Part Two.

THE GENERAL PRINCIPLES OF HYDRIATICS.

BEFORE entering upon the consideration of hydrotherapeutics proper, it will be profitable to review briefly the physiological effects of hydric applications.

SUMMARY OF THE PHYSIOLOGICAL EFFECTS OF COLD APPLICATIONS.

General Effects.

1. Cold is *primarily* depressant or sedative in its effects, lowering the temperature and lessening vital activity (**257, 261, 267, 268**). 606

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; hence the practical result of a short cold application is exciting (**269, 273**).

3. Short cold applications cause contraction of the small vessels both of the skin and of the internal organs, quickly followed, however, by active dilatation, the internal dilatation occurring almost instantaneously, the external later.

4. A prolonged moderately cold application to the skin (65° to 80°) causes prolonged contraction of the vessels of the internal part in reflex relation therewith (**274**).

Effects upon the Skin.

1. General cold applications first diminish, then increase, the perspiration (**287, 289**).

2. Cold applications cause first pallor from spasm of the smaller arteries, veins, and capillaries of the skin, later (with reaction) flushing from active dilatation of the vessels.

3. Cold causes contraction of both the muscular and the connective tissues of the skin.

4. Prolonged very cold applications to the skin lessen its sensibility and diminish reflex effects (**293–296**).

5. The mucous membrane, though less sensitive, reacts to cold in essentially the same manner as does the skin (**313**), both local and general effects resulting.

Effects upon the Circulation.

1. General cold applications first quicken, then slow the heart-beat, increase tension, and cause active dilatation of the small vessels (**298**).

2. Cold applied to one hand causes contraction of the vessels of the other hand. Similar relations exist between other symmetrically related organs (**303, 421**).

3. Cold applied over an arterial trunk causes contraction of its distal branches (**307**).

4. A continuous cold application over the heart depresses its action, and lowers arterial tension.

5. Short cold applications over the heart at first increase its activity and force, then lessen the pulse-rate and raise the arterial tension (**309**).

6. Short cold applications to a limited area of any portion of the body temporarily increase the pulse-rate (**312**).

7. A compensatory effect sometimes appears in increased heat production. A thermometer placed in the axilla shows increase of temperature when the elbow is held in water at 50° F. for some time (**305**).

Effects upon Respiration.

1. A general cold douche causes quick, gasping respiration.

2. A non-percutient cold application causes deepened and slowed respiratory movements (**318, 319**).

3. Oxidation of the tissues is increased by cold applications, and the amount of CO_2 in the expired air is correspondingly increased (**322**).

4. An atmospheric temperature of 40° F., or below, causes increase of heat production and CO_2 elimination when the body is so exposed as to cause shivering.

Effects upon the Muscles.

1. Prolonged cold applications decrease muscular irritability and energy (**327**).

2. A short cold application, general or local, increases the excitability and capacity of striated muscles.

3. Cold applications excite the smooth muscular fibers, as those of the skin, blood-vessels, bladder, bowels, etc. (**328**).

4. Cold applications to a relatively small area, as the skin of the back or the feet, may cause general pallor, goose-flesh appearance, and shivering (**330**).

Effects upon the Nervous System.

1. Cold applied to a nerve trunk paralyzes the parts supplied by it (**335**).

2. Cold diminishes the rate of transmission of nerve impulses (**336**).

3. Prolonged very cold applications to the head diminish mental activity, and may produce unconsciousness, while short applications are in a high degree excitant to the brain (**338**).

Reflex Effect of Cold Applications.

1. Short, very cold applications, with high pressure, to a reflex area, cause vasodilatation in the related viscera (**372**).

2. Prolonged non-percutient cold applications produce internal vasoconstriction (**372**).

3. Short applications to the face and neck stimulate the circulation and activity of the brain (**373**).

4. A short, very cold douche to the chest first excites, then slows, the pulse (**355**).

5. Prolonged immersion of the hands in cold water causes contraction of the vessels of the brain and of the nasal mucous membrane (**356**).

6. Short, very cold applications to the hands cause contraction of the uterine muscles (**358**).

7. A short, very cold douche to the feet, with strong pressure, dilates the vessels of the uterus (**359**).

8. Immersion of the legs in cold water causes contraction of the vessels of the lungs and the kidneys.

9. Short cold applications to the mammæ give rise to vigorous contraction of the muscles of the uterus. This simple measure is much utilized for this purpose in obstetrics.

10. Short, very cold applications to the abdomen, the hands, and the feet cause contraction of the muscles of the bladder, bowels, and uterus (**358**).

11. Prolonged applications of cold to the upper dorsal region cause contraction of the vessels of the nasal mucous membrane and of the lungs (**360**).

12. An ice-bag to the dorsal region causes contraction of the vessels of the stomach.

13. A cold lumbar douche at moderate pressure (duration from 15 to 45 sec.) causes contraction of the uterine vessels (**364**).

14. A very short, cold douche to the lumbar region (duration from 2 to 4 sec.), with strong pressure, causes dilatation of the uterine vessels (**365**).

15. A short cold douche to the thighs causes dilatation of the vessels of the uterus (**366**).

16. A short cold douche to the lower portion of the sternum causes increased activity of the kidneys (**368**).

17. Short cold applications, with strong pressure, over the stomach, liver, spleen, and bowels, cause first contraction, then active dilatation, of the vessels of these organs (**369**).

18. Prolonged cold applications over an internal organ, without pressure, produce contraction of its blood-vessels (**370**).

The Blood.

1. The reaction following cold applications increases the number of corpuscles in circulation.

2. Cold applications increase the amount of oxygen absorbed by the blood, and the rate of oxidation, the result of which is increased reduction of oxyhemoglobin (**385-387**).

Effects upon Absorption, Secretion, and Nutrition.

1. General cold applications increase absorption from the alimentary canal (**388**).

2. Short general and more prolonged local cold applications increase the activity of the glands of the stomach, liver, kidneys, and other secreting viscera (**390**).

3. Short general cold applications to the skin cause a quickening of all the vital functions, hastening the blood and lymph currents, stimulating assimilation and disintegration, and augmenting vital resistance.

Effects upon Animal Heat and Temperature.

1. General cold applications diminish the temperature of the skin and the general temperature.

2. A cold spray to the soles of the feet produces slight lowering of the general temperature (**425**).

3. Cold applications to the head lower the temperature by depressing the thermogenic centers.

4. Cold applications to the surface increase the thermo-electrical phenomena (**428**).

5. Short cold applications stimulate heat production (**416**).

6. Prolonged cold applications at first increase, then decrease, heat production (**411–418**).

7. General shivering under an application of cold is an evidence of lowered internal temperature and the beginning of increased heat production.

8. Circulatory reaction is produced by the reflex influence of cold applications upon the vasomotor centers and perhaps also by direct action upon the visceral sympathetic ganglia of the blood-vessels.

9. Cold applications produce thermic reaction by lowering the temperature of the skin and of the blood.

SUMMARY OF THE EFFECTS OF HOT APPLICATIONS.

Water is said to be warm at a temperature of 92° to 98° F., hot at 98° to 104° F., and very hot at 104° F. or above. **607**

General Effects.

1. Heat is *primarily* an excitant. It is, indeed, one of the most powerful of all vital stimulants. It increases vital activity, elevates the temperature, and excites the brain and nerve centers (**492, 564, 566**).

2. The secondary effect of heat is depressant through atonic reaction. The temperature is lowered through reflex action, which produces lessened heat production and increased heat elimination, with generally diminished tissue activity. Long-continued applications of heat increase heat production.

3. Short hot applications to the surface cause passive dilatation of the small vessels (venules) of the skin, with strong revulsive effects upon the internal parts (**516**).

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

Effects upon the Skin.

1. Contraction of the yellow elastic tissue, relaxation of the white fibrous tissue.

2. Goose-flesh appearance from contraction of the smooth muscle fibers (**496**).

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

4. Contraction of the vessels of the skin with pallor after the heat is withdrawn, when the application has been prolonged (**498**).

5. Increased perspiratory and respiratory activity (**503**).

6. Increase of tactile sensibility at 98°, decrease at 113°, extinction at 130°.

7. Increased heat elimination from the skin (*a*) through dilatation of the surface vessels, (*b*) increase of the flow of blood through the skin, (*c*) increased evaporation of moisture from the surface, and (*d*) increased conductivity of the skin (**508**).

8. Heat prepares the skin for cold applications (**510**).

Effects upon the Circulation.

1. A general application of heat first slows, then quickens the pulse. Pulse rate and tension diminish when free perspiration begins (**514**).

2. Very hot applications (115° F. and upwards) cause slight contraction of the small vessels of the skin, soon followed by relaxation. Warm and hot applications cause dila-

tation of the surface vessels, especially of the small veins.

3. Hot applications raise blood pressure when accompanied by friction, percussion, or other mechanical effects.

Effects upon Respiration.

1. A general application of moist heat (air or vapor) increases the rate and ease of respiration.

2. Hot dry applications (hot air) hinder respiration (**521**).

3. After the withdrawal of a very hot application there is for a time diminished rate and depth of respiration (**524**).

4. An external temperature above 60° to 70° F. increases CO_2 elimination, while a temperature below 40° F. also decidedly increases CO_2 elimination.

Effects upon the Muscles.

1. Short hot applications (98° to 104° F.) increase the excitability and energy of striated, or voluntary, muscles (**529**).

2. Prolonged hot applications (106° to 120° F.) lessen the energy and excitability of the voluntary muscles (**529**).

3. Very hot applications increase the excitability of the non-striated, or involuntary, muscles, as shown by the goose-flesh appearance of the skin following a very hot application, and the contraction of the small vessels of the skin (**527**).

4. Neutral temperatures (92° to 96° F.) have no influence upon the excitability of the striated muscles. The sedative effect produced depends upon the influence on the cutaneous nerves.

Effects upon the Nervous System.

1. Very hot baths produce various nervous disturbances, as sleeplessness, nervousness, headache, and other symptoms of nervous excitation and exhaustion (**540**).

2. Extreme heat, as in sunstroke, may give rise to the development of special poisons, which act upon the nerve centers of the brain and cord, producing grave and even fatal collapse. Hence the danger of a very hot bath if prolonged.

3. A short hot application powerfully excites the nerves and nerve centers.

4. The excitant effects of heat are followed by depressant effects or atonic reaction (**579**).

Effects upon the Blood. Heat, unless followed by cold, decreases the red and increases the white cells.

Effects upon General Nutrition. At very high temperatures heat is a powerful vital stimulant or excitant. It increases CO_2 production and the oxidation of nitrogen.

Effects upon the Stomach, Liver, and Other Abdominal Organs. 1. Prolonged applications of heat over the region of the stomach after eating, either fomentations or dry heat, increase the amount of hydrochloric acid secreted by that organ.

2. Short hot applications, especially the short hot douche, diminish the secretion of HCl, at least in cases of hyperpepsia (**569**).

3. Prolonged applications of heat over the region of the liver and other viscera increase their activity.

4. Short hot applications, especially the short very hot hepatic douche, relieve visceral congestion.

5. Large fomentations over internal parts lessen their blood supply and functional activity.

Effects of Hot Applications upon Heat Production and Body Temperature. 1. General applications of heat cause immediate rise of temperature. This is true even when the temperature of the bath is no higher than that of the body itself (**572**).

2. An external temperature above 60° to 70° F. occasions increase of heat production. An atmospheric temperature of 104° F. increases heat production three hundred and fifty per cent. in dogs.

3. An application of heat is followed by a fall of temperature, the result of atonic reaction (**578**).

COMPARATIVE SUMMARY OF THE CHIEF EFFECTS OF COLD AND HEAT.

COLD.	HEAT.
General.	*General.*
Primary, depressant.	*Primary*, excitant.
Short, excitant by tonic reaction.	*Short*, depressant by atonic reaction.
Prolonged, depressant.	*Prolonged*, mixed, excitant, and depressant.
Special.	*Special.*
Skin: Action, diminished activity.	*Skin:* Action, increased activity.
Reaction, increased activity.	Reaction, diminished activity.
Diminished sensibility.	Diminished sensibility.

COLD.

Heart: First quickened, then slowed.
Increased force.
Vessels: Action, contraction.
Reaction, dilatation.
Increased tone and activity.
Local anemia, collateral hyperemia.
With reaction, local hyperemia, collateral anemia.
Short, reflex dilatation of visceral vessels.

Nerves: Benumbs and paralyzes.
Excites by tonic reaction.
Muscles: Short, increased excitability and capacity.
Prolonged, lessened excitability and capacity.
Lungs: Slows and deepens respiration.
Increased amount of respired air.
Increased CO_2.
Increased respiratory quotient.

Stomach: Increased HCl and motor activity.
Kidneys: Congests and excites.

Animal Heat: Short, increased heat production.
Prolonged, diminished heat production.
Blood: Increased blood count, especially leucocytes.

Metabolism: Increased CO_2.
Increased urea, and improved oxidation.

TONIC REACTION.

1. Vasodilatation.
2. Skin red.
3. Pulse slowed.
4. Arterial tension increased.
5. Skin action increased.
6. Temperature lowered.
7. Feeling of invigoration.
8. Muscular capacity increased.
9. Amount of respired air increased.
10. Heat production increased.

HEAT.

Heart: First slowed, then quickened.
Decreased force.
Vessels: Action, contraction, then dilatation.
Reaction, contraction.
Lowered tone — paralysis.
Local hyperemia, collateral anemia.
With reaction, local anemia, collateral hyperemia.
Short, reflex fluxion and derivative effects.
Nerves: Excites.
Depresses by atonic reaction.
Muscles: Short, lessening fatigue effects.
Prolonged, diminished capacity and excitability.
Lungs: Quickens and facilitates respiration.
Diminished am't of respired air.
Decreased CO_2.
Diminished respiratory quotient.
Stomach: Decreased HCl and motor activity.
Kidneys: renders anemic and lessens activity.
Animal Heat: Short, diminished heat production.
Prolonged, increased heat production.
Blood: Decrease in number of red cells, increase in number of leucocytes.
Metabolism: Decreased CO_2.
Increased urea and general proteid waste.

ATONIC REACTION.

1. Vasoconstriction.
2. Skin pale.
3. Pulse rate increased.
4. Arterial tension diminished.
5. Skin action decreased.
6. Temperature lowered.
7. Languor.
8. Muscular capacity decreased.
9. Amount of respired air decreased.
10. Heat production decreased.

THE THERAPEUTIC EFFECTS OF HYDRIATIC APPLICATIONS.

608 THE classification of hydrotherapeutic procedures has given rise to much discussion among writers and practitioners, growing out of the fact that thermic applications are capable of producing a great variety of effects, which are not infrequently so intermingled that it is not easy, in all cases, to decide which is the dominant effect.

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 depressing effects, and the reverse.

This characteristic, however, is not peculiar to water; it 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 thermic applications as well as in the use of other therapeutic measures. Nevertheless, amid this apparent confusion, there is a sufficient amount of stability and unity to permit a basis for a simple and comprehensive classification of the effects which may be expected from definite and exact hydric applications under clearly and accurately defined conditions.

609 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 simple grouping of therapeutic applications of water into two general classes: (1) *Excitant;* (2) *Sedative.*

These two groups of effects may be almost indefinitely 610
subdivided, but the leading and essential subdivisions the author believes will be found included in the following table, which is offered as an attempt at a scientific classification of the therapeutic effects which may be obtained from hydriatic procedures: —

CLASSIFICATION OF HYDRIATIC EFFECTS.

