes a thin woolen cloth should be placed between it and the skin.

Physiologic effects.—It has been shown by laboratory experiments that a cold application made to the heart by dropping cold water upon it slows its action. A prolonged application made to the skin over the heart produces the same effect. The measurement of the blood pressure with the sphygmometer shows also that the blood-pressure is raised, indicating that the energy of the heart is increased, while its movements are rendered slower and more effective. The continuous application of cold over the heart for several hours depresses its action.

Therapeutic application.—The cold precordial compress is one of the most valuable of all local hydriatic measures. By its use a failing heart may be strengthened and assisted to do its duty more certainly and more effectively than by any known drug. This fact renders it of great service when
compensation is broken, in all cases of wasting disease accompanied by cardiac weakness, and in threatened heart failure. Its use is indicated in all fevers and exhausting diseases, in organic disease of the heart accompanied by swelling of the ankles, shortness of breath, and other indications of heart weakness, in endocarditis during chloroform or ether anesthesia, in collapse, shock, and in all conditions in which there is an abnormally low blood-pressure. In acute myocarditis, endocarditis, or pericarditis, the ice bag should be used continuously, with interruptions for five minutes every half hour. In connection with ether or chloroform anesthesia, the application should begin five or six minutes after the administration of the ether begins, or after the irritative effects of the drug have disappeared. In cases of great cardiac weakness in which an anesthetic is necessary, the compress should be applied ten or fifteen minutes before beginning the anesthetic.

Cautions and contraindications.—The cold precordial compress should never be applied in advanced cases of chronic myocarditis, or in fatty degeneration of the heart. In extreme cardiac weakness care should always be taken to improve the condition of the general circulation before applying the cold precordial compress. This may be accomplished by dry friction or by cold mitten friction. The cold mitten friction is usually preferable.
LOCAL PACKS.

Packs and compresses to the leg, foot, arm, hand, and joints, are extremely valuable hydriatic procedures which may be constantly utilized to great advantage in the treatment of various chronic and acute maladies affecting those parts.

Technic.—The technic of the heating compress consists simply in the application of a linen cloth wrung as dry as possible out of cold water, covered with flannel or flannel and mackintosh, as may be required, so as to secure quick warming.

The unprotected or tonic compress has a decidedly different effect from that of the protected compress, as has been elsewhere explained (see Page ).

The flannel covered heating compress should be used when the purpose is to quicken the circulation and to stimulate all the functions of the part to which the application is made. It produces an active rather than a passive congestion, owing to the fact that the temperature of the skin surface is usually kept a little below that of the ordinary skin temperature through the evaporation of moisture which takes place through the flannel covering. An impervious covering, however, retains the heat to such a degree that superheating occurs, producing passive congestion and sedative rather than tonic effects.

Therapeutic applications.—In painful effusions of the limbs or joints, the protected compress is generally indicated. It ordinarily follows a hot application of some sort. When inflammation and elevation of temperature are present, however, the tonic heating compress should be used so that the evil effects of superheating may be avoided. The protected compress may also be utilized advantageously in cases of chronic joint trouble in which there is thickening of the connective tissues, exudates, and stiffness, but without active inflammation.

The heating compress renders best service in these cases because it
serves to produce thorough dilatation of the vessels and by concentrating
the blood in the part promotes leukocytosis. This measure used in connection
with the hot fomentation produces effects similar to those secured by the so-called
ed Bier's method, but in a more physiologic way and with greater certainty.
THE DOUCHE.

The douche in its different forms constitutes in itself a complete hydraulic system. The picture of a douche may be seen on an Etruscan vase exhumed at ancient Tarquinium. A shower bath was constructed and used by Mühlau in 1785, and floating baths on the Seine in Paris were furnished with shower baths and sprays in 1760. About the same time the douche was used in Sweden under the name of the "serpentine Bath." It was used still earlier by Hahn, a Silesian physician, who wrote a book on the use of water one hundred years before the development of the work of Friessnitz at Graefenberg.

There are various forms of douches. The most common are the rain douche or shower bath, the horizontal jet, the broken jet, the ascending jet, the fan douche, the spray, the circle douche, and the percussion douche. Modifications of these various forms of douches are known as the Scotch douche, the alternate douche, the simultaneous douche, the massage douche, and irrigation.

Douches are also named and classified according to the part to which they are applied, as the spinal or dorsal douche, lumbar douche, epigastric douche, plantar douche, hepatic douche, splenic douche, perineal douche.

Technic.—

Douche Apparatus.—First of all it is necessary to have a good douche apparatus; next an ample, regular, also a perfectly controllable, supply of cold water, and hot water under proper pressure.

No one can properly appreciate the value of this hydraulic procedure who has not had an opportunity to observe its use under favorable conditions, the first of which, a thoroughly good douche apparatus, is absolutely essential. The ordinary shower bath which is installed by plumbers is not at all adequate for therapeutic purposes. After many years of experimentation the writer succeeded in preventing a simple apparatus which is herewith shown, which has the
advantages of simplicity, compactness, greater durability and greater versatility than any other the writer has seen described. The following is a brief description of this apparatus: two sets of hot and cold pipes, each pair controlled by a separate valve, and the two valves joined by connecting rods so adjusted that by moving the rod horizontally one rod is closed while the other is opened. The other valves are connected with a horizontal service pipe, from which pipes lead to various fixed parts of the douche apparatus, as the shower, the ascending douche, the circle douche, etc. Several flexible pipes are also connected with the horizontal service pipe between the two valves referred to, so that water may be admitted to them through either of the two sets of pipes. A flexible tube provided with a nozzle is connected with each end of the service pipe outside of the valves. These are controlled by separate valves so that they may be used independently. A thermometer is connected with each set of pipes and a pressure gauge is placed in the center of the service pipe so that both pressure and temperature may be perfectly regulated.

This apparatus provides for the administration of all forms of the douche at any temperature or pressure required. By means of the independent flexible tubes placed at the two ends of the service pipe different temperatures may be applied to different parts of the body simultaneously. For example, a general warm shower bath may be given and at the same time a cold horizontal jet may be applied to the spine.

Another individual feature of this apparatus is the percussion douche, which is administered by means of a special nozzle, the construction of which will be explained later. A careful study of the diagram and photo reproduction of this apparatus will give a clear idea of its construction.

The apparatus and pipes supplying it should be of ample size. With high water pressure an inch and a quarter pipe will answer very well, but an inch and a half pipe answers better. It is highly important that an abundance of cold water should be available. The temperature should be 50° F. to 60° F., or even less if possible. For efficient tonic applications a temperature as
low as 60° F. at least must be available. The importance of an efficient
water heater has already been emphasized. It should be automatically controlled
so that the water may be obtained at a uniform temperature, preferably a little
below boiling. Neither the hot water nor the cold water pipes which
supply the douche should be connected with pipes supplying water for other
purposes. They should pass directly from the original source of supply to
the pipes. This is exceedingly important, as it is the only means by which
a uniform and safe service can be secured. When either the hot or the cold
water source is variable in pressure or temperature the patient may receive
most unfavorable and possibly damaging shocks.

When uniform pressure cannot be obtained in any other way special
tanks specially elevated may be utilized. The elevation should be such as to
provide a pressure of at least thirty pounds. A higher pressure may sometimes
be advantageously employed. Each foot of elevation gives a pressure of 0.43
pounds. Hence, for a pressure of thirty pounds an elevation of about seventy
feet is required. If several douche apparatuses are employed on the same
premises each must have its own separate heater and its own supply pipe passing
directly from the tank. It is not necessary that there should be a separate
supply pipe from the main tank to the hot water tank. In arranging pipes the
plumber should be instructed to lead off the cold water pipes from the main pipe
just as it enters the hot water tank.

A special nozzle should be provided for the administration of the
various forms of the horizontal douche, jet, spray, and fan, as well as for the
fixed apparatus. In general, nozzles are too small, so the volume of water fall
ing upon upon the body is not sufficient to produce the thorough-going effects
which this procedure is intended to evoke.

Douches are given at all temperatures, from 40° F. to 120° F.; at
various degrees of pressure, from one to five pounds to fifty pounds, and with
periods of duration varying from three or four seconds to ten or fifteen seconds.
As a general rule, however, the douche is a vigorous procedure, occupying not to exceed five to thirty seconds when cool or cold water is employed, or at the most three or four minutes with water at a temperature near that of the body.

Physiologic effects.—The douche is a mixed procedure, combining thermic and mechanical effects. It is highly versatile in its effects, admitting of such perfect control and careful gradation that the energy or force of the application may be varied from the very gentlest application up to the most vigorous that can be produced by any hydriatic procedure.

The effects which will be produced by the douche depend upon several factors, which briefly stated are as follows: 1, temperature; 2, pressure; 3, duration; 4, form of the application, whether with the jet, fan, or spray; 5, whether general or local, and if the latter the part to which the application is made.

When very higher very low temperatures are employed the temperature is the dominant factor. When the temperature of the douche is near that of the body, the force or pressure with which the application is made is a more powerful factor than the temperature.

The effects resulting from the temperature of the application are essentially the same as those which accompany the application of hydriatic procedures of other sorts, as compresses or immersion baths, but to these effects are added certain mechanical effects which may modify the thermic effects to such a degree as to produce results the very opposite of those which accompany compresses or immersion procedures at the same temperature. This fact renders necessary a very careful study not only of the douche in general but of the various forms of douches and of the particular effects which result from the combination of the mechanical effects of the application with the thermic effect of the water at various temperatures.

The mechanical effect of a column of water impinged upon the surface is practically that of massage. When the column of water is of considerable
size and applied with strong pressure the immediate effect at the point of contact with the skin is to empty the blood-vessels of their contents, producing an area of pallor, due to the bloodless condition of the skin, and this irrespective of the temperature of the water, although the effect produced by water at a low temperature is most striking. This observation alone affords sufficient evidence of the remarkable effect of the douche upon the superficial blood-vessels of the body, and through the changes produced in the skin circulation, the entire circulatory system is profoundly affected. The douche is, in fact, a sort of hydraulic massage, and combining as it does the mechanical effects of massage with the thermic effects of hot and cold water, it produces reaction and reflex effects of the most vigorous character. These effects are not confined to the skin, but extend to the entire nervous system, and may influence every bodily organ and every function.

The cold douche at a low temperature and of short duration is one of the most powerful of all excitant procedures to which the body can be subjected. Reaction occurs more quickly than with any other hydraulic procedure. The reaction effects, if not greater than can be produced by other procedures, are certain much more prompt. Other effects produced by the general cold douche are lowering of body temperature, diminution of sensibility of the skin, increased muscular energy and contractility, first excitation then slowing of the pulse, elevation of blood-pressure, increased blood count, leukocytosis, increased alkalinity and viscosity of the blood. The systematic employment of the cold douche accelerates tissue change, increases appetite, improves digestion, increases heat production, raises the opsonic index, increases vital resistance, and generally invigorates and hardens the body.