I. Excitant.
II. Sedative.

I. EXCITANT EFFECTS.
- *A.* Primary effects.
- *B.* Secondary effects.

A. Primary Excitant Effects.
1. General.
2. Local.
   - *a.* Hemostatic { Direct. / Indirect or Reflex.
   - *b.* Cardiac.
   - *c.* Uterine.
   - *d.* Vesical.
   - *e.* Peristaltic.

B. Secondary Excitant Effects.
1. General.
   - *a.* Restorative.
   - *b.* Tonic.
   - *c.* Calorific.
2. Local.
   - *a.* Sudorific { (*a*) Spoliative or Reducing. / (*b*) Eliminative.
   - *b.* Expectorant.
   - *c.* Diuretic.
   - *d.* Cholagogic.
   - *e.* Peptogenic.
   - *f.* Emmenagogic
   - *g.* Revulsive.
   - *h.* Derivative.
   - *i.* Resolutive.
   - *j.* Alterative.
   - *k.* Calorific.

II. Sedative Effects.
1. Circulatory.
a. Antiphlogistic.
(*a*) Vascular.
(*b*) Cardiac.
b. Hemostatic.
2. Nervous.
a. Hypnotic.
b. Calmative.
c. Analgesic.
d. Anesthetic.
e. Antispasmodic.
3. Thermic.
a. Antithermic.
b. Antipyretic.
4. Secretory.

GENERAL PRINCIPLES.

611 The following brief statement of the general principles which determine the effects of hot, cold, and neutral applications, may be found of service: —

612 **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 at very high temperature is strongly excitant,* the depressant effects being practically imperceptible.

(*b*) *The effect of a less intense and slightly prolonged application of heat is moderately excitant* during the application; after the application, *decidedly depressant* effects appear, resulting from a lessening of thermic and other tissue activities through atonic reaction.

(*c*) *The effect of a prolonged application of heat at a high temperature is both excitant and exhausting or depress-*

ant, the excitation resulting from the elevation of the temperature of the body, the depression being due to the exhaustion of nervous energy. Practically, *cold contracts* while *heat dilates* the vessels *at the moment of application.*

Respecting Cold Applications.

613 1. *Cold is intrinsically sedative, but practically the primary effect (action) of a cold application is excitant.*

2. *The secondary effect (reaction) 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 at a moderately low temperature is less excitant and less tonic.

(c) A prolonged cold application is first excitant, then sedative, the depressant effects resulting from the exhaustion of the nerve centers from prolonged excitation and the lowering of the temperature of the body.

Respecting Neutral and Intermediate Applications.

614 1. *A neutral bath* (92° to 95° F.) produces no reaction, circulatory or thermic, but *suppresses reflex activity* by lessening the sensibility of the cutaneous nerves; consequently the effect is calmative. A neutral bath is also restorative by checking or abolishing the loss of energy and encouraging cutaneous and renal activity.

2. Baths at *intermediate temperatures* produce *mixed effects*, the *dominant effects being* those of the class most nearly approached, cold, neutral, or hot.

The characteristic effects of baths, either hot or cold, may be intensified by the mechanical effects of percussion,— as by means of the douche in various forms,— by friction with the hand, towel, sheet, or by other suitable means.

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. (443)

I. EXCITANT (Action) EFFECTS.

615 The excitant effects of thermic applications are chiefly reflex in character. They may be divided into two classes: (A) *Primary;* (B) *Secondary.*

A. PRIMARY EXCITANT EFFECTS.

616 Primary excitant effects are those which are the immediate results 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 effects are the sole or dominant effects; hence as will readily be seen by a study of the foregoing statement of principles, applications for excitant effects must necessarily be short (from 2 or 3 secs. to 1 or 2 min.). As a rule, the shorter the application, the more purely excitant will be the effect, provided the temperature is very hot or very cold.

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 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 skin surface to which it is applied, the more highly exciting will the effect be, whether hot or cold applications are employed.

Applications producing excitant effects may be subdivided into *general* and *local* applications.

617 1. *General Primary Excitant Effects.*— General applications are usually employed for general excitant effects, the most important of which are the very hot douche—shower, spray,

or jet — temperature 110°–130° F., continued from 15 seconds to 4 minutes; very hot affusion 110°–115° F., from 30 seconds to 5 minutes; hot-blanket pack, 105°–112° F.; hot-water drinking; general alternate hot and cold sponging; full bath, 105°–110° F., 5 to 10 minutes; hot enema, hot sitz bath. Hot applications to the head and spine, and very hot applications over the heart are powerfully excitant.

The effect of alternate hot and cold applications is continually to renew the exciting effect of the heat; the cold application should be long enough to remove the heat absorbed by the skin from the hot application, but not long enough to produce lowering of the general temperature, as announced by chill, shivering, or any other indication of thermic reaction. As a rule, in alternate applications the applications should be made of equal length,— about fifteen seconds each,— but the time during which the heat is applied may often be increased with advantage (**638**).

Alternate hot and cold applications are the exciting applications *par excellence*, for the following reasons:—

(*a*) For primary excitant effects it is desirable to arouse the nerve centers without exhausting them by decided reaction effects, and to suppress atonic thermic reaction by making the hot application very short, and following it by a short cold application.

(*b*) If a cold application is prolonged, the effect is to abstract heat from the skin and from the blood, and thus either directly lower the vigor of the patient or provoke an undesirable thermic reaction whereby the weakened resources of the body will be still further exhausted.

(*c*) By a short application of heat, immediately followed by an application of cold of equal length, the heat impression is made of only sufficient intensity and length to produce the desired nervous impression, any further effect being prevented by the neutralizing influence of the succeeding cold application, which restores the normal temperature of the skin, and thus prepares it for the new excitant impression to be

produced by the succeeding hot application. This renders possible an almost indefinite extension of the effect.

Although the strongest excitant effects may be obtained by the alternate douche, very powerful excitant effects may be made by alternate hot and cold sponging, compresses, affusions, etc.

The sun bath is a most valuable and practical exciting measure. It owes its properties to the three sets of rays of which it is composed, viz., heat, luminous, and actinic or chemical rays. The heat and luminous rays are directly stimulating to the cells of the tissues, causing a development and accumulation of heat, while the actinic rays (**597**) act upon the nervous system in a most powerful manner.

The electric-light bath possesses the same properties as the sunlight; hence the importance of utilizing this simple measure especially in countries blessed with little sunlight and at seasons of the year when sunlight is uncertain. By the use of colored lamps or screens the patient may be exposed to the action of the red or heat rays only, or to the chemic or violet rays, or to the full-light rays. The actinic rays may be used when stimulation of the nervous system is especially desired, independently of any calorific effect. When the heating effect alone is desired, the red rays should be employed.

In the employment of such non-percutient applications as the compress and the fomentation, or hot and cold friction, greater extremes of temperature may be employed than with the douche. As a rule, the temperature should be as extreme as can be borne without actual pain, except, of course, with extremely nervous patients, who may easily be over-excited by a too strong stimulation of the sensory nerves.

When to Employ Excitant Measures. The general excitant effects of heat or of alternate applications of heat and cold are indicated in cases of extreme exhaustion, collapse, surgical shock, collapse under anesthesia, drowning, suffocation, and syncope from hemorrhage, fright, or any similar cause.

The excitant effect of cold may be occasionally used with advantage in cases of collapse or asphyxia. The reaction must be quick and general; hence the colder the water and the greater the force with which it is applied, the better will be the effect produced. Cold friction may be used instead of the douche when more convenient.

As a rule, the excitant effect of heat is to be preferred to that of cold in conditions of collapse or pain. Depressant effects from heat may be prevented by making the application short and by a very short cold application following.

Contra-indications. In the employment of the hot full bath and the hot douche, great care must be taken to avoid cerebral excitement. To accomplish this, apply a cold compress or an ice-cap to the head when hot applications are being made to any large area of the skin. Care must also be taken to avoid overexcitement of the heart. General very hot applications are contraindicated in cases of weak heart, arteriosclerosis, advanced age, and infancy (below seven years), also in cases of previous injury from sun-stroke or heat-stroke.

2. *Local Primary Excitant Effects.* — The primary excitant effects of thermic applications may be usefully employed for numerous local therapeutic effects, the most important of which are the following: — **618**

Hemostatic Effects. The hemostatic effects of thermic applications may be obtained either directly through application to the bleeding vessels, or indirectly through reflex action. **619**

To obtain direct hemostatic effects, either very hot (140° to 160°) or very cold (32° to 40°) applications must be employed.

Of hot applications, the hot douche (**1024**) and the hot compress (**1289**) are the most valuable. A jet of hot steam has been used with success (**1422**).

Of cold applications, ice, ice compresses, and the ether or rhigolene spray are the most convenient methods of checking

hemorrhage by the direct application of cold to the bleeding part, or across the trunk of a main artery supplying a bleeding part, as the ice-collar or cravat for nosebleed.

This method of checking hemorrhage is, of course, not adapted to cases of bleeding from large vessels, and applies rather to cases of capillary oozing than to those in which the hemorrhage occurs from arteries or veins which have been cut or otherwise ruptured.

Other methods which are found efficient are the following: The hot nasal douche and sponging the face with very hot water for nosebleed; the hot vaginal douche for menorrhagia, hot uterine irrigation in metrorrhagia and post-partum hemorrhage; the hot bladder irrigation in vesical hemorrhage.

Indirect Hemostatic Effects.

Cold applications to the upper spine constitute a most excellent measure for checking nosebleed. Placing the hands in ice-water, and the application of ice to the base of the cranium, and especially to the cervical and the upper dorsal portion of the spine, are also very effective means of checking nosebleed when other measures have proved futile. Placing the feet in cold water constricts the blood-vessels of the nasal mucous membrane, and may be advantageously combined with the other measures mentioned.

For pulmonary hemorrhage there is no better remedy than cold compresses over the chest and very hot fomentations between the shoulders. Care should be taken to cover both the lower cervical and the upper dorsal region. The vasomotor nerves which supply the lungs find exit from the spine in this region, and hence applications made at this point are especially effective. The application of ice to the nostrils also contracts the pulmonary vessels (Brown-Séquard).

In cases of hemorrhage from the stomach, lumps of ice may be swallowed, and large ice compresses should be placed over the epigastrium.

In apoplexy, the ice-cap **(1314)** and ice-cold compresses to the head, face, and neck are most appropriate and valuable measures.

In hemorrhage from the uterus, short, very hot fomentations (**1328**) or the hot douche (**1024**) may be applied to the thighs and spine, and an ice-bag (**1314**) placed over the lower abdomen, while a hot vaginal douche is administered.

Among the most useful measures of this sort are a very short hot douche to the lumbar region, the inner surfaces of the thighs, and the soles of the feet, to combat uterine hemorrhage. Prolonged cold applications (55°–70°) to the same surfaces produce like effects. 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 can not be used in cases of menorrhagia, without the utmost care and discretion, at the beginning of a catamenial period, on account of the danger of producing hematoma or hematosalpinx, through the sudden checking of the outflow of blood. On this account, less violent measures should be employed during the first twenty-four or 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 author's opinion, very small after the first day.

A case which came under the author's observation in practice some twenty years ago illustrates very well the value of cold applications of this sort: A girl about fifteen years of age 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 had employed every sort of medicinal and many non-medicinal means for checking the hemorrhage, but without avail. Packing the uterus had not been tried, but tamponment of the vagina with alum and other astringents had been thoroughly employed, yet without material results. The patient was placed at once in a sitz bath of about 50° F. for fifteen minutes, the feet being placed in cold water at the

same time, 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 difficulty was relieved.

The great value of this principle as a means of controlling hemorrhage was recently illustrated in a case of menorrhagia in which the author was consulted by a medical colleague. The patient had been flowing continuously for a month, the hemorrhage following a curettement. The usual remedies had been employed most assiduously, but without result, tamponment of the uterine cavity having failed to control the hemorrhage even temporarily. The application of a cold pelvic pack controlled the difficulty at once, and completely for twenty-four hours, when a slight return of the flow occurred; another application of the same simple measure, however, resulted in permanent relief.

This measure will not control a hemorrhage due to vegetations, a uterine fibroid, or malignant disease, though even in cases of this sort it will often be found of value ; but for menorrhagia or metrorrhagia due to uterine or ovarian congestion, it is a most valuable resource. In cases of hemorrhage accompanied by severe neuralgic pain or by acute pelvic inflammation of any kind, very hot rather than very cold applications should be made to the inside of the thighs and the lumbar region. The application should be brief, and the temperature sufficiently high to be somewhat painful. It is most satisfactorily made by sponging the parts with water at a temperature of 140° F., or by the application, for 1 or 2 minutes, of cloths wrung from water of the same temperature. This measure acts in the same way as the hot nasal douche, or bathing the face with hot water, in relieving nosebleed.

620 **Hydriatic Heart Tonics.** There is no more powerful means of exciting increased activity of the heart than hydriatic applications. Short, very hot fomentations over the heart, the application of large, very hot or very cold compresses over the entire chest and trunk or to other large areas, hot and cold applications to the spine,

hot water drinking, and the hot enema are all efficient means of stimulating a flagging heart to increased action. The measures named are especially serviceable in cases of collapse under chloroform.

Prolonged cold quickens, then slows and energizes the heart. Prolonged heat slows, then quickens and weakens it.

Hot applications over the heart should be avoided where there is any considerable degree of cardiac dilatation, as in cases of this kind the indication is for withdrawal of the blood from the heart, through dilatation of the surface vessels by means of revulsive applications to the general surface, as the effervescing bath, cold friction, and carefully graduated passive exercises, rather than for excitation of the heart muscle.

A very short application of cold to almost any part of the body, but especially to the face and chest, stimulates the heart. The common practice of sprinkling cold water upon the face of a fainting person affords an excellent illustration of the primary exciting influence of cold in rousing the flagging energies of the heart to increased activity. The most excellent effects may be obtained from the application of cold over the heart in cases of cardiac insufficiency.

Cold applications excite the vasomotor constrictors, or accelerator nerves of the blood-vessels, as is clearly shown in the ordinary phenomena of reaction to cold, in which there is first a spasmodic and continuous contraction of the small vessels, later an active dilatation, accompanied by a vigorous rhythmical action of the vasoconstrictor muscles, whereby the movement of the blood is accelerated. The heart participates in this action. Its accelerator nerves, like those of the vessels, are derived from the sympathetic. Whatever affects the activity of the peripheral heart,— the small vessels,— affects in like manner the central heart.

Cold applications, through their influence upon the nerve centers which control the heart and vessels, cause an increased outflow of energy to the muscular structures of these organs, whereby they are brought into more effective activity. The

heart contracts with greater force, and more completely empties itself. The small vessels contract more vigorously, while at the same time dilating more fully, thus acting more efficiently in their capacity as a peripheral pump; and so the movement of the blood is hastened by increased activity at both ends of the vascular loop.

The most powerful effect upon both the heart and the vessels results from an application of cold to the whole cutaneous surface. Marked effects may also be produced by applications to the mucous surface, as by hot or cold water drinking and the hot or cold enema. For effects purely cardiac, the application should be confined to the precordia, the cutaneous surface overlying the heart, which is in special reflex relation with it. Cold applications made to this surface powerfully excite the accelerators of the heart, whereby the force of its contractions is greatly increased. The pneumogastric is also acted upon in such a manner that while the force of the heart-beat is increased, its frequency is diminished, thus giving greater efficiency to its action, by allowing more time for rest and repair of its tissues between beats. A continuous feeble action of the heart soon wears it out by depriving it of rest and interfering with its nutrition, while a slower action enables it to maintain its vigor and freshness. Cold applications to strengthen the heart action may consist of the following measures: —

1. The ice-bag or ice compress over the heart. The application must not be continuous, as the cutaneous nerves will soon become insensitive, whereupon the stimulating reflex effects will cease, and effects the very opposite of those desired will be produced. Thus the cold applications must be withdrawn frequently, and long enough to allow the nerves of the skin to regain their sensibility. An ice-cold application may be made for half an hour three times a day, or in cases requiring more vigorous treatment, once in two or three hours. Friction should afterward be applied to the cooled surface to maintain the circulation and normal sensibility.

2. The cold compress, consisting of a folded towel or half a dozen thicknesses of cheese-cloth, of sufficient size to cover half the front of the chest, and wet in water at the ordinary living-room temperature (60° to 70° F.). The compress should cover the cardiac area, extending over a portion of the chest wall contiguous. In cases of cardiac weakness, accompanied by pulmonary congestion, the compress may with great advantage cover the entire front of the chest. This moderately cold application maintains a constant stimulation of the cardiac centers, thus sustaining the heart tone and activity, as indicated by a slowed and strengthened pulse, and shown in a graphic manner by the sphygmograph. The increased cardiac force may be easily measured by the sphygmodynamometer. I have seen as the result of the cold cardiac compress, an increase of tension from 12 to 20 in a normal subject, and from a tension too low to be measured to 8 in a patient suffering from great cardiac weakness. The longer upstroke shows also that the arteries are better filled, as the result of a strong ventricular contraction.

To obtain from hydric applications the best results in energizing the heart, it is necessary in almost all cases to apply at the same time such measures as will lessen the peripheral resistance, and increase the movement of the blood in the vessels by stimulating the contractile activity of the peripheral heart (the small vessels). This is best accomplished by cold applications to the skin of such a character as to produce pronounced circulatory reaction. Cold friction, the rubbing shallow, the cold douche, the Scotch douche, the rubbing wet sheet, and the wet-sheet pack are all excellent means for this purpose. In cases of extreme cardiac weakness with degeneration of the heart muscle, or valvular disease, cold friction is the best of all measures, for the reason that complete general reaction is produced, but without sudden displacement of blood to the interior. In some cases the ice-bag protected by a single thickness of flannel may be applied over the heart continuously for several hours with advantage.

This measure is equally superior in cases in which cardiac weakness sometimes complicates apoplexy, hemorrhage, and visceral congestions.

The very short hot bath, the short hot-blanket pack, the hot and cold immersion bath, and moderate dry friction are all efficient means of stimulating the action of both the central heart and the peripheral heart. Cold applications to the gastric and rectal mucous membranes stimulate the heart and the pulmonary circulation.

In cases of nephritis with uremic poisoning and cardiac failure, I have seen most striking results from the cold trunk pack. In one case the patient was unconscious, pulse 160, and almost imperceptible at the wrist. The hot-blanket pack had been administered to relieve the renal congestion. Being consulted with reference to the cardiac weakness, I suggested the application about the trunk, excluding the arms, of a half-sheet wrung as dry as possible from very cold water. The result was magical. The pulse became strong, was reduced in frequency from 160 to 100, and the patient's entire condition rapidly improved. Such an application may be safely made even in cases of renal and other visceral congestions when preceded by a general hot application. With this preparation the cold application does not produce the usual intense internal congestion while the cutaneous reaction is being established, but the reaction of heat is simply converted into the reaction characteristic of cold, in which the cardiac and vasoconstrictor centers are powerfully energized and the circulatory functions accelerated and regulated.

When cardiac weakness demands therapeutic interference, there are three things to be done: (1) Increase the power of the heart; (2) Decrease the amount of work it has to do; and (3) Remove the cause or causes of the morbid conditions of the heart and vessels. In other words, we must, if possible, simultaneously lessen the work of the heart while we increase its ability to work, and remove the causes of the increase of work and the decrease of cardiac power. By

means of appropriate hydric applications, all these indications may be simultaneously and most efficiently met. The heart is energized, the small vessels dilate widely and contract more vigorously, behaving in this respect in the same manner as does the heart. At the same time the increased movement of blood secures better oxidation and elimination of the poisons which depress the heart and cause contraction of the small vessels, and thus increase the work of the heart while lessening its ability to work.

It will be in place to devote a few lines just here to the consideration of the remedies most commonly used in cases of cardiac weakness or failure; viz., alcohol and digitalis. While alcohol lessens the power of the heart, as shown by the experiments of Hare and other observers, it at the same time weakens the constrictors of the vessels, and so dilates the small vessels and lessens the blood pressure. In other words, alcohol, while lessening the power of the heart, at the same time lessens the amount of work it has to do. If the work is lessened more than the cardiac power is weakened, there may be a temporary gain to the patient in a given case.

Digitalis produces an effect the opposite of that of alcohol, causing the heart to contract with greater vigor, and also lessening the caliber of the small vessels, thus increasing peripheral resistance in the blood circuit. In other words, digitalis increases the vigor of the heart, and at the same time increases its work. If in a given case the heart's power is increased more than its work is increased, then there may be a temporary gain, but this advantage is not always secured

It is most profitable to note the difference between the effects of water and those of alcohol and digitalis. Alcohol diminishes the work, but also the working power. Digitalis increases the working power, but at the same time increases the work. *Cold increases the working power, while diminishing the work.* Moreover, alcohol and digitalis, both being toxic substances, add to the toxemia which is often a cause of cardiac inefficiency, while, on the contrary, hydric appli-

cations aid in the removal of the disturbing poisons. No condition requiring the use of a heart tonic or stimulant can be named in which a hydriatic application of some sort will not answer the indication far more efficiently than any drug known to the pharmacopeia.

621 **Uterine Excitation—Emmenagogic Effects.** Cold applications over the abdominal surface, especially over the lower abdomen, short and sudden cold applications to the mammary glands, the hot vaginal douche, and also alternate hot and cold applications applied to the breasts and lower abdomen, are efficient in stimulating uterine contractions in cases of delayed labor.

In cases of amenorrhea, the short cold douche to the lumbar region is a measure of very great efficiency. It operates by stimulating the circulation of the ovaries and the uterus, and, by improving the nutrition of the parts, restores the suspended function.

622 **Vesical Excitation.** A cold douche to the feet and over the bladder is a powerful means of exciting vesical contractions, and, used judicially, is applicable in many cases of motor insufficiency of the bladder. This remedy should, of course, be withheld in cases of retention of urine from obstruction.

623 **Intestinal Excitation.** The hot enema, the cold enema, the graduated enema, cold and alternating douches, and other applications over the loins and the entire abdomen, especially about the umbilicus, are measures which are highly efficient in exciting intestinal activity through the impressions made upon the sympathetic centers and splanchnic nerves.

The hot and cold rectal douche (**1410**) is an excellent means of arousing nervous activity in semiparalyzed conditions of the rectum, often so prolific a cause of constipation in cases where the bowels have become inactive through neglect to attend regularly to their daily evacuation.

There is no means by which gastric motility can be so efficiently excited as by cold applications made to the epigas-

trium or the dorsal spine. Sipping half a glass of cold water or the application of an ice-bag to the epigastrium for half an hour before eating powerfully stimulates gastric motility in atonic states.

B. SECONDARY EXCITANT (Reaction) EFFECTS.

Secondary excitant effects are altogether derived from 624
cold applications, as the reaction effects of hot applications are atonic or sedative. Heat may, in many cases, be advantageously used in connection with cold, in the production of excitant effects by reaction, as in the alternate douche (**1044**) and other alternate applications. The use of heat is not merely to renew or intensify the effect of the cold application by a preparation of the tissues which are to receive it, an important service, but to produce its own specific excitation, in accordance with principles elsewhere explained (**482**).

Secondary excitant effects may be either (*a*) general or (*b*) local, according to the form of the application.

1. *General Secondary Excitant Effects.*— The general ex- 625
citant effects of cold water occupy an important place in the hydriatic armamentarium. Indeed, there is no therapeutic measure known to modern medical science which is capable of producing more powerful general excitation of the entire system than a scientific application of cold water. A short application of very cold water is excitant, in whatever manner it is applied. When, to the influence of a low temperature, is added the percussion effect obtained by the douche with considerable pressure, the excitation resulting is of a most intense character, and is capable of arousing to action every nerve fiber and every cell, and awakening every form of activity in the entire body.

In the practical therapeutic employment of water, two important general excitant effects, quite similar, but differing in use, are especially recognized. These two classes of effects may be distinguished as (*a*) *Restorative*, and (*b*) *Tonic*.

626 **Restorative Effects.** A single short application of cold water in the form of a douche, affusion, rubbing wet sheet, immersion, or any other measure in which cold water is brought in contact with the general surface of the body, is always restorative and invigorating in its influence. A man who has been exhausted by laborious effort in a highly heated atmosphere, finds his muscular strength wonderfully re-enforced by an affusion of cold water, cold immersion, a cold shower bath, and especially by a cold douche.

The application of cold water to the face and head has a wonderfully refreshing effect. The brightened expression, the increased vigor, and the relief which follows a simple bathing of the head, face, and neck with cold water when exhausted, are the result of the reflex stimulation of the nerve centers of the brain and spinal cord and the tonic reaction which follows such an application. When the whole surface of the body instead of a small area is acted upon, the effect is proportionally greater.

During the heated term, thousands of lives have been saved in our great cities by the timely opening of free shower baths in crowded tenement-house districts, whereby the depressing and exhausting effects of a superheated atmosphere have been successfully antagonized and antidoted by the restorative influence of the cold bath.

In this connection it is important to mention the necessity of exercising care in the use of the general cold bath in cases of extreme exhaustion from violent exercise, and when, either with or without exhaustion, a sensation of chilliness exists. A general cold application should never be made when the surface is cold, blue, or covered with cold perspiration, nor when the body is in a state of extreme fatigue from violent exertion of any sort, nor when the patient is chilly.

When the surface is hot and dry, a cold bath may be administered without risk, and usually the presence of perspiration, even though it may be quite profuse, is not a contra-

indication to cold applications, provided, however, that the patient is not at the same time suffering from an infectious fever; but the application must be short, and must be followed by sufficient exercise or friction to secure proper reaction. Care must be taken, however, to see that the exercise be not such as to produce too violent a reaction, especially in cases in which the skin is hot and perspiring.

In cases of extreme exhaustion in which it is not prudent to administer a general cold bath, cold applications may be made to the head, face, neck, and spine, with advantage. The hands and feet may also be bathed in cold water, care being taken to keep the remainder of the body covered if there is cold perspiration. General cold friction may be applied safely in nearly all cases.

A short hot bath (2 to 4 min., 104° to 110°) followed by cold friction is one of the most efficient means of combating a state of collapse, such as often occurs in fever.

Tonic Effects. Tonic measures are such as increase vital 627 activity in a healthful direction. The most powerful tonics are the most powerful excitants, it being understood that by excitants is meant exclusively physiological means, such as thermic influence, light, and electricity. It must be remembered, also, that an excitant may be employed in such a manner as to exhaust the nerve centers, and thus produce effects the very opposite of those desired.

The tonic effect of cold water is its most constant and regular effect, this tonic influence being exerted whenever water is applied at a temperature below that of the body.

Trousseau defined a tonic as an agent having for its object to give tone to the tissues, to restore the functions of nutrition and assimilation, and to increase vital resistance. A more modern definition of a tonic would be an agent which, when systematically employed, aids in the restoration of normal tissue activities, both constructive and destructive, thereby promoting a renewal of the body and a recuperation of its forces, and an increase of vital resistance.

The tonic effects of water are, of all the remarkable therapeutic properties of this versatile agent, the most important and the most extensively used. They are obtained by the repetition of excitant measures, and are due to the reaction which, under ordinary conditions, always follows a short cold application.

Water, by its accessibility, its convenience in use, and its high specific heat, more readily lends itself to the assistance of the physician in producing restorative and permanent tonic effects than any other agent.

628 **Cold Water vs. Medicinal Tonics.**

The numerous medicinal tonics, so called, are universally toxic in character. Whatever tonic effects they may seem to produce are due to the fact that the system is aroused to resist their influence and to expel them from the body; and while a certain amount of benefit is perhaps derived from the use of such agents, there is always a possibility of serious damage; and doubtless in all cases a considerable amount of harm is done through the toxic influence of the drug, which falls with especial weight upon those organs which are most concerned in its elimination,— the liver and the kidneys.

A medicinal stimulant is a mortgage placed upon the vital capital of the body, which must be paid sooner or later. It is a draft upon the constitution. A stimulant is simply a means by which the nerve centers are made to give up a little more of the energy which they have stored up; and unless the stimulus is of such a character that the storing power as well as the expending power of the nerve centers is increased, there must be a loss from its employment.

A toxic agent like strychnia may provoke the expenditure of nervous energy, but it does not replenish energy; while it does lessen the activity of the kidneys in eliminating tissue poisons and the efficiency of the liver in the destruction of toxins and leucomains, thus encouraging the development and maintenance of a condition which is, in itself, an indication for the necessity of employing tonic measures; in other

words, a medicinal tonic or stimulant aggravates the very condition it is intended to cure.

Nervous Energy.

629 The establishment in modern times of laboratories for psychological and neurological research has been the means of throwing much light upon the nature of mental and nervous activity. Nervous energy no longer means, as formerly, an intangible, mysterious something, but, as has now been clearly demonstrated, is immediately and definitely connected with material elements found in the interior of the nerve cell. For example, a nerve cell, when in a state of rest, shows a large number of grayish granules, which have been shown to be intimately connected with the storage of energy; so that when the granules are abundant, the cell is like a fully charged battery, ready to discharge under the influence of the right sort of stimulus the maximum of energy which it is capable of exhibiting. On the other hand, when the cell is fatigued, as after prolonged, energetic work, the granules are found to be very few and small, and the cells shrunken and pale.

With these facts in mind, it is easy to understand why such disappointing results have followed the use of strychnia and a very large number of medicinal agents, so-called nerve tonics, since it is evidently impossible that these drugs should in any way increase the store of energy in the cell; and the most that can be expected of them is the excitement of the cell to activity when it has become exhausted to such a degree that a sense of fatigue supervenes as a warning that the store of nervous energy is reduced to a point where any further demand upon it is dangerous, and that rest is imperatively demanded.

The only way that the energy granules of a cell can be augmented is by the assimilation of food from the blood, and the development of energy-containing particles. Cold water surpasses all other agents in its power to promote the normal energy-storing processes. Cold applications also facilitate to

a very remarkable degree the discharge of nervous energy when a sufficient store exists, though sometimes it may not be available because its useful application is hindered by the influence of retained excretions or nerve-benumbing toxins generated within the tissues or absorbed from the alimentary canal. This effect of water is readily apparent in the influence of the cold bath upon muscular energy, to which attention is called elsewhere (**327**), and also in the sensation of well-being, buoyancy, and readiness for exertion which results from the application of cold water.