The cold douche is followed by a feeling of warmth, general exhilaration and well being that is an ample compensation for the momentary discomfort an inconvenience experienced during the bath.

Therapeutic applications.—The versatility of this procedure is so
great that a douche in some form may be employed in almost every case in which
hydriatic applications of some sort are admissible. Fleury, of Bellevue,
France, who perhaps did more than any other person to develop and systematize
this procedure, preferred it to all others, and believed that cases of disease
which were at all curable might be brought to recovery by means of the cold
douche. In most hydriatic establishments in France and Germany the douche is
in constant use. It has the advantage over other procedures that it occupies
very little time, and produces immediate results. In a large establishment
where many patients must be treated in a short time it is certainly a most
economical measure. This fact, however, should not lead to its use in cases
in which other measures offer superior advantages. In studying the hydriatic
methods employed in various parts of Continental Europe it has seemed to the
writer that this procedure is given undue prominence. There are special
classes of patients to which the douche is particularly adapted. For producing
tonic effects it excels perhaps all other procedures. For this purpose the
cold or very hot douche may be employed. The neutral douche is highly sedative
in its effects. The alternate douche produces most pronounced revulsive,
exciting, or sedative effects, according to the mode of procedure.

Cautions and contraindications.—The douche is generally contraindicated
in cases in which strong reaction is not desirable. It should not be employed
in acute inflammatory conditions, in the presence of skin eruptions, or when
there is a condition of excessive irritability of the central nervous system.
THE HORIZONTAL JET.

This form of the douche consists of a solid wall of water projected in a more or less horizontal direction with varying force. It is administered by means of a nozzle attached to a hose three to six feet in length, and having an opening three-eighths of an inch to one inch in diameter. This douche was much used by Charcot, especially in applications to the spine, from which it is sometimes called the Charcot douche. But Professor Charcot contributed nothing to the construction of the apparatus or the technic.

Technic.—The pressure employed may vary from five to fifty pounds. The average is twenty-five or thirty pounds. In this form of the douche in particular it is important that the pressure should be noted by means of a pressure gauge, as variations in pressure may modify in a great degree the effects produced. When the full effects of the douche are desired the pressure is made sufficient to produce a decided impression upon the skin.

The Broken Jet.—The pressure may be diminished either by lessening the supply of water, or better, by placing the finger in the stream of water close to the nozzle, and so breaking the solid column into a number of small streams. This is known as the broken jet. In the general application of the horizontal jet the broken jet is nearly always employed for certain regions of the body which are too sensitive to receive the full force of the stream.

Douches may be classified according to the temperature as very cold, 65° F. to 45° F.; cool, 80° F. to 65° F.; tepid, 92° F. to 80° F.; neutral, 97° F. to 92° F.; hot, 102° F. to 110° F.; very hot, 110° F. to 125° F.

In receiving the application of the douche the patient usually stands at a distance of six to eight feet from the attendant. Feeble patients may be allowed to sit on a stool.

The head should be cooled by bathing with a towel dipped in cold water, after which the wet towel should be placed about the head.
THE COLD DOUCHE.

Special care should be taken to cool the head thoroughly and to have the patient well warned. Special care should be given to the feet. A very feeble patient may stand in a hot foot bath during the first part of the application. The jet is allowed to play first upon the back and the shoulders, then upon the arms, hips, legs, chest, liver, spleen, abdomen, and lastly the feet. The full force of the stream is employed for the back, shoulders, legs, and feet, but for the other surfaces—the chest, liver, spleen, and abdomen—the stream is broken with the finger; that is, the broken jet is employed. The whole surface of the body is thus gone over, the stream being allowed to play upon the parts named one or two seconds only; then the same program is repeated three or four times, as may be required to produce the desired effect. The patient keeps constantly in motion, rubbing the chest with his hands, and when the stream of water is directed upon the chest the patient clasps his hands over his heart to avoid making too strong an impression upon this organ. The genitals are avoided altogether; also areas which are tender or the seat of pain. Care must be taken to direct the stream in such a way as to avoid spattering the face. In cases of visceral congestion the affected part may be protected by directing the stream of water over the organ for a few seconds before beginning the general application. In such cases it is advantageous to have the patient's feet in hot water during this local application. After the general application the local application is repeated for two or three seconds.

Physiologic effects.—The description of the physiologic effects of the general cold douche has been given elsewhere(see page ). Briefly summarized these are, general contraction of the small arteries throughout the entire surface of the body, strong fluxion of blood from the surface to the interior of the body, quickly followed by reaction with dilatation of the surface vessels and return of the blood to the skin; strong excitation of the brain and
spinal cord; diminished rate and increased energy of the heart contractions; increased vigor of blood movement; increased blood-pressure; slight fall of temperature with increased heat production; general increase of functional activity and tissue change throughout the body; increased blood count and increased proportion of white cells; increased viscosity and alkalinity of the blood; elevation of the opsonic index; increased absorption of oxygen; increase of hemoglobin; increased gastric motility and secretion of hydrochloric acid; increased appetite, buoyancy of spirits; increased mental and physical vigor—increased general vital resistance.

Most persons feel a decided exhilaration after a measure of this sort. There is probably no other physical agent capable of producing such a remarkable change in vital conditions in so short a space of time.

Therapeutic applications.—From the effects above described it is evident that the cold douche is possessed of marvelous properties as a rejuvenating or recuperative agent. It excels all other known tonics in the extent and permanency of its effects. Employed with circumspection under careful medical direction it renders valuable service in all forms of chronic disease. It is especially valuable in the treatment of various forms of neurasthenia, in which it renders greater service than perhaps any other agent. In these cases special attention should be given to the spine. In the various forms of dyspepsia it is also of great service, particularly in cases of hypochlorhydria, diminished motility, and constipation. It must be used with great care in cases of hyperchlorhydria, gastric ulcer, and gastritis. Other conditions in which it is especially indicated are chronic auto-intoxication, inebriety and other drug habits, hysteria, obesity, and diabetes, and with great care in selected cases of chronic rheumatism.

Cautions and contraindications.—This procedure is contraindicated in inflammatory conditions involving the viscera, in dermatitis, in Bright's disease, organic disease of the heart with broken compensation, neuritis,
inflammation of the bladder with tenesmus, in chronic disorders of the spine accompanied by pains, and in cases complicated by hemorrhage from the lungs, stomach, bladder, or kidneys.
The Horizontal Jet seems incomplete.

J. T. C.
THE HOT HORIZONTAL JET.

This procedure is much less used than the hot spray douche, which is preferable to it. It first raises then lowers blood-pressure, produces intense congestion of the skin, and at a temperature of 110° F. produces very marked analgesic effects.

Therapeutic applications.—A very hot horizontal jet when used at a very high temperature (110° F. or 120° F.), and of very short duration, produces tonic effects similar to those of very cold applications, and can be used in persons who have a decided aversion to or an idiosyncracy against cold water. A hot horizontal jet is a most excellent remedy in neuralgias and paresthesias, especially when affecting the lower extremities. It affords an excellent means of awakening circulatory activity in paralyzed limbs. Its use is generally followed by a very short cold application. When employed to relieve pain the temperature of the succeeding cold application should be moderate, 80° F. to 70° F.
THE NEUTRAL DOUCHE.

Temperature, 92° F. to 97° F.; usual duration, two to four minutes. It may be continued for fifteen or twenty minutes. The pressure is usually five to twenty pounds. The physiologic effects are sedative and derivative. This measure produces hyperemia of the skin through the circulatory reaction which is the result of the mechanical effect of the douche, without producing any decided reflex effects. It may be employed in cases in which intense visceral congestion exists, rendering the very cold bath undesirable. When employed at very high pressure a slight, temporary rise of blood-pressure occurs.

Therapeutic applications.—This measure renders valuable service in insomnia, for which purpose it should be administered for three or four minutes at bed time at a pressure of fifteen to twenty pounds. Applied to the spine it produces beneficial effects in chorea and seminal weakness in men. It is indicated in nocturnal enuresis and erotomania in both sexes. At moderate pressure (five to ten pounds) it often affords relief in paresthesias.
It seems to me that the therapeutic applications of the percussion douche is incomplete.

J. T. C.
THE PERCUSSION DOUCHE.

This is a horizontal douche in which peculiar effects are obtained by combining with the water stream a current of compressed air. A specially constructed nozzle devised by the writer in 1895 is employed, which is so arranged that a current of compressed air enters the water stream just before its exit from the nozzle. The result is a pulverization and dispersion of the water and a greatly accelerated velocity. The amount of pulverization and dispersion depends on the amount of air admitted and the pressure employed, so that a great variety of effects may be obtained.

The percussion douche differs from the percussion jet in several particulars. First, the water is much more finely and uniformly divided. Second, while in the broken jet the force of the stream is considerably diminished in the percussion douche this is markedly increased. The advantages offered by the percussion douche are that it permits the use of colder water, and produces with water of the same temperature more decided effects.

Physiologic effects.—The physiologic effects of the percussion douche are essentially those of the ordinary douche emphasized. The strong percutient effect produced by it lessens cutaneous sensibility to a marked degree to both hot and cold water. At neutral temperatures very strong derivative effects are produced.

When air at a pressure of forty or fifty pounds is employed the water stream is broken into a fine mist, particles of which are driven with such velocity as to produce a stinging sensation when brought into contact with the skin, producing very strong circulatory reaction and powerful reflex effects. When the water pressure is low this is an excellent means of procuring high pressure effects, which in certain classes of cases are quite essential for the best results.
Therapeutic applications.--The percussion douche is especially useful as an application to the spine in neurasthenics who have a fair degree of vigor.
THE SCOTCH DOUCHE.

In this procedure the patient receives the hot douche immediately followed by a cold douche. It derives its name from the fact that it was first employed in Scotland. According to Beni-Bard it was much used by Cullen in the treatment of rheumatism by means of a very crude devise whereby a rude sort of a shower bath or rain douche was administered. The patient was placed in a long box, the lid of which was perforated with small holes and the bottom with larger openings. This was suspended from the ceiling. Hot water poured upon the tub ran down over the patient in small streams, and when he was well warmed up a short application of cold water was made in the same way.

A German physician, Dr. Lespiere (?) who saw this rude devise in use in the hospitals of Edinburgh installed the hot douche beside the cold douche which he had previously been using and employed them in combination under the name of the Scotch douche.