The tonic effects of cold water are unquestionably to a large degree due to the influence of cold impressions acting through the nerves of the skin upon the sympathetic nerve centers. The great sympathetic nerve controls the blood-vessels, glands, heart, the functions of secretion and excretion, and, in fact, all the vital functions of the body. The awakening of the sympathetic to renewed activity, or a balancing of its action, is what is specially needed by the great majority of chronic invalids. The functions of the brain and spinal cord, and through them all forms of nervous activity, are to a remarkable extent influenced by the sympathetic. The sensation of well-being which accompanies the reaction following a general cold application is largely due to the increased activity of the cerebral circulation, brought about through the stimulation of the sympathetic. By its power to influence the sympathetic, hydrotherapy is capable of controlling, restraining, reorganizing, balancing, all the processes of organic life, and through them modifying the functions of animal life to a marvelous degree.

630 **Cold Water a Physiological Tonic.**

Cold water is a physiological tonic, and has the advantage over medicinal tonics of all sorts, in that it awakens nervous activity without the imposition of any extra burden upon any vital organ, and without hampering the activity of any function. The cold bath employed in such a manner as to produce tonic effects accomplishes its results by increasing

vital resistance to the causes of pathological processes, by making the wheels of life run more smoothly, by lifting the whole vital economy to a higher level. The impression made upon that harp of a million strings, the skin, with its vast network of sensory, motor, sympathetic, vasomotor, and thermic nerves, arouses every nerve center, every sympathetic ganglion, every sensory and motor filament in the entire body to heightened life and activity. Every blood-vessel throbs and every cell quivers with a new life; the whole body thrills with quickened impulses, the whole being is translated into a new state of existence.

A person who has never experienced the glow of exhilaration, the invigoration and buoyancy of body and mind, which accompany the state of reaction from a short, general cold application, can not well appreciate the value or significance of the cold bath as a physiological stimulant. It is not too much to say that it is of all measures known to man, the most valuable as a means of arousing to activity the flagging energies of the body, and lifting the enervated invalid out of the morasses and quagmires of chronic disease.

Tonic Effects of the Cold Bath Due to Repetition.

631 The reaction produced by tonic applications fills the skin with blood; and if it is daily repeated, the blood is finally fixed in the skin, thus permanently increasing its vascular activity, and relieving internal congestion.

The hidebound animal suffers from visceral congestion because of the deficient amount of blood in the skin and the excessive massing of blood in the internal organs.

In the employment of the cold bath as a tonic, there are a few principles which it is important to keep constantly in mind. Especially must it be remembered that the cold bath is, like other tonic agents, a two-edged sword,—it is capable of acting in opposite ways. The cold bath may be used in such a manner as still further to weaken and debilitate the patient who is already nervously exhausted. Indeed, it is so easy to produce such a result that it is not improper to say that no

physician should ever undertake the use of the cold bath as a tonic without an exact knowledge of the principles and methods of hydrotherapy and the most precise and complete information respecting the condition of the patient to whom the application is to be made.

All applications of water of a temperature low enough to provoke vital resistance are tonic; hence tonic effects are produced by all temperatures below 90° F.

It should be remembered that those forms of hydric application which are tonic when of short duration, become sedative when sufficiently prolonged. The sedative effect is accompanied and indicated by the lowering of the rectal temperature a few tenths of a degree. The length of time required to render a cold application sedative in character depends, of course, upon the condition and the susceptibility of the patient.

Although all baths at a temperature below 90° may be employed for tonic effects, the most certain and pronounced results are obtained from the douche in every form, which adds mechanical impact to the thermic effects of cold.

The tonic effects of non-percutient baths may be increased by vigorous friction during the bath.

632 The most durable tonic effects are obtained by the frequent use of very cold and very short baths. Short tonic baths may, in many cases, be employed twice daily with advantage.

Of the several forms of douche, the *rain douche*, or shower bath, is the most strongly refrigerant, since it impresses at each instant the largest portion of the surface. The next most vigorous purely hydriatic measure is the horizontal jet. The massage douche combines with the mechanical and thermic effects of the douche, the powerful influence of massage upon circulatory reaction and metabolism.

The horizontal jet, the spinal douche, the circle douche, the pail douche or affusion, the wet-sheet rub, the towel rub,

cold friction, the wet-hand rub, the plunge or swimming bath, the sitz bath, the full or immersion bath, the Scotch douche, the alternate douche, the percussion douche, and various modifications of these baths may be employed in such a way as to produce tonic effects varying in degree according to the method of application, the temperature, the length of the bath, and the conditions under which the application is made.

As tonic effects are obtained almost altogether from the use of cold water, great care must be taken to observe the general directions and precautions given elsewhere with reference to the use of the cold bath (767).

Indications for Tonic Applications.

633 Tonic measures are applicable in nearly all forms of disease. Although tonic baths can not always be employed at the outset of a course of treatment, it should be the constant aim to prepare the patient for them; and after the beginning with tonic measures, there should be a progressive training in the direction of more and more vigorous applications.

Tonic measures are especially indicated in cases of anemia, all forms of nervous exhaustion, or neurasthenia, hysteria, in the numerous varieties of dyspepsia in which enteroptosis and consequent irritation of the sympathetic nerve gives rise to general nervous irritability and exhaustion, in chronic inebriety, in many cases of insomnia, in obesity, in exophthalmic goiter, in convalescence from fevers, and most other chronic morbid conditions.

Tonic applications are also indicated in cases of irritable weakness, such as delirium tremens; in the extreme nervousness and agitation which often accompanies fevers of grave type, as typhoid and typhus; in chlorosis; in many reflex neuralgias growing out of irritation of the abdominal sympathetic; in insomnia; and in cases under treatment for the cure of the alcohol, chloral, opium, or other drug habit.

In depressed conditions of the nervous system, such as hypochondria, nervous dyspepsia, many cases of melancholia,

and general nervous exhaustion, without excessive excitability, very exciting applications may be employed, such as the different forms of the douche,—jet, percussion, spray, and rain,—in which the excitant effects of cold are supplemented by percussion effects. The rubbing shallow bath, cold friction, the wet-sheet rub, the cold-towel rub (wrung as dry as possible), the salt glow, and the shallow bath are also valuable. In very weak persons, simple dry friction may be employed for a few days at the beginning of the treatment, or a short hot bath may be administered just before the cold water applications are made.

There is no class of cases in which the tonic effects of cold water are of greater importance than in the treatment of acute infectious febrile disorders. Tonic hydriatic applications build up the bodily resistance as no other measures can do.

634 **Suggestions and Precautions Respecting Cold Applications.**

A few words may be useful in relation to the adaptation of tonic measures to the various classes of invalids that require tonic treatment.

Extremely feeble persons are in the greatest need of tonic treatment, and yet have the least tolerance for cold water; hence in the beginning the very gentlest measures must be employed, such as the cold wet-hand rub, cold friction, the salt glow, alternate hot and cold applications to the spine, and similar means.

In many cases it is necessary at first to confine the application to small areas, passing from one part of the body to another in rapid succession, as first a hand, then an arm, a foot, a leg, the chest, the upper portion of the back, the lower portion of the back, etc., carefully drying, rubbing, and covering each part before proceeding to the next. It is best to make the application symmetrical; that is, if the right hand and arm are first treated, the next parts to be treated should be the left hand and arm. This brings into action adjacent and related nerve centers practically simultaneously, and so secures the maximum effect.

In feeble patients a very unpleasant and discouraging 635
sense of fatigue is often experienced after tonic applications, especially at the beginning of a course of treatment. This arises from a deficiency in vital capital to support the loss of heat and the expenditure of nervous energy required by the reaction. The irritable condition of the nervous system occasions a very quick reaction, whereby heat dissipation, through the increased surface circulation, begins before the production of heat has proceeded far enough to repair the loss occasioned by the contact of cold water, and thus an unpleasant nervous perturbation continues, sometimes accompanied by chilliness and various nervous symptoms which only too clearly indicate the fact that the patient's vital resources are at a very low level. In such cases the greatest care is demanded to avoid producing so great a degree of exhaustion as to discourage the patient and blight his prospects for recovery. It must never be forgotten that cold water is a most powerful therapeutic agent, and potent for mischief as well as for good, and that an application which, if wisely managed, may produce powerful tonic effects, may, from lack of care or judgment, become equally depressing and highly injurious.

It must be remembered, also, in making tonic applications of water, and especially in the use of the cold douche, that the skin is abundantly supplied with sympathetic nerves; that these nerves are connected with the great ganglionic system, including the abdominal brain, which controls every vital process in the body, and that there is an intimate association between the sympathetic nervous system and the pneumogastric nerve, which exercises so profound an influence upon the functions of the lungs and heart.

The coughing, oppression, and distress experienced in the region of the chest as the result of a very cold application to this part of the body, are indicative of the profound influence thus exerted upon the respiratory center. This fact must be kept in mind in the treatment of persons of a nervous tem-

perament, especially those subject to asthmatic attacks, or suffering from dyspnea or cardiac weakness.

636 **The Cold Douche to the Chest to be Avoided.** Mechanical stimulation of the pneumogastric stimulates the inspiratory movements. This fact explains the effect of the douche with strong pressure when applied to the upper part of the chest; hence the necessity for avoiding strong percutient applications in cases in which there is an irritable and congested condition of the pulmonary structures, or a hypersensitive state of the pulmonary area of the pneumogastric.

Applications of the cold douche over the stomach, loins, and abdomen should be avoided in cases of hyperpepsia, ulceration of the stomach, hemorrhage from the bowels, or any form of uterine hemorrhage, as menorrhagia or metrorrhagia.

Very anemic persons, such as convalescents from fevers and other wasting diseases, or those who have suffered severe hemorrhage, and especially those who are greatly emaciated as well as weak, must be treated with careful regard for the precautions suggested.

Extremely nervous or neurasthenic patients invariably rebel at the application of very cold water. Such persons must be humored at the start until their confidence is secured. The author has found it a very good plan to prescribe at first for such a patient a hot bath, as the electric-light, vapor, or warm electro-hydric bath, which is likely to please the patient, especially as the immediate effect is usually quieting and comforting. But the application is made short (3 to 10 min.), and immediately followed by a cold application, from 65° to 70° F., very short (4 or 6 secs.), or if at a more moderate temperature, as from 75° to 80°, for 10 to 20 seconds.

637 **The Cold Bath in Anemia.** For very feeble and anemic patients the Scotch douche generally secures the best effects, as in such cases the heat-producing powers are weak. This is especially true with patients who are very susceptible and excitable. The bath should be

graduated by extending the length of the concluding cold application each time until it is well borne for ten to thirty seconds.

If the patient is so sensitive that the douche can not be tolerated, employ the wet-sheet rub, fomentations to the spine followed by affusion with water at 80° F., the electric-light bath, followed by affusion at the same temperature, or the hot-air or vapor bath, also followed by the tepid affusion or some similar measure. The patient must, however, be progressively trained to employ water at lower and lower temperatures until short applications of very cold water can be borne (55° to 60° from 1 to 3 secs.).

It is sometimes a good plan to have the patient, while taking the cold jet or spray douche, stand in a foot bath with the water so hot that he can scarcely stand still in it. His attention is thus diverted to his feet, and the impression of heat is so generalized that a brief general cold application is tolerated without complaint.

Or, the patient may be prepared for the cold application by a very hot spray or shower (110°–120°) lasting from one to three minutes, and of gradually increasing temperature. The hot shower may be instantly succeeded by the cold douche to the spine, or to the spine and lower extremities, or the temperature may be gradually lowered to 70° or 60°. Care must be taken to avoid the abdomen, the chest, and particularly the region of the heart in nervous cases, especially those in which hysteria is a well-marked symptom, and in cardiac disease and asthma. The author finds an arrangement of the electric-light bath in combination with the shower and douche very excellent in these cases.

In anemia, and especially anemia of the brain, whether 638
accompanying general anemia or an independent condition, there is an excessive accumulation of lymph in the ventricles and between the dura and the brain substance. As a result of this stagnation of the lymph, the nutrition of the brain is seriously interfered with, waste matters accumulate, the

nerve cells are unable to store energy, and chronic mental and nervous exhaustion is the result. Tonic applications of water afford the most efficient of all means of correcting this condition. As long ago shown by Schüller, cold applications to the surface cause a sudden filling of the blood-vessels of the brain, whereby a vigorous movement of the lymph current is produced; and when the applications are so managed as to create strong respiratory movements, as in applications to the chest, rapid fluctuations are induced in the volume of the brain, which are attended by a simultaneous agitation of the lymph, which can not be experienced without a salutary effect in cases of this sort.

The observations of Virchow, however, should be borne in mind in dealing with these cases. He showed that chronic anemia is liable to be accompanied by degeneration of the heart and blood-vessels, so that care must be taken to avoid violent measures whereby such strong reflex impressions may be made upon the weakened structures as to paralyze the heart or produce irreparable injury to the vessels. Cold friction, the sitz or shallow bath, and the tonic pack, with the water at a moderate temperature (70° to 80°), are the measures most suitable for these cases.

639 **The Tonic Bath in Cerebral Congestion.**

In most cases of chronic congestion of the brain, the difficulty is really due to a paralysis of the vasoconstrictors, though possibly in some cases the difficulty may be due to irritation of the vasodilators. In any case, the normal balance of action between these two sets of nerves is disturbed. It is evident that the most effective measures for securing permanent relief must be those whereby the caliber of the cerebral vessels may be lessened. By means of general warm baths, a large quantity of blood may be drawn to the surface, and the cerebral vessels contracted. But this effect is purely mechanical. Better effects are obtained by cold applications to the lower extremities (the broken douche, rubbing wet sheet, cold

friction), whereby the cerebral vessels may be brought reflexly into a state of vigorous contraction. This effect is, of course, transient, but the nutritive changes set up, and especially the stimulation of the flow of lymph in the ventricles and lymph channels of the brain, when repeated by daily applications of measures of the sort suggested, produce most happy results. These partial tonic applications must be accompanied by short and very moderate general applications. In cases where considerable irritability exists in connection with the cerebral congestion, the cold douche should not be employed, but warm and neutral baths, the shallow bath, wet-sheet rub, rubbing sitz, or tonic wet-sheet pack must be used.

In passive cerebral congestion, and especially in the congestion of the brain which frequently accompanies anemic conditions, these mild tonic measures are of the very greatest value, and will produce most happy results when carefully managed.

The Tonic Bath in Hypochondria and Rheumatism.

640 In hypochondria, tonic measures are of the highest importance, and are generally well tolerated. It is necessary, however, to precede the cold application by a short hot bath carried to the extent of perspiration, so as to secure the elimination of the poisons to which the depression is due.

Rheumatics can comfortably and safely receive cold applications only after a heating bath of some sort. The cold application must be very moderate in degree, and the painful joints must be avoided. These observations apply also to cases of painful gout, and to cases of neuralgia in which large nerve trunks or extensive areas are involved, as in sciatica, spinal irritation, and myalgia involving many groups of muscles.

In persons suffering from cardiac disease with deficient compensation, in arteriosclerosis, in apepsia, in hypopepsia, in acute mania, in advanced cases of consumption, especially those in which pulmonary hemorrhage is a marked symptom,

in diabetes with emaciation, in both acute and chronic Bright's disease, in locomotor ataxia, in persons who have an idiosyncrasy against cold, in conditions of fatigue from extreme exhaustion, as violent muscular exertion, or exhaustion from loss of sleep, or excessive expenditure of nervous energy in other ways, — in all these conditions very cold baths must be avoided, as also in the case of very young (children under seven years of age) and very aged persons. These remarks respecting the contraindications for the cold bath must be understood, however, as applying only to the very cold douche, the cold immersion, and like vigorous procedures. Cold applications are useful and necessary in all these cases, and may be safely made by means of cold friction, the cold rubbing sheet, the graduated Scotch douche, and other mild tonic measures.