Technic.—The patient having been prepared in the usual way receives a hot application from one to four minutes at a temperature of 102° F. to 120° F. The higher the temperature the shorter the duration of the application. The hot application is immediately followed by a cold application at a temperature of 70° F. to 50° F. for twenty to forty seconds. The pressure may be varied from five to forty pounds. Any form or combination of forms may be employed. An excellent combination is a hot shower followed by a cold jet or spray.

The Scotch douche may be used in general applications, but it renders its greatest service as a local measure. The change from hot to cold is usually made abruptly, but in certain cases it is advantageous to graduate the change. The gradation is effected by means of a mixing valve or some other equivalent device.

Physiologic effects.—Most versatile effects may be produced by the Scotch douche. When the hot application is long and the cold application
very short, the effects are essentially the same as those of the hot douche. A shorter hot application and a longer cold application produces effects approximating those of the cold douche. A short hot application followed by a short cold application produces excellent tonic effects. A long hot application followed by a short cold application produces derivative and revulsive effects of a most decided character.

Therapeutic applications.—The Scotch douche may be used in almost all classes of cases in which cold or tonic applications are required. It is perhaps more universally applicable than any other hydriatic procedure. It is especially indicated in the treatment of persons who have not been accustomed to hydriatic treatment, and who dread the contact of cold water. It is equally advantageous in the treatment of feeble patients who have little power to react. It renders special service in cases in which the skin is inactive and in neurasthenics who are troubled with profuse perspiration. In such cases the application should be at as high a temperature as possible, at quite high pressure, and very short (ten to twenty seconds for the hot water, and two to five seconds for the cold). A general Scotch douche relieves malaise and muscular weakness. As a local measure it renders great service in cases of spinal irritation, sciatica, and all forms of neuralgia, muscular rheumatism and rheumatism of the joints. Applied to the legs it relieves asthma, insomnia, and visceral congestion.

Cautions and contraindications.—Care should be taken in the employment of the Scotch douche to avoid over-heating the patient. The cold application should in all cases be sufficiently long to remove from the skin the heat which has been stored up in it by the contact of the hot water.
THE SIMULTANEOUS DOUCHE.

This procedure consists of a hot and a cold douche administered simultaneously. A double douche apparatus is required for its administration.

The technic, preparation of the patient, etc., are essentially the same as for the Scotch douche, the essential difference consisting in the fact that the hot and cold applications are made at the same moment.

The writer has used this procedure for a number of years, having first called public attention to it in his work, "Rational Hydrotherapy," published in 1900.

The simultaneous douche may be employed either as a general or as a local measure, and if desired may be graduated into a general cold douche. The application always begins with the hot douche, the cold being added after a decided heating effect has been produced.

The duration is usually five to ten minutes. A longer duration is permissible for local applications. Various combinations may be made. The most convenient are the hot shower combined with the horizontal jet, spray, or fan douche, and the circle douche combined with the spray, jet, or fan douche.

In administering a general simultaneous douche the procedure begins with a hot shower. After the skin has been well warmed the cold horizontal jet is applied, following the ordinary routine—back, hips, legs, chest, abdomen, and feet—about two seconds to each area. In cases in which this method is employed as a means of training patients to the use of the cold douche, the temperature of the shower bath may be lowered by proper regulation of the mixing valves until a temperature near that of the cold jet is reached, and the shower may be turned off, the procedure ending with a rapid and short application of the cold jet.

Local applications may be made in two ways: (a) by a continuous local application of the cold jet with a warm or hot shower or circle douche; or (b) the
simultaneous application of heat and cold to a circumscribed portion of the body, as a spray or circle douche to the legs, with the cold jet to the feet, or a circle douche to the trunk with the cold jet to the spine.

The simultaneous douche should always end with a short general cool or graduated application.

In the local application of this procedure various useful combinations can be made, of which the following are chief.

Heat to the abdomen (102° F. to 106° F.), with cold to the dorsal region. Duration, three to five minutes.

Cold to the spine and heat to the feet.

Cold to the lumbar region, with heat to the hypogastrum.

Cold to one side of the body, as one arm, or one leg, with heat to the other—the symmetrical simultaneous douche.

Physiologic effects.—The simultaneous douche is a revulsive and sedative procedure. It congests the skin, lowers blood-pressure, diminishes general nervous sensibility, accelerates blood movement in all parts of the body. The skin being warmed at the same time the cold application is being made, no retrostasis occurs, and the internal blood-vessels being already drained of blood, are prepared to contract vigorously in succession as the cold jet moves over the surface of the body.

Therapeutic applications.—The measure is applicable in all cases in which there is not a very great aversion to the contact of the cold water or an idiosyncrasy against it. By the daily application of the simultaneous douche such cases can usually be trained to receive with excellent results the usual tonic procedures which render valuable service in highly nervous and timid neurasthenics, and as a local procedure it is most valuable in all forms of visceral congestion. It may be used with excellent results in chronic disorders of the liver and gall bladder, chronic or subacute gastritis and constipation, with atony of the bowels. In hysteria affecting one side of the body the circle
douche may be employed to both legs while the cold douche is applied to the well leg, closing with a dash of cold water to both legs.

Cautions and contraindications.—Great care must be taken not to employ the hot douche for too long a time nor at too high a temperature. This procedure is contraindicated in severe cardiac weakness and in cases of acute inflammation of viscera, as otherwise depressing effects will be produced. Care must also be taken to cool the patient sufficiently at the close of the application to secure thorough toning of the skin.
THE REVULSIVE DOUCHE.

This procedure is really a variation of the Scotch douche. It differs from it only in the fact that the alternate applications of heat and cold are repeated and that care is taken to make the cold application just long enough to remove from the skin the heat which has been imparted to it by the preceding hot douche.

This douche produces purely derivative effects. It requires careful management to secure these results. The hot application should be just long enough to produce thorough reddening of the skin; as soon as the characteristic dull red color appears the cold application should be made. The duration of the cold application must always be very brief, only a few seconds. The characteristic change in the color of the skin from dusky red to bright cherry red indicates the development of the peculiar circulatory reaction which is evoked by the cold. These changes in color will be observed not on the entire surface, but only on those parts which are especially sensitive to reaction effects—shoulders and chest. When employed for the relief of pain, the fan douche is preferable, and low pressure should be used—five to ten pounds.

Therapeutic applications.—A revulsive douche to the hips and legs may be usefully employed in cardiac disease with loss of compensation as indicated by swelling of the limbs, in ascites, and sciatica, and to the spine, abdomen and lower extremities in hyperhydrochloria and gastralgia.
THE ALTERNATE DOUCHE.

The alternate douche is a variety of the Scotch douche which differs from it only in the timing of the hot and cold applications, and in the fact that the alternation is several times repeated. The duration of the hot application is fifteen to thirty seconds, of the cold fifteen seconds. Any form of douche may be employed. The changes in temperature are usually abrupt, but may be graduated by means of the mixing valve when the shock of the sudden change of temperature is too disagreeable or too exciting.

Physiologic effects.—The effects of the alternate douche are highly excitant, the procedure being always terminated by a cold application of more than sufficient duration to remove the effects of the preceding hot application. The final and essential effect of the procedure is that of a short, cold application rendered more intense by repeated changes made possible through the medium of the hot application.

The hot application first made prepares the skin to receive the strongest possible impression from the first cold application made. The second hot application again warms the skin and thus makes possible a repetition of the first excitant effects of the cold; so by the employment of heat and cold in alternation the excitant effects of the short cold application may be repeated as many times as may be desired. By employing as high and low a temperature as the patient is able to bear, the circulation of the internal parts may be influenced to a most remarkable degree. Each hot application dilates the vessels, while each cold application contracts them. Thus the movement of blood may be accelerated and functional activity increased. The walls of the internal hollow viscera are also stimulated to contraction; hence the motor functions and those parts are encouraged.

The general alternate douche is one of the most powerful excitant of all hydriatic procedures. It must be employed with caution, however, as it may
over-excite and finally exhaust the vasomotor centers.

**Therapeutic applications.**—The excitant properties of this douche render it of great value as a tonic measure when carefully employed. It may be used practically whenever the cold bath is indicated, but it has no advantage over the cold douche unless there are special indications for it. It is preferable as a tonic measure when the skin is relaxed, dry, and does not readily react to the stimulation of the cold douche. The alternate douche renders greater service as a local procedure. For this purpose it may be used three or four times daily. It is indicated in enlargement of the liver and spleen, in ascites, exudates left behind by traumatisms or inflammations, stiffness of the joints, chilblains, thickening of the skin in eczema, and it may be applied with advantage to the lower back and legs in amenorrhea. Neurasthenics usually experience immediate and prompt relief from an alternate douche to the spine. Malaise, fatigue, weakness of the muscles, feelings of depression, paresthesias, and annoying neurasthenic symptoms of various sorts generally yield very promptly to an application of this measure. It use is generally followed by a short general cold application.
THE RAIN DOUCHE OR SHOWER BATH.

In this procedure a large number of streams of water are made to fall upon the patient from above by means of a perforated disk. The diameter should be eight to ten inches, and the openings about 1/25 of an inch in size. The force with which the water falls should not be greater than that produced by gravity.

The technic and general method are the same as for douches in general. The patient's head must be protected from the force of the stream by a thick napkin. The patient should move about constantly during the application, so as to permit the water to fall upon all parts of the body and should rub himself vigorously with his hands. The hands should be placed over the precordial region when the water falls upon the chest. The temperature of the cold shower should be 75° F. to 65° F. Duration, fifteen to thirty seconds. The temperature of the hot shower should be 100° F. to 112° F. Duration, one half minute to two minutes. The temperature of the neutral douche should be 92° F. to 97° F. Duration, two to five minutes. The temperature of the graduated douche should be 100° F. to 60° F. Duration two to five minutes.

The hot rain douche is always followed by a cold or graduated application.

In preparation for this bath it is highly important that the feet should be well warmed and that the head should be very thoroughly cooled by repeated wash with a napkin dipped in cold water. The cold napkin should be wrapped around the head to protect it from the impact of the water. This protection is necessary for the hot as well as for the cold shower, as both of these procedures produce momentary congestion of the brain.

Physiologic effects.—The cold shower bath is a powerful refrigerative measure. It extracts a large amount of heat from the body, and hence produces strong thermic effects, stimulating heat production and tissue change to a marked
degree. It produces strong chest movement and hence powerfully influences the cerebral and portal circulations and stimulates the movement of blood throughout the body. A cold shower bath combined with the horizontal jet is the most powerful of all hydriatic procedures. All the other physiologic effects produced by the ordinary cold douche which have been described elsewhere (see page ) are induced by this procedure.

The hot shower bath is a powerful exciting measure. It congests the brain, quickens heart action, first raises then lowers blood pressure, and when long continued is very exhausting because of the depressing effects.

The neutral shower bath lessens cutaneous sensibility, quiets the nervous system, and promotes the activity of the skin without producing marked reaction effects.

The graduated shower bath combines the effects of the heat and cold, avoiding the strongly excitant effects which result from the sudden application of cold.

The physiologic effects produced by different temperatures are the same as those of douches in general, for a full description of which see page .

Therapeutic applications.—The cold shower bath is especially indicated in obesity and in diabetics who are strong and not emaciated, and in neurasthenics who are fleshy and phlegmatic. In the early morning when the patient first rises from bed is in many cases the best time for the application of this procedure, especially in neurasthenics. It quickens the circulation, creates appetite, and dissipates the depressed feelings from which many neurasthenics and dyspeptics suffer in the early part of the day.

The hot shower bath is most frequently used as a preparation for a cold horizontal jet or some other cold procedure. It is a very convenient and quick method of preparing the skin to receive a cold application. It may also be usefully employed for the relief of pain in general neuritis. A short application of the hot shower bath may be used as a preliminary measure to
preparing the skin for a sweating procedure such as a sweating pack, an electric-light bath, or a dry pack.

The neutral shower bath renders capital service in insomnia and general nervous irritability.

The graduated shower bath is chiefly used as a means of cooling the skin after a prolonged heating procedure.

Cautions and contraindications.—The hot and cold shower bath must be avoided in advanced cases of Bright's disease and in cases of cardiac disease in which compensation is broken. Both the hot and the cold shower bath should also be interdicted in cases in which there is general feebleness or cardiac weakness, as the standing position and the powerful character of the application may give rise to fainting or collapse.
THE SPRAY DOUCHE.

This is simply a horizontal douche in which the jet nozzle is replaced by a nozzle with a perforated disk which divides the column of water into a large number of fine streams.

The physiologic effects and therapeutic applications are the same as for the horizontal jet. The spray is a more universal application, however, being comparable with the broken jet. The spray may be used at all practicable temperatures, and has either a local or a general application. It is on the whole preferable to the horizontal jet, although in certain cases the latter form of douche presents undeniable advantages.
THE ASCENDING DOUCHE.

The ascending douche is administered by means of a fixed nozzle so located that the stream of water is projected upwards. It may have the form either of the jet or of the spray. It is chiefly employed for applications to the anal region or the soles of the foot. When employed for the anal douche, the patient receives the application while seated upon a support of special construction. This douche is often used in connection with the flowing sitz bath.

Therapeutic applications.—The short cold ascending douche stimulates intestinal peristalsis and excites the pelvic circulation. Hence it is useful in constipation, in amenorrhea and in scanty menstruation. When prolonged at a moderate temperature (80° F. to 70° F.) for eight to twelve minutes a strong sedative effect is exercised upon the pelvic circulation. Applications of this sort are indicated in hemorrhoids, in atony of the bowels and bladder, and in chronic pelvic congestion. The hot or neutral ascending douche with little pressure may be employed as a means of relieving the pain of rectal ulcer and to overcome the contraction of the sphincter ani.
THE CIRCLE DOUCHE.

This procedure is administered by means of a number of perforated tubes arranged in a circle. The physiologic effects and therapeutic applications are the same as those of the shower bath and the spray. This procedure is most commonly used in connection with the shower bath, and is capable of producing powerful effects.
THE FAN DOUCHE.

This douche differs from the horizontal jet and the spray in the form of the water column which, issuing from a narrow slit, is a broad thin stream with little pressure. A similar form may be given to the stream by holding to the opening of the ordinary jet nozzle a flat piece of wood or metal.

Physiologic effects.—The fan douche is only administered with a very low pressure, the water column being given this form for the purpose of reducing the mechanical effects.

The general effects of this application are essentially those of the ordinary jet douche at very low pressure. It is far less exciting than the ordinary jet or spray douche, and is especially indicated when the purpose of the douche is to relieve pain and when the application is made to especially sensitive parts.
THE MASSAGE DOUCHE.

In this procedure the ordinary douche is combined with the kneading movements of massage. This is essentially a local procedure. Strong intermittent pressure is made with the palms of the hands while the thumbs and fingers execute kneading movements upon the skin and underlying muscles. The massage is commonly employed in connection with the cold horizontal jet.

Physiologic effects.—The effect of massage in connection with the douche is to intensify the mechanical effects of the douche. Circulatory reaction is greatly aided by the manipulations, and the undesirable effects of retrostasis are antagonized. Being commonly employed with the cold jet at high pressure it produces powerful revulsive effects.

The hot massage douche produces very powerful derivative and analgesic effects. The blood-vessels are widely dilated, giving to this procedure great power as a means of producing colateral hyperemia and colateral anemia of deep-lying vascularly related parts.

The hot and cold massage douche affords perhaps the most effective of all known means of producing intense and durable derivative effects.

Another special advantage of the massage douche over the ordinary douche is that when given at a low temperature it is much more readily tolerated than the ordinary cold jet.

Therapeutic applications.—The cold massage douche is a valuable means of reducing an undue accumulation of fat about the hips and abdomen. The cold massage douche to the lower extremities affords an excellent means of producing durable derivative effects, in cases of pulmonary congestion and congestion of the abdominal viscera. When thus used the temperature should be gradually graduated from 100° F. or 102° F. at the beginning to 70° F. at the end. By this means retrostasis may be entirely prevented.
The massage douche, both hot and cold, is an excellent measure for relief of stiffness of joints due to inflammatory exudates. In these cases the cold massage douche should follow a thorough and prolonged application of heat.

The cold massage douche is equally indicated in lumbago, and sciatica, especially when preceded by an electric-light bath or a hot application of some sort. The neutral massage douche to the legs is an excellent derivative means in the treatment of insomnia. When employed for this purpose it is well to precede the application by a hot hip and leg bath or a hot pack to the hips and legs.

Cautions and contraindications.—The cautions and contraindications are the same as those of the ordinary cold douche.
THE AFFUSION OR PAIL DOUCHE.

The affusion douche, sometimes called the pail douche, is an exceedingly simple procedure which may be substituted for the douche when the necessary douche appliances are not available, or in cases in which the douche is not applicable, for the pail douche has special indications of its own. The position of the patient is standing, or seated with his legs in a tub. Water at the required temperature is dashed or poured upon the patient. The patient should be prepared for the affusion the same as for the ordinary douche. The feet and the body should be thoroughly warmed and the head should be well cooled. The affusion is always employed in connection with the Brand bath, and also in connection with the revulsive sits bath, as has been stated elsewhere.

When the general affusion is to be administered the patient stands erect while several pailfuls of water are poured over him. The attendant lifts the pails as high as possible and manipulates them in such a way as to cause the water to fall upon the patient's back or shoulders, the patient in the meantime placing his hands upon his chest and rubbing himself vigorously. Three pailfuls of water are always employed, one for each shoulder and one for the back. The temperature of the water may vary from 85° F. to 65° F. The application may be graduated by making each succeeding pailful of water lower in temperature. The application should be quickly administered and the patient should be well rubbed and dried afterwards. Patients who are very sensitive to cold water may stand in a hot foot bath during the application, stepping out of it just at the end of the application so that cold water may be dashed upon the feet.

In a private house the bath may be most conveniently administered in an ordinary bath tub. The patient may sit with the legs extended in warm water while cold water is dashed upon the upper part of the body; then rising while two or three additional pailfuls are poured upon the hips and back and allowed to run down over the legs.
In making local affusions to the extremities the part may be held over the tub while water is poured upon it from a dipper or pitcher. The spinal affusion or spinal pour may be conveniently given with the patient sitting over the edge of a tub. In the absence of a douche apparatus excellent effects may be obtained in visceral congestions and constipations by placing the patient over a bath tub and pouring water upon him from a pitcher held as high as possible by the attendant standing on a chair. A short cold pour administered to the abdomen in this way is an excellent remedy for constipation.

The affusion bath was successfully employed by Currie, of Liverpool, in the treatment of a sudden epidemic of scarlet fever, in which he proved its superiority over all other methods of treatment then in vogue. A traveler visiting the West Indies more than a hundred years ago observed that the natives treated yellow fever by placing the patient upon the sand near the shore and pouring water upon him from the sea.

Cold affusions employed in connection with the Brand bath are a powerful means of stimulating the spinal centers and of overcoming the depressant effects of typhoid toxin.

Administered in connection with the warm half bath the cold affusion renders excellent service in capillary bronchitis and broncho-pneumonia, especially in children. The cold affusion may also be employed in the treatment of drug habits, especially opium poisoning and alcoholism.

The effect of the cold bath in lowering temperature may be increased by a short hot affusion just at the end of the bath. The temperature of the water employed should be 85°F. to 75°F.

There is no more valuable remedy for sunstroke than a cold affusion combined with vigorous massage. The patient is placed in a horizontal position and vigorously rubbed by two persons while cold water is poured upon him from a pitcher or dipper held as high as possible by an assistant standing
in a chair.

When exciting effects are desired, as in conditions of depression, a temperature of 75°F. to 60°F. should be used.

Cautions and contraindications.—Cold affusions should be avoided in cases of great cardiac weakness from organic disease or degeneration, when hemorrhage has occurred or is feared to be impending, in typhoid fever or tuberculosis, in arteriosclerosis, Bright’s disease, and acute visceral inflammation.
THE VAPOR DOUCHE.

This is simply a jet of steam applied to the patient by means of a rubber hose with a suitable nozzle. A nozzle of special construction is required to prevent the ejection of hot water. The writer's device for this purpose is shown in figure. It consists of a vertical metallic cylinder about three feet in length and three or four inches in diameter. Both the supply pipe and the service pipe are connected with the top of the cylinder, but the supply pipe passes down into the cylinder at least two-thirds of its length. At the bottom of the cylinder is placed a small outlet controlled by a stop-cock. The nozzle should have a diameter of three-eighths of an inch to half an inch and should be incased in wood so that it may be conveniently handled. The length of the nozzle should not be greater than is necessary. A length of thirty-five or forty inches is quite sufficient.