It should be here noted that age must be judged not entirely by the number of years lived, but by the evidences of senile decay. One person may be older at fifty than another at seventy. An elderly person who has been in the habit of taking a cold bath daily may be able to tolerate the cold douche without injury, while another person of the same age, who has not been accustomed to cold bathing, might be greatly harmed unless gradually trained to it. The presence of arteriosclerosis is always an evidence of senility.

Calorific Effects.

All tonic and restorative procedures are accompanied by general thermic or calorific effects. It is necessary, however, in some cases, to secure strong calorific effects independently of other effects, or at least to emphasize thermic reaction and the resulting calorification. The short cold immersion bath (20 secs. to 2 min.), the cold douche with little pressure, cold affusion, and especially the wet-sheet pack prolonged to beginning perspiration, are most efficient calorific measures

641 2. *Local Secondary (Reaction) Excitant Effects* — Applications of water at suitable temperatures may be made in such a manner as to affect the function of any organ or set

of organs in the body. The chief local effects, however, to which it is here desirable to call attention, are the following: Sudorific, expectorant, cholagogic, peptogenic, emmenagogic, hemostatic, revulsive, derivative, resolutive, alterative, and calorific. We will briefly consider each 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.

642 Sudorific effects, or stimulation of the perspiratory function, are obtained by various means which are capable of raising the body temperature. Bouchard has shown that an elevation of the temperature of the blood .7° F. 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 the part by warm or impervious coverings.

The measures which may be most conveniently employed for the production of active perspiration are, the electric-light bath, the Turkish bath, the Russian bath, the hot-air bath, the vapor bath, the 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, and the sun bath. Any one of these measures may be found the most convenient and serviceable in individual cases, and under special conditions.

The electric-light bath is without doubt the most efficient and satisfactory of all modes of inducing perspiration, as it produces such powerful stimulation of the perspiratory glands and other structures of the skin as to cause the perspiration to appear in a remarkably short space of time, thus avoiding the necessity of subjecting the body to the exhausting effect of prolonged exposure to heat. Profuse perspiration generally appears in the electric-light bath in from three to five minutes, and often when the temperature of the air surrounding the patient is not above 85° F. Winternitz has noted a

case in which sweating began at a still lower temperature. The dry pack not infrequently fails to produce perspiration within less than an hour and a half or two hours.

643 **Importance of Attention to the Skin in Chronic Diseases.**

When the extent of secreting surface presented by the skin is taken into consideration (the area of the perspiratory ducts being more than eleven thousand square feet), it appears 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 invisible vapor. Practically, the whole skin takes part in the function of perspiration, acting essentially in the same manner as does the mucous membrane lining the lungs, which the skin still further resembles in its ability to eliminate carbonic acid gas. In profuse perspiration, the sudoriparous glands are brought into vigorous activity, sometimes pouring out their secretion at the rate of from thirty to sixty ounces per hour, or from twenty to forty times the normal amount.

The secretion produced by the sweat-glands closely resembles urine in its character, containing urea and various other toxic matters, and particularly, as has been shown by Bouchard, a ptomain or toxin capable of causing a fall of the body 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 perspiration.

The healthful activity of the skin is one of the conditions most essential to physical well-being. The state of inactivity and disease of this organ found present in nearly all chronic maladies is not only a consequence but a cause of a large number of serious morbid conditions of the body; and it is in a great majority of cases quite impossible to effect a cure until the skin has, by patient and persevering treatment and training, been brought into a healthy state.

The dry, sallow, dingy skin so often observed in the chronic dyspeptic — indeed, in most forms of chronic disease — is not only a symptom of the disordered bodily state, but

a cause of the perpetuation of this condition. This appearance of the skin is due to the accumulation of effete matters in it, and to its impaired nutrition, which state exists not only in the skin, but in the entire body. Hence the correctness of the observations 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 so largely upon the state of the skin as a perfect index to the patient's general vital condition, and as a test of his progress toward recovery.

As previously stated, it is practically impossible to effect a permanent cure in a large number of chronic disorders without first restoring the skin to a normal state. Diseased conditions of the skin are common among the civilized races because of the disease-producing influence of clothing and the neglect of the daily bath.

Sweating baths are of the highest value as a means of ridding the skin of its accumulated impurities, opening up the obstructed lymph channels and spaces, thereby encouraging the circulation of the nutritive fluids and the development of normal nerve and gland structures, unloading obstructed sebaceous follicles of their hardened contents, as well as arousing to activity the nerve ganglia and the secreting cells of the internal organs, through the reflex movements set up by the cutaneous sensory impressions made.

A diseased state of the skin is always connected with a congested or otherwise disordered condition of important internal viscera, and the restoration of the skin to activity is the most important means of relief from visceral congestion and other functional disturbances. 644

Neglect of Heating Procedures by Hydrotherapeutists.

The value of heating measures as therapeutic means has not generally been sufficiently appreciated by those who have undertaken to employ water in a scientific manner. Indeed, many hydrotherapeutists, as Fleury and his followers, have held that scientific hydrotherapy is confined to the use of cold water exclusively. On the other hand,

there are a large number of those employing baths, in this country at least, who make excessive use of hot applications, particularly the Turkish bath, the Russian bath, hot mineral baths, mud baths, etc. 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 may be antidoted or antagonized. This very serious fault exists almost universally in the methods employed at mineral bath establishments and other popular bathing resorts, especially those connected with natural sources of hot water.

The author was pleased, however, in visiting various European bathing establishments some years ago, to note an exception to the general rule, in the practice prevalent at Leukerbad, Switzerland. At this quaint old resort, the patient sometimes spends six or eight hours "soaking" in a great tank filled with alkaline waters derived from artesian wells at a temperature of about 100° F., but on leaving the bath the massage douche is employed, and produces 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 vigorously rubs and kneads the tissues with the hand covered with a hair mitten. In taking the massage douche, at the end of an hour's seance in the tank, I found it necessary to lay fast hold of a strong iron bar arranged for the purpose, and to keep my feet firmly braced, to avoid being thrown down and carried 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; but it is certain that equally good effects might be produced by less tedious means and milder measures.

The cold bath in some form should be universally employed after sweating baths, except when contraindicated, as in Bright's disease, rheumatism, neuralgia, and cases in which the sedative effect of heat is desirable.

Alterative or Spoliative Effects.

645 Sweating baths may be employed advantageously for the purpose of reducing the weight, or to remove serous deposits in the tissues, as in anasarca, or in the abdominal or pleural cavities, and also as a hygienic or prophylactic measure for the purpose of atoning, to some degree, for the neglect of active muscular exercise. It is perhaps most valuable as a hydriatic means in the rational treatment of obesity. It must be remembered, however, that the sweating produced by heat is by no means so efficient in reducing flesh as that induced by exercise. It is by a combination of the two means that the most pronounced effects obtainable may be realized.

646 In cases of obesity there is great danger of overheating the blood in consequence of the obstacle to heat elimination presented by the thick layer of non-conducting fat. Therefore, hot applications for the reduction of flesh should never be too greatly prolonged, and the bath should always be finished off by a vigorous cold application.

The sudden removal from the blood of a large quantity of serum 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 failure, a tendency to which is 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 the mediastinum.

A short general cold application following an application of heat for the purpose of 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 spoliative effects of the hot bath the still more positive effects of prolonged muscular exercise.

647 In administering a sweating bath for the purpose of reducing flesh, it is an excellent plan to interrupt the hot application at intervals by a cold application, a cold shower bath, a cold horizontal douche, or an affusion being best employed for this purpose. The temperature should be from 50° to 60° F., and the application continued not only long enough to remove from the skin the surplus heat which has been absorbed, but from five to twenty seconds longer, so as to produce a strong reaction. The atonic reaction of the hot bath, whereby heat production and tissue activity in general are reduced, will thus be antagonized, oxidation will be encouraged, and effete matters and surplus tissue broken down and prepared for the elimination which will be effected by the succeeding application of heat. By the adoption of this plan the hot bath may be prolonged to two or three times the period otherwise admissible.

Hot Baths Must be Used Carefully in Dropsy.

548 In the application of hot baths for the relief of dropsy, great care must be exercised, especially in cases of cardiac disease. The appearance of dropsy in a case indicates that the small blood-vessels have lost their power of active contraction, and the heart is weak and dilated. The stimulating effect of strong applications of heat may cause still further dilatation of the heart, which is already so weak as to be unable completely to empty itself of its contents, while the depression resulting from the atonic reaction of heat will still further weaken the organ, and may result in so embarrassing it as to induce grave symptoms. Death from cardiac weakness has not infrequently occurred in Turkish bath establishments. The danger is even greater in the Russian bath, and the vapor bath is not wholly free from danger.

Attention should be called to the fact that in cases of edema due to anemia, especially when associated with obes-

ity, sweating baths, even when quite prolonged, are often borne without inconvenience and with decided benefit. The same is true of cases in which edema of the legs is associated with chlorosis, provided that marked cardiac weakness from fatty degeneration or other cause is not also present.

A cold application following a hot bath in dropsy due to 649
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 brings, for the moment, 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 must be managed with great care, and extreme temperatures should not be employed.

A douche at 75° or 80° is better suited to these cases than lower temperatures. The application should be made first to the feet and legs, then to the arms and back, and lastly to the chest. It is well to mitigate the shock to the lungs and heart by dipping the hand or a towel in cold water and applying to the face, neck, and chest before making a general cold application. In cases of well-marked cardiac insufficiency the douche must be altogether avoided, and such milder measures as the rubbing shallow bath and cold friction employed instead.

The Hot Bath in Bright's Disease.

The hot bath is also an invaluable measure in 650
certain cases of dropsy of renal origin. It is of special value in acute dropsy due to the nephritis sometimes encountered as a complication in scarlet fever, smallpox, diphtheria, and in the puerperal or pre-puerperal state. In these cases it proves beneficial chiefly by drawing a large quantity of blood to the surface, and thus relieving the congestion of the inflamed organs. It is, of course, also of some service by the elimination of toxins through the sudoriparous glands, but the amount of urea and other toxins thus carried off, even during the most profuse perspiration, is comparatively small.

The hot-blanket pack is a most serviceable measure in 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 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 it should not be cooled to such a degree as to antagonize the effect of the pack.

In the dropsy of chronic nephritis the hot bath is less serviceable, in consequence of the organic nature of the affection, which leads to the almost certain reappearance of dropsical symptoms after they may have been removed. In these cases there is also great constitutional weakness as a result of the disease, so that the system is poorly prepared to endure the depressing effect of the hot bath.

651 The hot bath also has the effect of leaving the patient in a condition of diminished resistance to colds, which is one of the most serious dangers to the chronic sufferer from Bright's disease. On this account, some eminent authorities wholly forbid the use of hot baths in this class of cases. In the author's experience, however, the hot bath has been found invaluable in these cases, in one special condition; namely, when the sufferer from chronic nephritis has suddenly become dropsical through an exacerbation of the disease, as 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; but the application must be short (10 to 20 min.) and it must be administered so as to give the patient as little fatigue as possible, never so hot nor so long as to be weakening or exhausting. The heart may be protected by a cold compress (**1383**).

In most chronic cases of renal disease, the neutral bath at a temperature of 92° to 95° F., and especially the effervescing bath (**1139**), has proved more serviceable than the sweating bath, as it produces stimulation of the skin circula-

tion without inducing depressing effects. The well-known effect of the neutral bath in exciting renal activity is also here made serviceable.

The electric-light bath is far superior to any other form of 652
sweating bath for cases of Bright's disease, for the reason that the skin may be excited to a high degree of activity by a very short application and without exposing the patient to the risk involved in the breathing of highly heated air or a hot atmosphere saturated with moisture, as in the Turkish or the Russian bath. During the last seven years the author has employed this bath in a very large number of cases, and without witnessing any untoward effects, but with advantages not afforded by other methods of applying heat. One great advantage of this bath is that the medium about the patient is not overheated. The air may be readily maintained at a temperature of 85° to 90°, so that heat elimination may go on normally, which can not be the case in any other form of hot bath.

In the hot immersion bath, heat elimination, except through the lungs, is entirely suspended. 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.

Another advantage of the electric-light bath is that heat is produced in the depth 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 tissue which it penetrates, reaching, with some degree of intensity at least, the innermost recesses of the body.

The Sweating Bath in Dropsy.

653 In dropsy 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 condition of the blood and the general interference with nutrition. Here again the electric-light bath shows itself superior to other measures for applying heat to induce perspiration, for the reasons already pointed out.

In these cases 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 means 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, as these organs have, for one of their functions, the destruction of blood cells.

The sweating bath may be advantageously employed in many cases of dropsy of the abdomen and of the chest. Not infrequently absorption takes place 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.

654 It must be remembered that a cold application should 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. The remarks previously made with reference to cold applications after the sweating bath in cases of obesity are equally applicable to cases of dropsy. Respecting the application of cold in cardiac cases, it is only necessary to add that usually the cold-towel rub or cold friction, and, in persons sufficiently

strong and vigorous, the wet-sheet rub or the rubbing shallow bath, 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.

The Cold Bath in Renal Disease.

655 In cases of dropsy with renal disease also, cold applications must be administered with the very greatest care. If the application of cold be so intense as to produce the slightest indications of chill, it will be accompanied by congestion of all the viscera, and consequently increased activity of the renal disease. The cold douche and similar percutient applications must be entirely avoided. The cooling off after a hot bath must also be managed with great care. The best method of doing this is to wrap the patient in blankets after the hot bath, and cool the skin by cool or tepid sponging of limited portions of the surface, taking first one arm or leg, then the other, 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. If too strongly sedative effects are produced by the bath managed in this way, a tonic effect may be secured by supplementing the bath, after the general surface has been cooled and dried, by cold friction.

To avoid the possibility of taking cold, 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. The skin must be not only superficially dry, but thoroughly dried out by the evaporation of the absorbed moisture, as will be indicated by its condition of smoothness and firmness. By reason of the great liability to chilling after a warm bath, it is preferable in cases of renal disease that the patient should be confined to his room for several hours after treatment. It is better, on this account, to administer the treatment in the evening, so that the patient

may retire at once. By morning the normal equilibrium will have been so completely established as to obviate the risk of taking cold.

In cold applications following a sweating bath 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 part of the application should be made to the lower half of the body, the purpose of this 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.

The Sweating Bath in Icterus.

The sweating bath is of great value in icterus, both as a means of relieving the intolerable itching, and of aiding the elimination of bile. The electric-light bath is especially useful for this purpose. The sweating process should, however, in these cases be employed only until profuse perspiration is induced. The neutral bath should then be administered for twenty or thirty minutes, at a temperature of from 92° to 95° F. Very hot sponging frequently relieves pruritus when other measures fail.

656

Surgical Uses of the Sweating Bath.

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 relief thus afforded by a 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 tissues, the chief constituent of the ligaments which bind together the bony structures entering into the formation of a joint. Heat expands white fibrous tissue, thus relaxing the tissues.

The general sweating bath should be employed in cases of hernia not readily reducible by skilful taxis without the bath. The hot immersion bath is perhaps the most appro-

priate measure for this purpose, and has often proved very effective. The patient lies in the bath with the head (not the shoulders) raised, and the knees well drawn forward. After the bath has been continued long enough to induce active 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 the muscles controlling it, to secure the necessary relaxation of the muscles and ligaments.

Depurative or Eliminative Effects.

657 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 ordinarily eliminated through the urine may be, however, under some circumstances, carried off through the skin, is evidenced by the peculiar urinous odor noticeable when profuse perspiration is induced in a patient suffering from renal insufficiency.

The author has often seen most excellent results from the application of a 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 the removal of diseased uterine appendages.

658 The sweating bath is occasionally valuable as a means of averting or aborting a threatened attack of uremic convulsions. A patient under the author's care many years ago, who had for some years suffered from chronic Bright's

disease, discovered for himself that the characteristic symptoms of incipient uremic poisoning might be thoroughly controlled 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 by the application of cold in the form of 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; by cold over the heart, or by cold friction.

659 **Eliminative Baths in Toxemia.** The eliminative effects of the sweating bath may be resorted to with advantage in all forms of chronic toxemia due to the retention of tissue poisons, as gastric neurasthenia, migraine, jaundice, and chronic "biliousness." To be of the greatest service in these cases, however, 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 (**1020**), cold wet-sheet rub (**1216**), or cold plunge (**1108**). The electric light (**1250**) 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 made to a limited portion of the body when desirable, as in the treatment of exudates, the enlarged and stiffened joints of chronic rheumatism, pluritic adhesions in the chest, chronic peritonitis, and in certain forms of neuralgia, as sciatica.

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 resist-

ance, leading to the contracting of colds through slight exposures, by which the good effects of the treatment may be more than lost. With care, however, this may be avoided.

In diabetes with emaciation, and when the perspiration does not contain sugar, the sweating bath must be avoided, or at least used with extreme care. In cases of skin disease accompanied by painful eruptions, furuncles, or other evidences of extreme excitation and irritation, if the sweating bath must be employed, it should be in the form of the vapor, the Russian, the hot-water, or the electric-light bath. The Turkish and dry-air baths irritate the skin, while the wet-sheet pack is too exciting.

Expectorant Effects.

660 The mucous membrane is closely allied to the skin in its structure and functions. Thus, applications which produce general perspiration of the skin at the same time encourage increased activity of the mucous membrane, through its close sympathy with the skin. This explains the great relief experienced by persons suffering from a severe cold and obstruction of the respiratory passages within a few moments after entering a Russian or vapor bath. A dry, painful cough is quickly loosened and relieved under the influence of a warm bath; but if great care is not exercised, the condition is likely to be decidedly aggravated by a fresh cold acquired through the diminished vital resistance naturally resulting from the atonic reaction of heat. Persons suffering from hay fever, so called, and other forms of asthma are often quickly relieved by the Russian bath, but the distressing symptoms are very likely to return with redoubled force as the result of some inadvertent exposure, unless the cutaneous activity is maintained, which is likely to be very exhausting if long continued. This measure is useful only as a palliative. Cold applications are required for the tonic effects absolutely essential to permanent relief from chronic asthma. Hay asthma, of course, requires change of climate and the services of a specialist, as well as general tonic baths.

Local applications of vapor in the form of steam inhalations are also of great value in the treatment of those forms of throat, ear, and nose affections in which increased secretion is desirable, the expectorant effects of these measures being very marked.

The chest pack (**1373**) is an invaluable means of favorably influencing the pulmonary mucous membrane. In a febrile state, or acute congestion, do not cover with oiled muslin or other impervious material; but if chronic passive congestion is present, as in bronchial catarrh, apply an impervious covering, so as to procure more decided revulsive and derivative effects.

The expectorant effects of water, particularly in the form of the sweating bath, are often of service in breaking up a hard cold, if it is 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 attack, provided, of course, that sufficient precaution is taken against exposure to chill subsequent to the bath.

Water drinking, and especially the free use of hot water internally, is of the highest value as a means of encouraging activity of the skin and mucous membranes. A copious draft of hot water should always be taken before entering a sweating bath of any kind. Cold water may be substituted, if greatly preferred, provided it is not swallowed so rapidly and in such quantity as to produce a chill.

661 **Diuretic Effects.** The cold douche applied over the lower portion of the sternum has long been recognized as a means of stimulating the kidneys to activity. A short cold douche to the loins is effective in the same way.[27]

The cold trunk pack is also a very efficient method of stimulating activity of the kidneys. When used for this purpose, the pack may be confined to the central and lower portions of the trunk, the sheet with which it is applied

being wrung as 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.

Fomentations to the lumbar region may be advantageously employed in cases of renal insufficiency, and for the purpose of obtaining revulsive effects in cases of pain in the kidneys.

Cholagogic Effects.

662 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 epigastrium. The alternating douche is a more agreeable and in most cases an equally exciting measure. Where congestion or pain is present, the hot or Scotch fan douche, without pressure, may be substituted for the cold or the alternate douche (**1044**), or if the douche can not be conveniently administered because of the feebleness of the patient, or for any other reason, the fomentation may be substituted. The effect of the fomentation will be prolonged and intensified if followed by the heating compress.

In painful affections of the liver, fomentations repeated every two or three hours, with the heating compress applied during the interim, may be commended as a most efficient means of relieving pain and restoring the organ to its normal state. The hot douche and fomentation followed by 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

663 The cold douche (50° to 70° F.) applied over the region of the stomach by means of the horizontal jet with considerable pressure (20 to 30 lbs.), 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 alternate douche may be employed to better advantage than the cold douche in many cases. The author makes use of the circle douche or the percussion douche, which produces more pronounced effects than the ordinary horizontal douche. The percussion douche should be employed if possible, especially in the cold application.

664 The ice-bag over the stomach for an hour before eating is a most powerful peptogenic procedure, and is of the highest value in cases of atonic dyspepsia or apepsia and hypopepsia. The good effect of the treatment is quickly shown in improved appetite and digestive vigor.

The application of heat over the stomach for an hour or two after eating is also a peptogenic measure of high value. The constricted gastric vessels are thus relaxed and the anemic stomach provided with an abundant blood supply.

665 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 gastrorrhea, 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 over the region of the stomach. The heating trunk compress and the hot and cold trunk pack (**1367**), applied just before eating and retained for an hour or two afterward, are most excellent means for relieving gastric irritability and combating painful hyperpepsia.

666 **Emmenagogic Effects.** Of all methods whereby the menstrual function may be stimulated, hydric measures are both the safest and the most effective.

Perhaps the most powerful of all excitants of the menstrual function is the cold douche to the loins (horizontal jet or spray; temperature, 50° to 70° F.; time, 2 to 10 secs.; pressure, 20 to 40 lbs.).

The prolonged hot foot bath (temperature, 100° to 104° F.), the hot sitz (temperature, 100° to 104° F.), the hot

enema (temperature, 105°), the hot immersion, the tonic hip pack daily in the intermenstrual period, and the hot hip pack (temperature, 110°, 10 to 15 min.) 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.

Revulsive and Derivative Effects.

667 The revulsive effects obtainable by water constitute one of its most interesting and valuable therapeutic uses. This effect is nothing more nor less than a strong circulatory reaction localized in accordance with the indication present. The anatomical basis of this therapeutic action is the association of vascular areas in the skin with definite and well-understood visceral vascular areas. These associations have been elsewhere carefully pointed out, so that we need not here devote space to a lengthy description of them. It will only be necessary to point out the principle upon which the revulsive method rests, and the best methods of utilizing it.

As previously stated, applications of cold water to the surface of the body set up both *circulatory* and *thermic* reactions. In revulsion pure and simple, it is desirable to obtain only the circulatory reaction; hence the application 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, as in cases of passive congestion without pain (**673**).

668 When this circulatory reaction is produced in an area of the skin supplied by an artery, a branch of which supplies some deeper structure, as in the case of an inflamed muscle or joint, a congested nerve, or an alveolar abscess, a considerable amount of blood may be by this means diverted away from the inflamed or congested part, thus affording relief from urgent symptoms by producing a local hyperemia of the skin and a collateral anemia of the affected part. By continuous cold applications, local anemia and collateral hyperemia may be produced.

669 **Fluxion.** Fluxion, or movement of the blood, is one of the most important of all the functional modifications which may be affected by hydric applications. The permanency of chronic disease is generally due to a disordered state of the blood-vessels of the affected parts.

The most important thing that can be done therapeutically in relation to a chronically congested organ is to increase the supply of healthy blood, not necessarily by augmenting the volume of blood which the organ contains at any moment, but by quickening the rate at which the blood passes through it. This may be accomplished by increasing the energy and activity of the heart as well as the activity of the blood-vessels of the affected parts, and by concentrating the blood in the diseased organ by the use of appropriate measures.

The blood is the great healer. In the words of Holy Writ, "The blood is the life." It washes out of the tissues the waste and toxic products which they contain, and brings new vitalizing and energizing elements to take their place. The only way in which a diseased organ can be restored to permanent health is by complete renovation in its tissues, since function depends upon structure. This requires a tearing down and a rebuilding through increased movement of the blood and lymph.

670 **Revulsive Methods for Combating Superficial Anemia.** Some of the measures most useful for this purpose are, first, short cold applications followed by vigorous rubbing. The cold application must not be too long, otherwise the anemia will be increased; but the rubbing should be sufficiently prolonged and vigorous to insure thorough circulatory reaction, which is the end sought. The cold percussion douche, temperature 20° to 60°, duration 4 to 10 seconds, is most efficient. Cold affusion and other measures are efficient just in the proportion in which mechanical and thermic effects are combined. When the anemia is general, the cold bath should be preceded by the incandescent electric-light bath or some other form of hot bath, from 3 to 5 minutes, or

a sufficient time to heat the skin, as in these cases the heat-generating powers of the body are lowered, and the abstraction of heat is not well borne. The application should be intense, as a douche at high pressure, vigorous wet-sheet rubbing, or a vigorous shallow bath of short duration. The temperature may be, for the general douche, 60° to 70° F.; the shallow bath, 70° to 75°; the wet-sheet rub, 60°.

The hot and cold compress is a powerful revulsive measure; the heating compress, preceded by a fomentation or rubbing of the parts sufficiently prolonged, is also very efficient. The compress should be covered with flannel, but with no impervious covering, so that the slight cooling effect produced by evaporation may maintain vigorous skin activity, and prevent superheating and resulting vascular paralysis. Fomentations at a temperature of 104° to 106°, prolonged from 15 to 20 minutes, is another valuable means in many cases. The fomentation should not be too hot, as Max Runge has shown that prolonged application at a temperature above 104° produces paralysis of the small vessels, with turgescence from slowed movement of the blood. What is desired is not paralysis and congestion, but activity of the vessels. In anemia there is intense tonic spasm, which is ordinarily overcome by the relaxing effect of heat; but if the heat is at too high a temperature, or the application too prolonged, the vessels of the parts may be paralyzed instead of energized. Increased activity through vital stimulation of the tissues is the end sought by hydric applications, and this object may be readily attained by the varied means suggested, which individually meet the peculiarities encountered in the treatment of special cases.

Methods Adapted to Anemia of Deep-Seated Organs.

In deep anemias, general cold applications are of special service, especially when many of the large viscera are involved in the morbid state, a condition which, though generally overlooked, is, in the opinion of the author, of very frequent occurrence. Tonic spasm of the vessels set up

by the irritation resulting from these anemias is usually due to a strain upon the sympathetic nerves occasioned by prolapse of the stomach, colon, viscera, and other forms of visceral displacement. Contraction of the muscular walls of the hollow viscera, such as the colon, resulting in obstinate constipation, as well as contraction of the visceral blood-vessels, is not an uncommon condition due to this cause.

671 Renal insufficiency, hepatic inactivity, and functional feebleness of all the viscera are also conditions due to this cause. Amenorrhea is another illustration often encountered of anemia due to vascular spasm. In these cases the condition of the viscera is precisely the same as that of the feet and hands of the nervous dyspeptic, which are often pale, cold, and bloodless, not because of feebleness of the heart, but because of vascular spasm.

For the relief of conditions in which there is general visceral anemia, as in enteroptosis, nephroptosis, gastroptosis, and atony of the pelvic viscera, general cold applications, such as the douche at 80° for 30 to 60 seconds, the shallow bath at 80° to 85° for 5 to 6 minutes, the tonic half-pack, cold friction, and the wet-sheet rub, are means possessed of wonderful curative power. Very low and very high temperatures must be avoided on account of excessive excitation of the skin. What is desired is moderate fluxion between the surface and the interior of the body, with general increase in the movement of the blood and moderate concentration of the blood in the internal viscera. This *retrostasis*, if excessive, may be followed by reaction, leaving the parts in a condition of greater anemia than before.

Such local anemias as occur in amenorrhea, and also in general atony of the genitals, indicated by coldness of the external parts, and infantile uterus, are combated by ice-bags and ice compresses to the spine. A very cold lumbar douche, a cold douche to the hypogastric region and the inner surfaces of the thighs, and the tonic pelvic pack may be advantageously used in most cases. In amenorrhea, the best results

will be obtained from the measures named, supplemented by vaginal irrigation at 110° for 10 minutes and 80° for 1 minute. In the treatment of these visceral anemias it is not only important to concentrate the blood in the affected part, but to increase the activity of the entire circulation of the body by improvement in its general conditions, so that the whole vital tone may be elevated and the blood supply increased.

Hydriatic Measures for Relief of Deep Congestions.

672 Visceral congestion is illustrated in gastro-duodenal catarrh, intestinal catarrh, infectious jaundice, splenic and hepatic congestion, congestion of the spinal cord, menorrhagia, subinvolution and general relaxation of the uterus and appendages, congestion of the prostate, catarrh of the bladder, catarrh of the rectum, hemorrhoids. Congestion of the sympathetic ganglia, giving rise to hyperesthesia and vascular spasm of the parts supplied by these ganglia, as indicated by tenderness of the epigastrium and the umbilical points (**168**), is a condition responsible for a great variety of morbid phenomena expressed for the most part in remote symptoms rather than by local indications.

For pelvic congestions, very hot fomentations or a hot douche administered to the lumbar spine and the inner surfaces of the thighs, render invaluable service. For congestion of the spine, fomentations, followed by the heating spinal compress (**1355**) covered with flannel only, is an excellent measure, especially in cases in which spinal congestion and irritation coexist.

In deep passive congestions, alternate hot and cold compresses may be applied to the related cutaneous area, followed by a heating compress covered with flannel, to be changed once in 40 minutes. By this means the dilated blood-vessels of the congested parts are made to contract and relax alternately, so that the organ is emptied of its venous blood, and the muscular walls of its vessels, being fed by fresh blood, are better prepared for vigorous and sustained contraction under the influence of the cold compress.

In the treatment of acute inflammation, whether near the surface (but not involving the skin) or affecting a deeply seated viscus, great care must be observed to avoid such procedures as may cause increased fluxion of blood toward the inflamed organ. For example, in inflammation of a muscle, a cold application over the affected part will cause local anemia of the skin and collateral hyperemia of the inflamed tissues, thus aggravating the condition, unless the application is very intense in character, as an ice-bag or an ice poultice long continued. The fomentation, on the other hand, by producing hyperemia of the skin, causes collateral anemia of the muscle, and so relieves pain. A simple compress at 60°, changed every half hour or every hour, succeeds better than very cold applications, maintaining after fluxion through reaction, while to a degree reflexly affecting the inflamed area in a favorable way through vasomotor influence.