In preparing the apparatus for use the bottom of the upright cylinder should be widely opened so that when the supply valve is opened the condensed water which is always present in larger or small quantities may find ready exit. The apparatus is not ready for use until live steam issues from the outlet. The outlet should then be partially closed but should always be sufficiently open to allow the escape of water, which condenses in the steam chamber. The steam should be allowed to pass from the hose and nozzle for a moment until it is well heated. The pressure employed should be just sufficient to permit the drops of water which condense at the mouth of the nozzle to fall to the floor instead of being broken up and carried with the column of steam. If greater force is employed small amounts of hot water will be forced against the patient with most unpleasant effects. The patient should stand about three feet from the end of the nozzle. By approaching the nozzle to the patient the temperature of the application can be gradually raised as the tolerance of the skin
increases. The nozzle should be kept in constant but not too rapid motion, so that as high a temperature as may be desirable may be employed. By approaching or withdrawing the nozzle the temperature may be varied to suit the feelings of the patient and other indications. Any desired degree of temperature may be employed, from a temperature just above that of the body to $150^\circ$ F. or $160^\circ$ F. Vapor is tolerated at a temperature much higher than water.

The vapor douche may be employed in place of the hot water douche in all the various complications and combinations in which hot water is employed. In connection with the cold spray it is a most agreeable and effective means of producing powerful revulsion.

Physiologic effects.—The physiologic effects of the vapor douche are essentially the same as those of the hot water douche. It dilates the vessels more completely and more quickly than the hot douche and is more agreeable in application. It lessens cutaneous sensibility and produces all the derivative, analgesic and sedative effects which are produced by the hot water douche.

Therapeutic applications.—The vapor douche is especially valuable as a means of relieving painful effusions in which the skin is hypersensitive, as in spinal neuralgia, neuritis and the neuralgia following herpes zoster. It is also indicated in painful muscles and joints, eczema with dryness and thickening of the skin, pruritis ani and vulvae, and in connection with ice rubbing or the cold spray in chronic sciatica and lumbago.

Cautions and contraindications.—The limitations to the use of the vapor douche are much fewer than those of the hot water douche. It can scarcely do harm in any case unless by excessive continuance the parts are over-heated. It is generally contraindicated in most cutaneous eruptions. After its use a cooling measure of some sort should not be forgotten.
Note for p. 228.

Effects of cold on reflex areas, heat on reflex areas, physiologic effects, etc.
LOCALIZED DOUCHES.

The douche is perhaps the most effective of all means of awakening reflex activity in internal parts by applications to the proper skin areas. The note of these effects and the particular skin areas which may be utilized for the control of circulation and functional activity in individual internal organs has been fully explained elsewhere, so that we need not recapitulate here (see pages ). In general it may be stated that: 1. Prolonged cold applications with little pressure produce a more or less durable contraction of the blood-vessels and lymphatics in the skin and internal related parts. 2. Short cold applications with strong pressure produce both locally and reflexly a brief primary contraction followed by dilatation of the blood-vessels and lymphatics. 3. Very hot, prolonged applications produce local and reflex dilatation together with marked analgesic effects. 4. Alternate applications produce powerful excitant and pluxion effects. 5. Neutral applications produce local circulatory reaction with derivative effects without reflex disturbance.

The principal local douches which may be named are the following:

The cephalic douche, applied to the top and back of the head. Short cold applications are indicated in cerebral congestion and sunstroke, or a hot, dry skin. The tepid douche is of service in insomnia and mental and nervous excitement. Hot affusions to the head are useful in collapse, syncope, migraine with low blood-pressure and cerebral anemia.

The dorsal douche, applied to the upper half of the spine. A short cold douche is useful in spinal anemia, neurasthenia, and urinary incontinence from atony of the bladder. A prolonged tepid douche is useful in hysteria, spinal irritation, and sexual weakness. A hot douche is indicated in hyper-hydrochloria and gastralgia. A warm douche is employed in locomotor ataxia and spinal sclerosis.
The lumbar douche, applied to the lower half of the spine. Short cold applications are indicated in atony of the bladder, constipation from atony of the colon, amenorrhea, and scanty menstruation. Hot or revulsive douches relieve renal congestion, vesical tenesmus, lumbar, uterine, and ovarian neuralgia, backache, and coccygodynia.

The epigastric douche. This douche applied just below the sternum should be given with little force. The cold epigastric douche renders service in dilatation of the stomach without pyloric obstruction, flatulence, hyperhydrochloria, and prolapse of the stomach. The hot or Scotch douche may be used with excellent effect in all painful disorders of the stomach except gastric ulcer and gastritis.

The abdominal douche. A short cold douche to the abdominal surface stimulates the motility of the intestines and bladder. It is especially indicated in enteroptosis with dilatation of the colon, relaxed abdominal muscles, and diminished intraabdominal pressure, and the resulting congestion of the abdominal viscera. The Scotch douche relieves enteralgia, uterine and ovarian pain, neuralgia of the bladder and kidneys, and pain due to hyperesthesias of the lumbar ganglia.

The plantar douche. This is applied to the soles of the feet. A short cold plantar douche excites the circulation of the brain and of all the viscera of the abdomen. Hence it is useful in cerebral anemia and atonic states of the stomach and bowels. This application is also useful in atony of the bladder, amenorrhea, or scanty or delayed menstruation, and by dilating the vessels of the feet warms the lower extremities when coldness is due to vasomotor spasm. A prolonged cold douche with little force contracts the vessels of the brain and abdominal viscera, and hence may be usefully employed in cerebral and visceral congestion.

The anal douche, applied to the anus, perineum, and buttocks. A short
cold douche to this region stimulates peristalsis, and so relieves constipation. It is also indicated in atony of the bladder. The prolonged anal douche relieves hemorrhoids and pelvic congestion. The very hot anal douche relieves ovarian neuralgia, irritability of the bladder, vaginismus, anal spasm, and the pain of rectal ulcer.
VISCERAL DOUCHE.

The writer has applied the term "visceral douches" to a series of applications or a combination of applications by which a powerful impression may be made upon the large viscera of the trunk. The visceral douche differs from the localized douche in that the latter consists of an application to a single skin area, whereby a number of different viscera may be influenced, whereas the visceral douche consists of several applications may simultaneously for the purpose of reflexly influencing a single internal viscus. The writer has devised and for many years made use of a number of visceral douches, the chief of which are the following:

The cerebral douche. For exciting the circulation and activity of the brain short cold or alternate applications are made to the back of the neck, the face, hands, and soles of the feet. To relieve congestion of the brain prolonged cold applications are made to the above named surfaces. Hot and warm applications to the face, neck, and scalp congest the brain. Very short, very hot applications to the face, neck, and the soles of the feet, contract the vessels of the brain and diminish cerebral irritability.

The cerebro-spinal douche. The brain and spinal cord are powerfully affected by hot or cold applications made either simultaneously or in rapid succession to the whole length of the spine and the soles of the feet. Still more powerful effects may of course be produced by similar applications to the whole surface of the body, but when such a general application is made the effect is not so concentrated upon the brain and spinal cord as when the application is made to the neck, back, and feet only.

The gastric douche. The application is made over the stomach or the spine opposite, and to the feet and legs. A very short cold application stimulates the motility and glandular activity of the stomach. A very hot application diminishes motility in cases of emesis, relieves hypersecretion.
application diminishes motility in cases of spasm, relieves hypersecretion, and diminishes pain when present.

The hepatic douche, applied over the liver and to the feet and legs. Short cold applications and alternate applications increase the movement of blood through the liver.

The genito-urinary douche. Short cold applications to the lower part of the back across the lower abdomen, to the inner surfaces of the thighs, to the breasts, and the feet, contract the bladder and stimulate the circulation of blood through the pelvic organs. This douche is indicated in amenorrhea, scanty menstruation, and atony of the bladder. The hot douche to the same surfaces is indicated in tenesmus of the bladder, vaginismus, ovarian and uterine neuralgia, in neuralgia of the testicles, spermatic cord, and prostate.
In getting out this book I want to illustrate it by some pictures of
Graefenberg, the first Graefenberg douche, the wooden dipper and bucket, the
big bath tub, and perhaps several other pictures.
COLD WET HAND RUBBING.

Cold wet hand rubbing, or the wet hand rub, as this procedure is most commonly called, is systematic friction of the skin with the wet hand cooled by frequent dipping in cold water.

Technic.—The requisites are a woolen blanket, a Turkish sheet, two or three Turkish towels, and water at a temperature of 60° F. or less.

The friction begins with the face, the two hands working symmetrically and gently on opposite sides. The movements are in general from the median line outward. The hands must be dipped in the cold water every five or six seconds, and after dipping should be held horizontal with the palms upward so as to retain as much moisture as possible on the palmar surfaces. From the face proceed to the neck, the chest, the abdomen, one arm, then the other, then the two legs in succession. The patient then turns over upon his face, and friction is applied first to the neck, then the shoulders including the outer portion of the upper arm, the sides of the trunk, a few long sweeps down the back, then the buttocks, the back of the legs, and lastly the feet. The parts named should be treated in succession, first by the cold rubbing, then by thorough drying with the Turkish towel, and lastly by dry friction so as to establish good reaction before proceeding to the next part. Great care is taken to keep the entire body covered and warm except the part which is being treated. The movements should be very rapid, and with considerable pressure. Each part should be gone over several times so as to quickly establish and maintain good reaction.

Hot water or water at neutral temperature may be used in a similar way.

Physiologic effects.—Cold wet hand rubbing produces moderate tonic and derivative effects. The colder the water the more decided the physiologic stimulation produced. Some time after the application a notable increase in the depth of the respiratory movements may be noticed, blood-pressure is slightly
raised, and there is a general feeling of well-being and even exhilaration. As this measure combines the physiologic effects of friction with the thermal stimulation of cold, it produces when properly managed very strong reaction and is an exceedingly effective means of increasing the circulation in the skin.

Therapeutic applications.—This measure is of the greatest service in the treatment of very feeble patients. It is of special value as a means of training the patient to bear more vigorous measures. It constitutes the first round of what we have termed the "hydriatic ladder," a full description of which will be given later. Cold wet hand rubbing may be administered to the very feeblest patients, even to infants. There is almost no occasion on which it cannot be employed with advantage except in cases of cutaneous eruption, and those rare cases in which hot water must be substituted for the cold water because of idiosyncrasy against the latter. Defective skin activity, which exists in most chronic invalids, may be greatly improved by the application of this simple procedure at the first, to be followed later by more vigorous measures. Cold wet hand rubbing may be employed as a means of reducing temperature in fever. When employed for this purpose a rubber blanket should be placed under the patient, and the attendant should dip water freely upon the patient by cupping the hand.

Cautions and contraindications.—Cold wet hand rubbing is contraindicated in eruptive fevers and acute skin eruptions.
THE SPONGE OR TOWEL BATH.