In the case of deeply seated inflammations, prolonged applications to the associated cutaneous areas, with renewals every 20 to 40 minutes, succeed better than continuous very cold applications, as renewed contraction is produced at each renewal, thus maintaining both the vessel tonus of the affected part and an active fluxion of healing blood through its vessels.

The term revulsion is perhaps most properly applied to effects produced in an internal organ, as the abdominal viscera or the brain, by applications to a cutaneous area in reflex relation therewith. In relation to these effects it may be sufficient here to remark that the vessels of the internal area are, in general, affected in the same manner as those of the skin. A short cold application causes temporary contraction of the vessels of the skin, and likewise of the associated internal vascular area, and is quickly followed by reaction, with dilatation of the vessels of both areas.

A prolonged cool application causes continuous contraction of the vessels of both the external and the internal associated areas.

Very hot applications produce effects similar to those of cold applications. Warm applications produce little or no reflex effects.

Very hot applications to the abdominal surface afford the most efficient revulsive means of relieving visceral pain in this region of the body, whether the pain is neuralgic or inflammatory in character; but the application must be very hot (115° to 130°), and the high temperature must be maintained by frequent renewal of the application. The surface vessels become filled with blood by exhaustion of the constrictors through the accumulation of heat in the skin; but the internal associated vascular area is constantly cooled by the blood currents passing through it, so that the first, or vasoconstricting, effect is maintained.

From the above it is evident that we must depend upon very cold, cold, cool, hot, or very hot applications for producing revulsive effects. Neutral or warm applications are incapable of awakening the nervous activities which are the essential factor in this class of hydriatic effects.

673 **Simple Revulsive Effects.** For purely revulsive effects, we seek to obtain results very different from those which follow a short cold application, but we 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 thermic reaction.[28]

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 frequent failure of attempts to employ water for revulsive effects. The physician or attendant who knows how to apply, under varied circum-

stances, hydriatic measures so as to produce the best revulsive effects, is an adept in the employment of water for curative purposes, and is entitled to be called a hydrotherapeutist.

674 The true 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 bag, 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° F. 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.

The revulsive effect of heat is often inconvenient, however, in cases in which it is necessary to extend the application to a very large area, or to the whole surface of the body, for the reason that such extensive applications of heat give rise to excitation of the cerebral and spinal centers, which interferes with the application, and produces untoward effects.

675 Revulsive effects are also obtainable by the application of cold, but in revulsion by cold a strong thermic reaction is set up in connection with the desired circulatory reaction, which is often most undesirable and injurious. 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 the thermic reaction may be either 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 be followed by a suitable cold application so adjusted and manipulated as to absorb just the amount of heat which has been absorbed by 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 only when the temperature of the skin is lowered 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 balance exactly 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 more 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 an active dilatation of all the surface vessels, both arterioles and venules, thus producing a quickened circulation through the skin rather than stagnation.

This effect of cold, in increasing the circulation of the 676
blood through the skin and dilating the small arteries as well as the veins, gives rise to a crimson or bright-red color, which is easily distinguished by a practiced eye from the dusky hue resulting from a hot application.

It is evident that if an application of cold follows 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 in the employment of revulsive measures, showing just the right instant to check the cold application in order to secure a purely circulatory reaction and wholly to suppress all thermic reaction.

A little practice is required to enable one to distinguish, at a glance, the color produced by reaction to heat from that produced by reaction to cold. It is, of course, evident that 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. The time usually required with the cold douche is ten to fifteen seconds.

In the employment of heat for revulsive effects, the result will be (within certain limits) as much more intense as the temperature is high and the application prolonged. The maximum effects are usually reached in from ten to fifteen 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.

677 **Revulsion by Means of Hot and Cold Applications.** In the production of revulsive effects by the combined use of heat and cold, the effects will be 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 from 115° to 130° F., though a temperature of from 110° to 120° 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 aspersions, and made in rapid succession upon different portions of the surface. In the alternate douche a temperature of from 50° to 60° 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.

Revulsive effects may be produced either by percutient or non-percutient applications, or by a combination of percutient and non-percutient means ; for example, revulsion to the lower extremities may be obtained by a very hot foot or leg

bath followed by a cold douche, as well as by the hot and cold douche. The leg or foot bath may be of seven to ten minutes' duration, but generally an 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. Equally good effects are obtained, and somewhat more speedily, by the employment of the hot douche, especially the vapor douche, preceding the cold douche. Three or four minutes will suffice for the hot application, and from ten to fifteen seconds for the cold application.

When neither hot immersion nor the cold douche can be employed, a fomentation followed by a cold compress or cold friction may be used. The latter is an excellent measure in the case of bedridden patients. When the skin surface to be acted upon is so sensitive that percutient applications can not be tolerated, a towel wrung as dry as possible out of very cold water should be applied for twenty to thirty seconds after a fomentation.

One of the most generally useful of all the various revulsive applications which can be made is the revulsive Scotch douche, which consists of a very hot horizontal jet or spray for three or four minutes, followed by a very cold douche from five to fifteen seconds.[89]

Revulsion as an Analgesic Measure.

678 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 explained. 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.

The Scotch douche may be used with equal success in neuralgia in other regions, though sometimes with less convenience. In cases of neuralgia accompanied by extreme sensitiveness of the skin, strong pressure must be avoided; in some cases, also, extremes of temperature give pain. In such cases the neutral douche with little pressure (3 to 5 lbs.) must be used until the surface pain is lessened, as a preparation for the Scotch douche, which should at first be employed at very moderate temperatures, and with little pressure, both temperature extremes and pressure being progressively increased as tolerance is established.

679 **Analgesic Effects of the Scotch Douche.**

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 may be employed. For enteralgia and gastralgia, apply the fomentation for 10 or 20 minutes.

In chronic visceral congestion, the Scotch revulsive douche may be administered to those 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 the Scotch douche or by a hot leg or sitz bath, followed by a short cold application.

When it is desirable to produce revulsion in the opposite direction, the Scotch douche may be administered to the upper part of the back and the arms. Such an application is often useful is cases of pelvic congestion or hemorrhage, while at the same time efforts are being made to reduce the congestion of the affected parts by other suitable measures.

The Hot and Cold Trunk Pack.

This ingenious hydriatic application, first described by Winternitz, is one of the most valuable of all revulsive measures. It is especially

sociated with hyperesthesia of the great abdominal sympathetic centers. The various forms of the hot and cold compress, and their several applications, will be found fully described elsewhere.

General Revulsive Effects. 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 combating 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 a hot one, 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. 680

The lumberman brings the blood 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. In accordance with this idea, it has been the practice from time immemorial in Persian cities to place upon every street-corner vessels of water during epidemics of cholera; and if a person falls upon the street, the bystanders immediately deluge him with water, and rub the whole surface of the body with the greatest vigor.

The author 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 or alternate it with a hot application. In this manner both an excellent circulatory reaction and simultaneously a calorific effect may be obtained.

The hot immersion bath may sometimes be used with advantage as a revulsive measure for the relief of visceral congestion, as in acute nephritis, especially in the nephritis

of scarlet fever. It is equally useful in cerebrospinal meningitis. The hot-blanket pack may be successfully used in the same conditions. Care must, however, be taken to guard the head by a large towel saturated with cold water; and if the heart is feeble, or seems unduly excited, it should be protected by an ice-bag placed over it during the bath, or by a cold chest compress.

681 When the suppression of 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; the alternations should be eight or ten in number. The application may be renewed several times a day, or as frequently as 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, the measure being adapted to the case in hand.

The alternate douche differs from the Scotch douche in that it is primarily exciting rather than calmative or sedative in its effects. It is one of the most exciting of all hydriatic applications. Nevertheless, it often relieves pain by its powerful revulsive effects.

682 **Derivative Effects.** So-called derivative effects do not differ essentially from revulsive effects, except that they are generally somewhat less intense in character, and the term is applied to the relief afforded a congested organ by diverting the blood into a distant part, as in relief of cerebral congestion by a hot foot bath. All the measures suggested for producing revulsive effects are equally useful for inducing derivative effects. Ordinarily, however, it is not necessary to avoid thermic reaction in producing derivative effects. Any measure whereby the blood can be drawn

into a part distant from the congested part to be relieved may be utilized for this purpose. The most generally useful procedures are the following: The hot leg bath; hot sitz; short cold sitz; rubbing sitz; leg pack; half pack; hot, cold, or alternate douche to legs or arms, as may be indicated; cold friction; rubbing shallow pelvic pack; heating abdominal compress. General derivative effects may often be advantageously procured by the wet-sheet pack, the rubbing wet sheet, and general cold friction. Derivative measures are of the greatest possible service in the treatment of insomnia, pulmonary congestion or hemorrhage, apoplexy, acute mania, and cerebral congestion.

By a reversal of the method, cerebral anemia may be 683
combated as successfully as the opposite state. For example, a short cold douche to the feet powerfully stimulates the circulation of the brain, and the short cold douche to the lumbar region and feet is an excellent means of combating amenorrhea.

In this connection may be properly mentioned an important application of the principle of derivation which may be utilized by one skilled in hydriatry to most excellent advantage in the use of the cold douche and many other general cold applications.

It will be recalled that the contraction of the surface vessels set up by the application of cold water is accompanied by a similar but 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 and dilatation quickly follow if the cold application is a short one, — more quickly, in fact, in 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, and because of the inrush of blood from the surface to the interior of the body.

When the application is made to a circumscribed portion of the surface, the reaction which follows, both external and internal, is likewise circumscribed, and particularly as regards the viscus or viscera associated with the area operated upon, which may be the stomach, 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 an outward indication of the quickened activity in the internal parts under the influence of the application.

684 While this vascular and cellular activity is sometimes desirable, it must often be suppressed as much as possible. When, in such cases, general cold applications must be made, any part that is likely to be damaged by the congestion following the first contact of cold water with the skin, may be protected by the application to the cutaneous area associated reflexly with the part, of water at a lower temperature than that to be used in the general application, or in case the douche is used, both lower temperature and higher pressure may be employed. The effect is to cause so vigorous a primary contraction of the visceral vessels that the part will be protected against the mechanical distension arising from the sudden inrush of blood from the surface when the general application is made. The brain should be always thus protected before either a cold or a hot bath, by bathing the face, neck, and scalp with cold water, and applying a cold wet towel. The liver, when congested, may be protected by a short hepatic douche before the general douche. Congested pelvic viscera should be protected by the douche to the lumbar region and the thighs. In pulmonary congestion, the douche should be first applied to the arms, and then generalized. The brain and lungs may also be protected by a preliminary Scotch douche to the legs. The

hydriatist must have in mind all these interesting and important principles of protection and adaptation, and the facilities for applying them at command, if he would avoid many most unnecessary and unfortunate failures in the use of general cold applications.

Resolvent Effects.

685 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 obtainable by means of it are highly valuable. Similar effects, though less vigorous, may be obtained by non-percutient applications, such as the fomentation followed by the heating compress, or by alternate hot and cold compresses, the alternate pail douche etc. In the employment of alternate hot and cold compresses or other applications for resolvent effects, the length of the hot and the cold applications should usually be approximately equal, about fifteen seconds each.

When the part under treatment is painful, the hot application should be somewhat prolonged, the times of duration being as follows: Heat, 60 seconds, cold, 15 seconds; or heat, 2 minutes, cold, 15 seconds. By this means strongly resolvent effects may be obtained, while at the same time pain is mitigated if not wholly relieved.

Alterative Effects.

686 The multiple reflex activities 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 these are quite unequaled by any other known therapeutic 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 there may be something 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 embarrassing obstacles, an opportunity to organize her resources and to

set in operation favorable vital processes or recuperative actions.

The alterative effects of water are obtained by the cold douche, the alternating douche, the wet-sheet pack, the full or immersion bath, sweating procedures, and in fact nearly all general applications, both hot and cold. The most effective, however, are cold applications, and especially those accompanied by strong percussion, as the horizontal douche or spray. The percussion douche and the massage douche are perhaps the most powerful of all means for producing general 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, headaches, and neurasthenias. In fact, the alterative effects of cold water may be regarded as among the most important and fundamental means by which this agent proves serviceable in the treatment of the majority of chronic affections.

687 **Calorific Effects.** Local heating or calorific effects may be obtained by various hydric procedures, one of the most efficient being the short cold douche with strong pressure. The colder the water and the higher the pressure, the greater the calorific effect produced. If the application be greatly prolonged, the ability of the tissues to react may be exhausted, and then the effect becomes sedative instead of exciting. The aim in an application of this sort is to produce as decided thermic reaction as possible (**460**). Short cold applications produce local calorific effects.

The heating compress is an excellent measure for this purpose. The compress must be wrung very dry, out of very cold water, and should be well covered first with flannel and then with mackintosh or some other impervious material.

The heating compress managed thus not only stimulates heat production, but diminishes the local elimination of heat, and is thus very appropriately named.

Cold friction of a part, either with the hand or with the friction mitt, is an efficient means of stimulating local heat production.

Immersion of a part in cold water for a short time (15 secs. to 3 min.) is a successful calorific measure if accompanied by constant and vigorous friction.

Prolonged hot applications, as the hot bag or the fomentation, are important means not only of accumulating heat, but of stimulating local heat production. The local hot air, vapor, or electric-light bath are also invaluable means of local calorification. The special apparatus required for this purpose are described elsewhere in this work (**1250**).

In the use of the local electric-light bath for purely calorific effects, lamps with red globes or covered with red screens may be used instead of the ordinary clear-glass globe so as to exclude the chemical rays; but this is scarcely necessary, as the actinic effects of the incandescent ray is very feeble. (It may perhaps be questioned whether hot applications are not direct or primary rather than secondary excitants of thermic action. This is a matter for further study.)

Applications capable of producing local calorific effects are **688**
indicated in all cases in which it is desired to quicken the functional activities of a part. Heat production is so intimately associated with all other forms of vital activity that it may be considered as a good measure of vital action in general. A subnormal temperature means vital depression, whether general or local. By increasing the calorification of a part, we at the same time increase its activities in all directions,—glandular, nervous, catalytic, etc. Calorific measures are thus applicable in all cases in which there is need of increased local activity of any kind. They are very generally useful, and form the basis of many of the most important of the various therapeutic uses of hydric procedures.

Calorific measures, both general and local, are of great service in preparing the body for cold applications. For this purpose, heat is generally preferable; but we may also employ friction with water at a temperature lower than that of the proposed application.

C. SEDATIVE EFFECTS.

689 A sedative is an agent which moderates the abnormally increased action of an organ or set of organs. There are three general classes of sedative effects which are therapeutically indicated: —

1. *Sedative of the circulatory system.*
   - *a.* Antiphlogistic
     - (*a*) **Vascular.**
     - (*b*) Cardiac.
   - *b.* Hemostatic.
2. ***Sedative of the nervous system.***
   - *a.* Hypnotic.
   - *b.* Calmative.
   - *c.* Antispasmodic.
   - *d.* Analgesic.
   - *e.* Anesthetic.
3. ***Sedative of metabolic activity.***
   - *a.* Antithermic or Antipyretic.
   - *c.* Antifebrile.

Sedative applications and effects may be either general or local. Antiphlogistic and hemostatic remedies are usually employed for 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 depressant 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 hydriatic 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 has so well defined as "irritable weakness," — is made to disappear under the tonic influence of cold applications systematically employed.