Technic.—The requisites are a woolen blanket, a Turkish sheet, several Turkish towels, and water at the proper temperature. Either cold or hot water may be used, as the case may require.

The patient should be well warmed, especially the feet. The head, face, and neck should be cooled with a wet towel. The patient stands in a hot foot bath while the attendant rapidly goes over the whole surface of the body with a sponge or towel saturated with water at 150°F. to 650°F. The sponge or towel should be re-wet every few seconds. The whole time spent in the sponging should not occupy more than thirty seconds for the whole surface of the body. The application should be made in long sweeps from neck to hips before and behind, from shoulders to hands, and from hips to feet. As soon as the sponge is completed the whole surface should be rapidly gone over with the hands with long rubbing strokes with firm pressure.

When the patient is unable to stand, the application must be made in bed. A smaller amount of water is used unless employed for reduction of temperature, in which case the patient should have a rubber blanket placed under him. The water should be freely used and the sponging should be continued until the desired effect is obtained.

The sponge or towel bath is an excellent hygienic measure for use by persons in ordinary health. It may be taken daily on rising in the morning, while the body is still warm, with excellent effect, improving the appetite and assimilation, hardening the skin, and improving vital resistance.

Therapeutic effects.—The sponge bath may be used as a tonic measure in cases which are not strong enough to admit of the use of more vigorous treatment. It is less agreeable and less effective than the mitten friction or towel rubbing, and has in recent years in large places part given place to the
last named procedures.

Copious sponging with water at 75° F. to 65° F. is an excellent
means of reducing the temperature in fever. The sponging should be executed
rapidly, and should usually continue for five to fifteen minutes, being repeated
as often as is necessary to keep the temperature below 102° F. There are some
cases in which the sponge bath seems to succeed quite as well in controlling
temperature as the more vigorous measures which are more commonly employed.

The short hot sponge bath is an excellent measure for use in fevers
when the skin is sett led and cold. It relaxes the vessels of the skin. This
improves the surface circulation and so promotes heat elimination, which results
in a lowering of temperature.

Alternate sponging may be employed in place of the alternate compress
or douche in cases in which the excitant effects of alternate applications
are required. Alternate applications may render excellent service in neurasthenic conditions.
THE SALT GLOW.

This procedure consists in rubbing the whole surface of the body with moistened salt. The salt should be of medium fineness, and the vigor of the application should be carefully graduated to each individual case. The patient may stand, but usually sits upon a stool during the application. The attendant works with both hands, and goes over the whole body with short strokes and a considerable degree of pressure.

The effects of the salt glow are those of moderate cold combined with the powerful circulatory effects induced by friction and chemical irritation of the skin. It produces an excellent and durable reaction, and fills the skin with blood.

The salt glow is useful in cases in which tonic effects are desired, except in eczema and most other forms of skin disease. It is also contraindicated in fevers.
THE MITTEN FRICTION.

This is an exceedingly simply but highly effective procedure in which friction is applied to the skin surface by means of wet mittens by which the hands of the attendance are covered. The best material for the mittens is a closely woven woolen cloth resembling hair-cloth but slightly rougher to the touch, manufactured in Egypt or Turkey. Ordinary Turkish toweling is not desirable for the purpose. When better material is not obtainable, coarse mohair answers fairly well.

The patient should be prepared as for an ordinary wet hand rubbing, lying in bed wrapped in a Turkish sheet and woolen blanket. The friction is made in succession to the following portions of the body: the front of the trunk, including the abdomen, the right arm, the left arm, the right leg, the left leg, the shoulders, the back, the hips, the legs and the feet. The entire body is kept covered with the exception of the part being treated.

In making the application the hand (or hands) of the attendant covered with the mitten is dipped in cold water, then shaken or pressed slightly to expel the excess of water, then applied to the skin with short, vigorous strokes for five or six seconds; the mitt should then be redipped and the rubbing repeated. When it is desired to make the application very vigorous, the rubbings may be repeated four or five times. Ordinarily two or three dips are sufficient.

After the friction the parts should be covered with the Turkish sheet or a towel. After the body has been rapidly gone over in this way, occupying from three to five minutes in the operation, the whole surface should be carefully dried, and dry friction administered until good reaction is established.

Physiologic effects.—The physiologic effects of the cold mitten friction are essentially the same as those of other general cold applications.
Heart action is slowed, blood-pressure is slightly raised, and vital resistance is improved, and there is a general invigoration of the whole body, with improvement in appetite, digestion, assimilation, and general functional activity.

**Applied locally cold friction produces effects similar to those produced by the cold douche.**

By prolonged cold friction very marked derivative effects may be produced. In this way it may render great service in many cases in which the local douche is indicated but which cannot be given because the patients are not strong enough to receive so vigorous an application, or in the absence of a douche apparatus. Such use of the cold mitten friction is indicated in all forms of visceral congestion. Cold friction of the back is an excellent measure in various forms of backache. Cold friction of the feet and legs, especially the calves, and the soles of the feet, relieves the vasomotor spasm which frequently accompanies neurasthenic conditions. Headache cannot infrequently be relieved by cold friction of the back of the neck.

**Therapeutic applications.**—The cold mitten friction is one of the most valuable of all hydriatic measures in the systematic treatment of chronic invalids. It has the advantage over the more vigorous measures that it is perfectly safe, and at the same time thoroughly effective. It never fails to secure good reaction and may be modified to suit the condition of the feeblest patient. Besides its use as a general tonic measure in chronic maladies of all sorts, it renders excellent service in collapse. It is an excellent cardiac stimulant, and rarely fails to improve the condition of the circulation when employed for this purpose.
THE COLD TOWEL RUB.

In this procedure the skin is not rubbed with a towel but a wet towel is placed upon the skin and friction movements are made over it.

Technic.—The requisites are a woolen blanket, a Turkish sheet, two coarse linen towels and a bowl or pail half or two-thirds full of water at the temperature required. A large dipper filled with colder water should be at hand. This is to be poured into the pail later, as will be indicated.

The patient should be well warmed and wrapped in the Turkish sheet and the blanket. The skin surface is divided into areas which are treated in succession, the rest of the body being carefully covered in the meantime, as follows: (1) Head, face and neck. (2) Chest and abdomen. (3) Right arm. (4) Left arm. (5) Right leg. (6) Left leg. (7) Shoulders and back. (8) The left leg. (9) Right leg. (10) The feet.

The temperature required is usually 60° F or lower. The towel is dropped into the pail. When ready to begin the application the towel is wrung out and spread upon the face and neck, care being taken to exclude the nose so as not to interfere with the patient's breathing. Rapid movements are made over the towel from the median line over the face, the fingers carefully adapting themselves to the contour of the face and ears, and from the front of the neck backwards. The movement is repeated two or three times, then the towel is wrung out of the cold water and applied to the chest and abdomen. The patient holds the upper end while the attendant makes long rapid strokes from above downward. These strokes are made with considerable pressure and with slight percussion so as to promote good reaction. In patients who are fairly strong, the long stroking is alternated with sharp percussion strokes, going rapidly over the whole surface. As soon as the towel seems to feel warm it is dropped into the pail. The chest and abdomen are covered with a Turkish sheet or a towel.
and vigorously rubbed outside the sheet. The sheet should then be removed and
percussion is applied with the dry hand until the surface is well reddened. The
surface is then covered while the towel is wrung out and applied to the arm,
the patient again holding it at the shoulder. Long stroking and percussion
is applied to the arm as described for the chest. The arm is then dried and
wrapped, and the other arm treated in the same way; then the legs. The patient
now turns over. The ice-water is poured into the pail to restore the original
temperature, and an application is made to the back, the legs and the feet.
The applications to the posterior surfaces may be made with much more vigor
than to the anterior. Extra strong pressure and percussion may be made over
fleshy parts. This tends to promote the absorption of superfluous fat.

In concluding the application both legs are treated at the same time. The
soles of the feet are not rubbed but sharply percussed, vigorous friction
movements being applied to other parts of the feet.

When patients are too feeble to assist by holding one end of the towel,
the towel may be kept in place by making friction movements with the two hands
from the center toward the ends.

The vigor of the application may be graduated in three ways: first, by
the temperature of the water employed; second, by the amount of water left in
the towel; and third, by the number of times the towel is applied.

In special cases very hot water may be employed instead of cold water.

Physiologic effects.—The characteristic feature of this bath is the
strong thermic effect produced by the application to a considerable surface
of water at a low temperature. A much stronger thermic impression is made than
with the mitten friction or the wet hand rub. Reaction is encouraged, not
by cold friction of the surface, but by the intermittent pressure whereby the
blood-vessels are alternately emptied and filled by the percussion strokes
executed by the hand upon the outside of the towel. The towel rub is, in fact,
the wet sheet rub applied piecemeal. It stimulates the cutaneous circulation,
diverts blood from the interior of the body to the surface, reflexly stimulates
diverts blood from the interior of the body to the surface, reflexly stimulates
the circulation of internal parts, raises blood-pressure, increases the vigor
of the heart, excites the central nervous system, raises vital resistance, and
produces general tonic and invigorating effects.

Therapeutic applications.—This procedure is admirably adapted to use
in a very large number of cases. It may render service in fact in
nearly all forms of chronic disease. It is a somewhat more energetic measure
than the wet hand rub and cold mitten friction, and hence constitutes an excellent
means of training whereby the patient can be induced to take more vigorous
measures. The towel rub is an excellent cooling measure to follow fomentations
to the spine or abdomen, short electric light baths and other light heating
procedures which may be employed with feeble patients, or as a local application
for the relief of pain, or for other purposes, as in sciatica and otherms of
neuralgia, rheumatic joints, backache, indigestion, etc. When employed for
very feeble patients the temperature of the water employed may be at first
from 75° F. to 80° F. The temperature is lowered daily two or three degrees
until a temperature of 60° F. or less is reached.

The towel rub is contraindicated in cases of acute skin eruptions,
when hyperesthesia of the skin is present, nervous asthma, and in certain persons
who have an incurable idiosyncrasy against cold water.
Add to the sits bath—

Celsius described the use of the sits bath in 23 A.D. This bath was employed by Flexilus (?), a French physician, in the sixteenth century, and by Hahn, who was a countryman of Priessnitz, one hundred years before its use was systematized at Graefenberg.
Add to the Half Bath—

The hot half bath was described by Hippocrates 450 B.C. Marteau and Hockett employed the half bath in the eighteenth century.
THE WET SHEET RUB.

This very powerful therapeutic means was invented, or perfected, by Priessnitz. It consists in friction of the whole surface of the body over a cold wet sheet.

Technic.—The requisites are a woolen blanket, a Turkish sheet, a linen sheet, two or three towels, a foot bath, hot water, a pailful of water at 60° F. or 70° F., and another pailful at five degrees lower.

The patient should be well warmed in preparation for the application. While wrapped in a blanket or Turkish sheet and with the feet immersed in hot water the head is thoroughly cooled by bathing for a couple of minutes in water at a temperature of 50° F. or 60° F. This is necessary to protect the brain against the inrush of blood, which occurs when the cold sheet is brought in contact with the whole cutaneous surface. Two attendants are necessary for an efficient application of this hydriatic measure. When the warm patient is ready the patient’s sheet is wet in cold water, then wrung out by two attendants, not as dry as possible, but so it will drip slowly. For the first applications, and especially for very feeble patients, the sheet may be made a little dryer. One of the attendants gathers the edge of one sheet in his right hand. Then taking the upper left hand corner of the sheet with his left hand he steps in front of the patient, who stands uncovered in readiness. The patient holds both hands above his head and the attendant places the corner of the sheet held in his left hand in the patient’s right axilla. The patient lowers his right arm, presses it close against the side of the body so as to hold the sheet in place and quickly turns around, winding the sheet about him, lowering his left arms as the sheet passes under it. As the right shoulder comes around in front of the attendant the sheet is carried over it, first down across the chest, then upward over the left shoulder, the corner being tucked down under the sheet behind. The assistance attendant looks after the bottom of the sheet in the
meantime, taking care that it is snugly wrapped around the legs. The whole movement must be executed with great rapidity. Care must be taken to secure the sheet well at the top so that it will not become loosened during the application. As soon as the sheet is applied, both attendants begin making very vigorous percussion strokes from above downward, thus combining the effects of percussion and friction. One attendant stands erect and executes movements upon the chest, arms, and sides, while the other stooping works from the hips downward. Very sensitive parts should be gently patted, or simply rubbed with light pressure so as to avoid giving pain. Strong percussion may be applied over fleshy parts which are not sensitive.

The rubbing continues until the sheet is fairly well warmed. The sheet is then loosened at the top and dropped, and the patient enveloped in a Turkish sheet and vigorously rubbed. The rubbing is applied not only over the sheet but with the sheet. After thorough drying friction is applied, either with or without oil, as may be indicated, until reaction is well established. After the bath the patient should exercise by walking at a moderate rate for twenty or thirty minutes.

This procedure may be given in bed for very feeble patients, and in fever cases. Care must be taken to keep the feet warm. When reaction is difficult, or the patient has great dread for cold water, a foot bath may be administered at the same time as the wet sheet, the patient being allowed to stand in water at a temperature of 102° F. to 104° F.

The intensity of this application may be increased in several ways:
1. By lowering the temperature of the water. 2. By rendering the sheet less dry. 3. By using a thicker sheet, or two sheets instead of one. 4. By cooling and reapplying the sheet several times, thus prolonging the duration of the application.

Instead of reapplying the wet sheet it may be cooled by pouring over it
water at the proper temperature. Half a pintful of water is poured over first
one shoulder, then the other.

When a more vigorous application is desired the sheet is usually
applied first without wringing. This is known as the dripping sheet.
The sheet may be cooled two or three times if desired, and thus the intensity
of the application may be regulated at will. When the sheet is cooled two
or three times the temperature is usually lowered from two to five degrees
at each application.

Physiologic effects.—This is a very powerful procedure. The effects
produced by it are essentially the same as those produced by the cold douche
and shallow bath, which need not be recapitulated here. This procedure
produces powerful derivative effects by stimulation of the circulation of the
skin. A slight fall of temperature is produced. The bath should always
terminate while reaction is still good, and before shivering has been produced.
When too prolonged, too strong reaction accompanied by unwholesome effects
is likely to be produced.

Therapeutic applications.—The wet sheet rub or the dripping sheet
affords an excellent substitute for the general douche, when this is not
available. It is somewhat less vigorous than the douche, and hence may be used
as a means of training to prepare the patient for this more vigorous measure.
The excellent derivative effects produced by this procedure render it of very
great service in all forms of visceral disease not accompanied by severe pains,
or by acute inflammation. It is an excellent means of stimulating blood
production and tissue building in anemia and emaciation. The application should
be very short, and the sheet should be wrung very dry. In obesity the dripping
sheet should be employed; the rubbing should be very vigorous, and the sheet may
be cooled several times. When thus employed it is an admirable means of
stimulating oxidation and so burning up surface fat. It may be usefully
employed as a derivative measure in congestion of the brain, chronic disease of
the liver, chronic catarrh of the bowels, bronchial catarrh, neurasthenia, constipation, atony of the stomach, colon, or bladder, diabetes, insomnia, myxedema, and chronic auto-intoxication.

Caution and contraindications.—It is important to avoid making the mistake of employing this procedure at a temperature higher than 70° F. It is only at comparatively low temperatures that it succeeds. It is rarely of service at a temperature higher than 60° F. At higher temperatures the reaction is not sufficiently vigorous and prompt. For the patient who cannot endure a sufficiently low temperature others should be employed. The chief contraindications are eruptions of the skin, severe neuralgia or general neuritis, hyperesthesia of the skin, extreme cardiac weakness, visceral inflammation, and idiosyncrasy against cold.
THE HALF SHEET RUB.

This measure has been somewhat recently devised by the writer in an effort to perfect his hydraulic ladder (see page ). Neurasthenics who as a class derive the greatest possible benefit from the use of cold water are often very sensitive to cold and very averse to cold baths of any sort. In such cases the greatest care must be exercised in carrying out a course of graduated training. The cold towel rub was devised by the writer as a measure neutral between the cold friction and the rubbing wet sheet; but experience has shown that the step between the cold towel rub and the rubbing wet sheet is too long and still another intermediate step is required. The half sheet rub fills this gap.

Technic.—The half-sheet rub is administered as follows: The patient, undressed, lies upon his back upon a Turkish sheet, the ends of which are folded over him. Care should be taken to see that his feet are warm, and that the general surface is such as to prepare him for a cold application. A very large towel, long enough to reach from chin to feet, or half a cotton sheet, or a piece of yardwide bleached muslin two yards in length, is now wrung quite dry out of water at 60° F. The corners of one end are drawn close up under his chin and tucked over the shoulders. The balance of the sheet is quickly spread over the patient the whole length of his body. The attendant rapidly runs his hands over the outside of the sheet so as to bring it in close contact with the skin everywhere, then begins a series of rapid strokes from above downward, alternated or combined with percussion strokes, going rapidly over the entire front of the trunk and limbs. This continues until the sheet begins to feel warm, when it is removed and dropped into a bucket of cold water where it remains while the patient is assisted to utrn over. The contact of the moist surface with the Turkish sheet will rapidly dry the skin, while the wet sheet, having been freshly wrung our of cold water, is applied to the back of
the trunk and legs in the same way as has been described for the front. Care is taken to apply the sheet to the sides of the trunk and the sides of the legs. When the sheet is warm, it is thrown aside, and the ends of the Turkish sheet are brought over the back, which is quickly dried, then rubbed with the bare hands until it is warm and well reddened.

Therapeutic applications.—The therapeutic applications of the half-sheet rub are the same as those of the towel rub and the rubbing wet sheet. It is especially adapted to neurasthenics, and anemic and feeble patients who are not quite strong enough to endure the wet sheet rub. It may be administered to patients who are not strong enough to stand upon their feet during the wet sheet rub, and who are not too sensitive to receive without being too greatly excited a cold application involving half the cutaneous surface.

Cautions and contraindications.—These are the same as for the cold towel rub (see page 260).
IRRIGATION.

Under this head are included all procedures in which water is allowed to flow through or over a part without force or pressure. The term douche is employed when water is projected against the surface with a greater or less degree of force.

Irrigation may be applied to the surface of the body or to cavities. The ear, nose, stomach, rectum, bladder, vagina, and uterus are the parts in the treatment of which this treatment is most commonly employed.

The most satisfactory means of applying irrigation is a reservoir from which a rubber tube conveys the water to the part to which the application is to be made. The height of the reservoir should not be so great as to produce any considerable degree of pressure. Two or three feet is usually sufficient, and in some cases the elevation should merely be very much less—only a few inches—barely enough to maintain a current. Reservoirs are constructed of tin or enamelled metal, of rubber, and glass. Enamelled metal or glass is to be preferred. A thermometer connected with the reservoir is a convenience, but is not indispensable. In regulating the temperature account should be taken of the fact that considerable heat is lost from the water in passing through several feet of small rubber tube. This usually amounts to three or four degrees.

Irrigation of the ear.—Warm or hot irrigation of the ear is an excellent means of combating inflammations of the external canal of the ear and of the middle ear. A special devise of hard rubber or glass is provided for this purpose. One end of this is placed in the ear and the hot water is introduced through one of the two openings placed at the outer end, escaping through the other opening. The reservoir should be placed only a few inches above the ear, so that no considerable amount of force will be given to the water. The water employed should be at as high a temperature as can be borne without
discomfort and the duration of the application should be ten to twenty minutes, or until the desired effect is obtained. After the application the parts are carefully dried and covered so as to prevent chilling by evaporation. A very hot foot bath given at the same time greatly increases the effect of the douche.

**Nasal Irrigation.**—By means of a fountain douche saline and other solutions are made to pass through the nasal cavity. By holding the head forward the water may be allowed to pass in at one nostril and out the other, or by holding the head erect and tilted a little backward, the water may be passed through the nose and out through the mouth. The temperature of the solution employed should be about 102° F. to 104° F. Pure water should never be used. A solution containing about one dram or one teaspoonful of salt to the pint of water is much less disagreeable than pure water, and is more effective as a cleansing agent. A solution consisting of half a teaspoonful of chlorid of sodium and an equal amount of carbonate of soda to the pint of water is a very excellent cleansing agent for the nose, dissolving and removing dished solutions and allaying the irritation which is produced by retained secretions.

Nasal irrigation is little used at the present time, experience having shown that the application of cleansing solutions by means of an atomizer giving a coarse, somewhat energetic spray is very much preferable. Irrigation is to be used only when a satisfactory spray apparatus cannot be obtained. Great care must be taken in its employment to avoid force whereby existing infection may be carried into adjacent cavities, thus producing extension of the disease.

**Gastric Lavage or Irrigation of the Stomach.**—This measure is indispensable in the treatment of certain chronic disorders, particularly chronic gastric catarrh and gastric dilatation with or without pyloric obstruction. The lavage tube has quite displaced the old fashioned stomach pump, and furnishes an entirely satisfactory method of evacuating and cleansing the stomach.
When used for ordinary cleansing purposes water is employed at a
temperature close to that of the interior of the body—100° F. to 102° F.
Pure water may be used for gastric lavage, but when considerable mucus is
present it is well to add bicarbonate of soda to the water in the proportion
of half a teaspoonful to the pint.

The tube having been passed, one or two quarts of this solution is
passed in and out, a pint at a time, and finally one or two pints of pure
water are passed through the tube so that no considerable amount of the soda
solution may be left behind. In washing the stomach in cases of gastric
catarrh or gastric dilatation, the lavage should generally be continued until
the water comes away clear.

In general, the most satisfactory results are not obtained at the first
attempt. After a short time the patient becomes sufficiently accustomed to
the tube to permit of greater thoroughness. In passing the tube into the
stomach the following points should be observed:

1. The tube should be very thoroughly cleansed, both inside and
outside.

2. The tube should be dipped in water just before it is introduced.
Oil or similar lubricants should never be used, as they give rise to nausea.

4. A medium sized or large sized tube can generally be passed
more easily than a small tube.

5. The passage of the tube should not be attempted in persons
suffering from aneurism or severe organic disease of the heart, or who have
recently suffered from hemorrhage from gastric ulcer, arteriosclerosis, or
cerebral apoplexy.

6. Not more than one or two pints of liquid should be introduced at
a time, and at first the greater part of this should be withdrawn before more
is introduced.
7. On withdrawing of the tube it should be tightly pinched with the thumb and forefinger close to the mouth and thus held until completely removed, as otherwise liquid may escape from the tube into the larynx as the other end passed over the epiglottis, giving rise to violent coughing or even more serious consequences.

8. When employed to remove remnants of food from the mouth stomach, in cases of pyloric obstruction, the lavage should be used daily just before the patient retires.

9. When the tube is used for gastric catarrh, thorough lavage two or three times a week is generally sufficient.

10. It is rarely wise for the patient to be taught to make use of the tube himself, as this practice involves great risk that the tube habit may be acquired, greatly to the patient's injury.

The best device for emptying the stomach is a large strong bulb which may be easily inserted into the tube after the cleansing liquid has been introduced into the stomach. The bulb is strongly compressed then connected with the end of the tube while the patient bends forward so as to facilitate siphon action. When the bulb is filled it is emptied, connected with the stomach tube as indicated before. In case of poisoning the tube connected with an ordinary siphon type syringe has more than once been successfully used, in place of the ordinary stomach tube.

Therapeutic indications.—Pyloric obstruction, gastric dilatation, persistent vomiting, intestinal obstruction, and gastric catarrh are the principal indications for the use of the stomach tube. It may perhaps be used with advantage as a means of making hot or alternate applications to the interior of the stomach in cases of gastric atony.
The Water Emetic.—Since the invention of the stomach tube the water emetic has fallen into disuse. It sometimes fails altogether, while the gastric tube can be depended upon. If for any reason the tube cannot be employed when evacuation of the stomach may be necessary, the water emetic may be tried. The patient may be made to swallow three or four, or even five or six glasses of water at a temperature of 95° F. or 100° F. If after giving three or four glassfuls the patient is unable to stimulate emesis by tickling the throat with a feather or with a finger, one or two glassfuls more of water may be taken to which salt has been added in the proportion of a teaspoonful to each glassful.

After the administration of ether or chloroform considerable amounts of these substances are found in the stomach, a portion of which has been swallowed, while another and considerable quantity has been excreted from the blood into the stomach by the mucous membrane. In cases of poisoning by the hypodermic injection of morphia, large quantities of morphia have been found in the stomach contents, even though it has not been taken by the mouth. Hence, gastric lavage should be practised in cases of poisoning by morphia, in which the morphia has been introduced by the hypodermic syringe as well as in cases where it has been swallowed. By washing the stomach after the administration of ether or chloroform the distress and vomiting may often be prevented.

Gastric lavage may be employed without danger of serious difficulty, even in very young infants. A small tube is provided for this purpose, but in case a gastric tube of the proper size cannot be obtained, a soft rubber catheter may be used instead.

In the treatment of insane patients the tube is frequently passed through the nose, instead of the mouth. It is sometimes found more convenient to pass the tube through the nose. This may be done without the slightest injury.
The enema.—This very ancient hydriatic procedure is capable of rendering very great service when judiciously employed, and when improperly used is capable of doing much harm. Water may be introduced into the bowel by the aid of a number of different devices. The most satisfactory are the ordinary bulb syringe and the so-called fountain syringe, both of which are too well known to require description. It is perhaps worth while to know that in the absence of either an ordinary funnel inserted into the end of a piece of rubber tubing may be used as a substitute, and a small piece of rubber tube may serve in case of necessity to siphon water into the bowel from an ordinary pitcher or other vessel.

The enema is ordinarily administered with the patient lying upon the back. When it is desired to empty the colon completely or to distend it with water, it is better that the patient should lie upon the right side, turned a little upon the face, with the limbs partially flexed. In this position gravitation assists in leading the water into the cecum, whereas in the ordinary position water is by gravity retained in the lower portion of the bowel, the upper portion remaining filled with gas.

The quantity of water may be varied from a few ounces or a pint or two to two or three quarts. The general rule should be to employ no more water than is necessary, as repeated distension of the bowel may give rise to relaxation and weakening of its walls.

In introducing the water into the bowel excessive pressure as well as excessive quantity should be avoided. Undue force is likely to provoke premature expulsive movements by irritating the rectum. The rectal tube employed should be smooth and at least two inches and a half or three inches in length. The use of long rectal tubes is rarely indicated, and very seldom renders service. A rigid tube can be introduced into the rectum more than four or five inches without running the risk of producing more or less serious injury, and a flexible tube can seldom be introduced more than the dis-
stance named without the use of a speculum so that the passage of the tube may be directed by the eye.

The water employed may be of a neutral temperature, or hot or cold. When employed for the purpose of softening and dislodging intestinal contents, water near the temperature of the body may be employed, but as a rule it is far better that the temperature of the water should be either above or below the body temperature. The principal reason for this is the fact that simple water at neutral temperature does not provoke peristalsis, whereas a temperature several degrees above or below the body temperature excites intestinal contractions.

The time of administering the enema must vary according to the purpose for which it is employed. When employed as a temporary expedient to relieve constipation the best time for its use is within an hour after breakfast. This is the time when the normal daily movement of the bowels most frequently occurs. Recent studies of the subject have shown that the food normally occupies about seven hours in passing from the mouth to the cecum. It remains in the cecum and ascending colon about fourteen hours; then occupies three hours in completing its journey along the thirty feet of alimentary canal. If the intestinal contents remain too long a time in the cecum and ascending colon an excessive quantity of liquid is absorbed, and movement along the transverse and descending colon is slow and difficult. The consequence is that when the food remnants finally reach the sigmoid flexure of the rectum they have assumed the form of hardened masses which do not readily find exit from the body. After a delay of a day or two evacuation may be resumed, but an abnormal residuum remains which may steadily be increased in amount from time to time until the accumulation of decomposing material in the colon becomes very considerably distended with irritant fecal matters. In such cases the enema renders very great service as a means of removing the accumulated residues of decomposing material, the retention of which is a constant menace to the body through auto-intoxication.
It is important, however, that in the use of the enema it should be employed in such a way as to avoid aggravating the diseased conditions already present, and if possible to effect a cure. The neutral enema rarely if ever accomplishes this, neither is a cure effected by the use of laxatives or mineral waters.

The cold enema.—While less agreeable than the neutral enema, the cold enema is of far greater service and should be generally used in preference to water at a higher temperature. The temperatures most satisfactory are 80° F. to 70° F.; occasionally a lower temperature may be employed. The writer recalls a case in which a comfortable daily movement was secured by the use of water at a temperature of 40° F., and in no other way could the bowels be made to move. The cold enema stimulates peristalsis, contracts the vessels of the structures with which it comes in contact, and is followed by a reaction in which there is an increased movement of blood through the intestines, liver, and all other abdominal organs. The contraction of the mesenteric vessels raises the general blood-pressure. The increased movement of blood stimulates secretion, and thus creates appetite and relieves constipation. The quantity of water employed may be varied from half a pint to one or two quarts, according to the purpose for which it is employed.

Therapeutic applications.—As a means of relieving constipation, the cold enema as has already been mentioned is much superior to the warm enema, chiefly through the fact that it stimulates secretion and peristalsis. In cases of chronic constipation the cold enema should be administered at the hour when the daily movement of the bowels normally occurs, or generally soon after breakfast. In most cases a half pint to a pint of cold water introduced into the bowels sets up vigorous peristalsis, so that a larger quantity of water is seldom required. In occasional instances the introduction of half a pint of water into the rectum at night to be retained over night, supplemented if need be by another half pint introduced into the bowel before breakfast, will secure a normal evacuation of the bowels within an hour or two after
breakfast.

It should be mentioned, however, that in order that the bowels should be made to move normally it is necessary that the meals should be taken at regular intervals. Food is the natural stimulus of peristalsis. When a meal is omitted the result is disturbance of the normal rhythm which which nutritive materials are moved along the alimentary canal in the process of digestion and of absorption.

The cool enema is always indicated in cases of atony or dilatation of the bowels. When for any purpose it is necessary to use the hot enema this procedure should be followed by a small cool enema for the purpose of restoring normal tone of the intestinal walls.

The cold enema is an excellent remedy in dysentery. Half a pint or a pint of water at 60° F. to 70° F. should be introduced into the bowel after each movement. When there is very great tenesmus the neutral enema is sometimes found preferable.

A large cool enema administered several times daily exercises a beneficial influence upon the abdominal circulation, and as has been shown by experience to be of use in cases of jaundice.

The cool enema perhaps renders its greatest service in fever when used as a means of lowering temperature. The water employed should have a temperature of 80° F. to 70° F. When administering the enema for control of fever water at the temperature of the enema should be passed in and out of the bowel continuously or almost continuously until the desired effect has been obtained, as shown by the reduction of the temperature & to a safe point. Several eminent clinicians have recommended the continuous enema in typhoid fever, water being made to flow in and out through a properly constructed rectal tube. The normal saline solution is employed by some in preference to the use of water. The writer is not certain that this is necessary or beneficial.
Note.

The hydriatic ladder referred to several times has not yet been described. Neither is vaginal irrigation, bladder irrigation, intrauterine irrigation been described. It was the intention to go on to describe the use of hydrotherapy in fevers, particularly typhoid fever; the use of hydrotherapy in nervous diseases and the treatment of the insane; the use of hydrotherapy in surgery, and the use of hydrotherapy in diabetes, obesity, gout, and other nutritional disorders.

J. T. C.