Sedative effects may be obtained — **690**

1. By cold applications.

2. By warm applications; and in two ways by each class of measures.

Sedative effects may be obtained by *cold* applications: —

(*a*) By restoring nerve tone through the use 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 92° (immediate effect). Water at a temperature below 92° produces at first an excitant effect, through arousing the resistance of the body, the thermic reaction provoked extending to every cell and tissue of the body. If the application be 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.

Sedative effects from *warm* applications may be produced in two ways, as follows: —

(*a*) Short applications of hot water, which produce an excitant or stimulant effect, followed by an atonic or asthenic reaction, the reverse of the reaction produced by cold.

(*b*) By prolonged applications of water at a neutral temperature, from 92° to 97° F.

The leading sedative effects which are obtainable by water, and the most convenient methods for obtaining them are the following: —

691 **Sedatives of the Circulatory System.**

The effect of cold, when directly applied to the skin, 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 may 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 active dilatation of the small vessels, both venules and arterioles, giving rise to a greatly increased rate of flow of the blood current throughout the whole system.

For the suppression of tonic reaction, it is necessary —

1. That the cold application should be prolonged.

2. That percussion and friction should be 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, continuing 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 after withdrawal of the heat is followed by prolonged contraction. A prolonged application of cold and a short application of heat are alike in producing at first stimulation, later sedation. The fully developed effect of *cold* is *sedative*, while that of *heat* is *stimulant*. The subsequent, or reaction, effect of *cold* is *excitant*, or *tonic;* of *heat*, *depressant*, or *atonic*. This is true of all forms of functional activity, since all vital activity depends upon blood supply and blood pressure.

Sedative Applications Useful only when Well Borne.

Sedative baths are beneficial only when well borne. Weakness after the bath, secondary 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 hot application was too intense or prolonged, or that the concluding cold application was not employed for a sufficient length of time to obliterate the exciting effects of the heat.

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 employed for any considerable length of time, and often untoward effects follow immediately upon their use.

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 all hypnotic drugs are poisons, and capable of doing great mischief if habitually used. The neutral bath at bedtime is worth more as a genuine and efficient hypnotic than all the medicinal agents known to pharmacy.

All the medicinal *heart sedatives* are toxic agents, which may produce highly untoward or even fatal effects. There is no drug sedative which can be used for any considerable length of time that will not produce injurious effects.

Water, on the other hand, may be made to produce prompt and highly sedative effects without leaving behind any damaging influence.

By cold applications the pulse rate may be reduced from 692
150 to 100 beats per minute, and the volume of blood in a part reduced 20 tiı ies.

693 **Nerve Sedative Effects.**

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 circulatory system is controlled by the vasomotor and sympathetic nerves. It is not easy, in fact, to distinguish definitely between circulatory and nerve sedatives, though for convenience we may specially designate by the latter name those measures which are particularly helpful in lessening the activity of the cerebrospinal system of nerves. Measures of this sort are usually classed as *hypnotic*, *calmative*, *antispasmodic*, *analgesic*, and *anesthetic*.

For hypnotic or general sedative effects there is no measure superior to the warm bath, which should be employed at a temperature of 92° to 97° F., and may be continued from 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 given very cold, but at a temperature of from 70° to 75° F. The sheet should be wrung very dry, and the patient should not be too warmly covered, in order that the tendency to perspire may be avoided.

The broken jet douche at 85° to 92° F. for three minutes, the ice-cap or cold compress to the head, the evaporating head-cap, revulsive compresses to the spine, are measures of the highest value. The alternate application to the spine may consist of compresses, hot and cold sponging, the alternate hot and cold pour, or the alternate hot and cold douche. Avoid percussion effects or shock from too strong impressions, the effect being to excite the 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 one which is much relied upon in Germany as a brain sedative for the relief of insomnia. The wet girdle, or Neptune's girdle, owes its hypnotic effects to the diversion of a large amount of blood into the portal veins, whereby the brain is relieved.

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 quieting the patient when other measures fail, and obviating the need of drugs also in the delirium of typhoid fever, especially when the skin is hot and dry, but the temperature not excessively high.

The spinal pack (**1355**) is a valuable means of combating insomnia, when spinal irritation is a marked symptom.

Local Analgesic Effects.

For local quieting effects the neutral rain douche, from 5 to 15 minutes, with little pressure, is a means of great value. In cases of locomotor ataxia, sclerosis of the spine, and in neurasthenia with marked exaggeration of the deep reflexes, the warm fan douche (92°) to the spine, from 3 to 15 minutes, will usually be found highly useful. The heating compress also proves highly serviceable in cases in which a circumscribed irritation exists without inflammatory action or active congestion, as in hyperesthesia of the lumbar ganglia of the abdominal sympathetic or of the solar plexus. **694**

The pain of circumscribed acute inflammations and certain neuralgias accompanied by inflammatory conditions is frequently relieved in an almost marvelous manner by the prolonged cold compress, the ice pack, or the evaporating compress. As a rule, the cold application should be moderate in degree (60° to 70°), and continued for several hours if necessary. After the acute stage of the onset is passed, fomentations should be employed for 10 to 15 minutes at intervals of from 2 to 6 hours, and the cold compress should be exchanged for the cool compress (60°) every hour, well covered with flannel.

For chronic pains, revulsive applications (**678**) are the most generally useful. Derivative applications are useful in both acute and chronic painful conditions (**1341**).

Hot applications may be continued for hours, if necessary to control pain, in nearly all cases except those in which the pain is located in the head or the eyes. As a rule, however,

it is wise to remove the hot application once an hour, applying in its place a tepid compress for a time, or, what is better in many cases, a towel wrung as dry as possible out of very cold water, for half a minute. In applications to the head and eyes the hot application should be interrupted by a short cold compress at least once every thirty minutes, and often better results are obtained by a change every ten minutes.

The pain of pleurisy is best relieved by very hot applications, as fomentations, a rubber bag filled with hot water, hot bricks, hot sand-bags, or similar means. The same means may be employed for the relief of pain in the stomach, as in colic, gastralgia, gastric crises, also in hepatic colic, renal colic, and other painful affections. For the relief of pain, the fomentations should be as hot as can be borne (140° to 160°).

In chronic cases and in deep-seated acute inflammations the heating compress renewed every half hour (60°) with fomentations for 15 min. every two to four hours is a better method than continuous heat.

Pain in the bowels, when not due to inflammation, generally yields to large fomentations; the hot enema, however, is highly useful in a large proportion of cases in which the pain is not of an inflammatory origin, as in the case of intestinal colic, enteralgia, and pain due to hyperesthesia of the abdominal ganglia, also in renal and hepatic colic.

Fomentations are also useful when the pain in the bowels or abdominal region is due to local inflammation of some sort, as enteritis, colitis, peritonitis, or other inflammatory affections of the abdominal or pelvic viscera, but should not in these cases be long continued. The temperature should be as hot as can be borne; but the application should not be continued more than 15 or 20 minutes, when the cool compress should be applied for an hour or two, after which the fomentations may be again renewed.

The hot enema is valuable in some cases in which the pain is due to inflammation, as in inflammation of the ovaries or tubes. This application may be repeated two or three

times a day. The quantity of water introduced at once should not be more than one or two pints after the bowels have been emptied, as the application is designed for the lower pelvis. The water should be retained for five minutes, when it may be allowed to escape, and a fresh quantity introduced, this being repeated from 3 to 6 times. It is not necessary to remove the rectal tube. By detaching the tube from the fountain, and lowering the end, the water may be allowed to escape into a suitable vessel, as directed for the cold enema.

The patient should lie upon the back, to avoid filling the colon at a higher level than is necessary. In most cases hot irrigation by means of the author's rectal irrigator (page 902) is preferable to the enema.

The pain of hemorrhoids and rectal ulcer generally yields to fomentations applied over the inflamed region. A very hot sitz bath is also effective in cases of this sort. The water need not be more than two or three inches deep, but should be as hot as can be borne, the temperature being gradually raised, after the patient enters the bath, to 115° or 120° F. The pain of inflamed hemorrhoids is sometimes best relieved by an alternation of heat and cold. In cases in which there is great pain at stool, relief is often experienced by sitting over a pail or slop-jar half filled with boiling water while moving the bowels. The hot steam relaxes the muscles, and exercises a powerful analgesic effect upon the painful tissues.

A short, very hot sitz bath (112° to 120°) is a most excellent means of relieving chronic pelvic pain. The duration should be from 3 to 5 minutes, and it should be instantly followed by a dash of cold water upon the hips or rapid cold friction of the parts. This is a most excellent and serviceable analgesic measure, and may be advantageously employed in chronic ovarian and uterine pains, painful affections of the rectum, and chronic inflammation of the prostate.

The pain of sciatica and other forms of neuralgia is best relieved by either revulsive applications, which may consist of very hot fomentations continued for 15 or 20 minutes,

followed by a well wrung, very cold compress for 30 to 60 seconds, or by cold friction. The Scotch douche is, however, probably the most effective of all means which can be employed for the relief of sciatica. The hot fan douche should be applied with moderate force at a temperature of 120° to 130° F., or as hot as can be borne, over the lower part of the back and along the track of the affected nerve. The hot application should continue for 4 or 5 minutes, being immediately followed by a very cold jet (50° to 60°), broken when the skin is sensitive, or the fan douche, continued from 6 to 10 seconds.

The prolonged leg pack following a fomentation (**1313**) is an analgesic measure of great potency and value in cases of sciatica and crural neuralgia.

The pain of congestion, as congestive headache, is best relieved by rubber bags filled with ice, or the ice compress. The application may be made not only to the head, but to the face and about the neck, with excellent effect. Indeed, ice-cold water is in all cases an excellent remedy for the relief of inflamed parts, as inflamed hemorrhoids, painful wounds, burns, etc. Cold irrigation with water at a somewhat higher temperature, 60° to 70° F., is almost equally effective, and often more convenient and agreeable.

For the pain of sprains and bruises administer very hot applications, followed by cold compresses or ice-bags. The fomentation may be renewed every two or three hours for 15 minutes, cold compresses being maintained in the interval.

For the relief of painful affections of the eye, either hot or cold applications may be employed, according to the case. In pain due to inflammation of the lids, very thin cold compresses are most efficacious, the compress being kept cold by evaporation, stimulated by fanning, either with an ordinary fan or the electric fan, or by dripping on ice-water. A very good plan is to have two sets of compresses, cooling them by laying upon a block of ice, so that a fresh cool compress is

ready for immediate use when the one in contact with the tissues, having become slightly warm, is removed.

Painful affections of the eyeball are generally best relieved by very hot applications; but heavy fomentations, bags filled with hot water, and similar hot masses should never be applied to the eye. Instead, thin compresses should be employed, not more than five or six thicknesses of cheese-cloth, three or four inches square; these should be wrung out of very hot water and applied to the eye, covered, and changed every 1 to 2 minutes. The application should not be continued long without a brief cold application. A good plan is to apply heat for 3 to 5 minutes, then cold for 15 to 30 seconds. By these applications to the skin over and about the eye, a vigorous revulsive effect with collateral hyperemia of the skin is produced, and the pain thus relieved.

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 author was involved in a serious railway wreck in a Mexican desert, he succeeded in bringing almost immediate relief to two badly scalded porters by wrapping their burned legs in wet sheets, which were kept cool by pouring water over them continuously. In ten minutes the poor fellows, who had been writhing and groaning in agony, were almost entirely at ease, and both secured a good night's rest.

For the relief of pain in conditions unaccompanied by inflammation, fomentations, the local hot douche, the revulsive douche, and other revulsive and derivative applications are generally most effective. Dry heat is sometimes more serviceable than moist heat. Occasionally, alternate applications are most efficient. The fomentation, followed by a heating compress to be worn overnight or for several hours, is also a means which can be highly commended in this class of cases.

695 **Anesthetic Effects.** 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 the numerous classes of nerve filaments which it contains, and especially of the sensory nerves, is diminished to a marked degree. Thus the application of ice for a few minutes will almost completely abolish sensibility in the part. By the employment of freezing mixtures of salt and ice or an ether or rhigolene spray, the skin and subjacent parts may be so benumbed as to render minor operations painless.

696 **Antispasmodic Effects.** For true antispasmodic effects we are obliged to rely wholly upon applications of such a temperature that the exciting effects of both heat and cold are avoided. The neutral full bath 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 97°, duration from 15 minutes to an hour or more. This is a sovereign remedy for hysteria, and will usually avert a threatened attack if perseveringly employed.

The neutral fan douche, which is especially serviceable in cases of nervous agitation with insomnia, should be given at a temperature of 95° to 97°, duration 1 to 5 minutes.

The neutral fan douche and the hot bath should be employed only as an introductory or palliative measure, to be followed by tonic applications as rapidly as the patient can be trained to endure them.

Local antispasmodic effects may be obtained by the application of the neutral douche, warm (not hot) compresses, the neutral pour, and when the extremities are involved, by the neutral spinal douche, without pressure, or the spinal pour.

In constipation due to spastic contraction of the colon or the anus, and in gall-stones and renal colic, hot fomentations, the hot sitz, and the hot enema are measures which rarely fail to give satisfactory results.

Hemostatic Effects.

697 The sedative 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 oozing, plugging the nostrils with ice in epistaxis, the ice-cap in apoplexy, swallowing ice pills in hemorrhage from the stomach, the application of the ice pack to the loins in hemorrhage from the kidneys, the ice-bag or compress over the abdomen in case of hemorrhage from the bowels, and the application of ice-cold compresses to the vulva and perineum in uterine hemorrhage.

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 involves dilatation of the vessels, and defeats the object sought. Hence the applications must be absolutely continuous. If compresses are employed, a freshly cooled compress must be ready for instant application when the warm one is removed.

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 140° to 160° F. is a most efficient means of checking capillary oozing. This means of controlling hemorrhage is very generally 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 from 125° to 130° F. to the interior of the uterus will almost instantaneously control uterine hemorrhage. The application must not be longer than 4 or 5 minutes, for, as shown by Runge, prolonged very hot applications produce paralysis of the uterine vessels, with stasis. Cold applications following hot often produce the best results.

Heat may also be applied to the uterine cavity by means of a hollow metal sound (**1416**), through which a stream of hot water is allowed to flow. The author has made use in this way of water at a temperature of 160° with advantage. Cold may be applied in the same manner.

698 **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, a felon, an acutely inflamed joint, a pneumonia, a pleurisy, a peritonitis, an iritis, a phlebitis, an erythema, and also a circumscribed erysipelatous inflammation.

In the use of antiphlogistic measures, the various conditions involved in local congestion or hyperemia must be constantly kept in mind. The hyperemia may be due either to mechanical injuries or obstructions, or to vasomotor disturbances. The several conditions which should be especially noted and provided for in the arrangement of a hydriatic prescription, together with the appropriate measures for use in the conditions named, may be briefly mentioned as follows: —

1. Mechanical congestion of the viscera in cardiac insufficiency and certain forms of valvular incompetency.

2. Congestion of the organs connected with the portal system from hepatic sclerosis.

3. Hyperemia from the pressure of a tumor or other morbid growth, or mechanical obstruction, as in congestive headache due to overloaded bowels from enteroptosis or other cause.

4. Vasomotor spasm in some other portion of the body, proximate or remote, causing congestion by retrostasis.

5. An atonic or paretic state of the vaso constrictors of the affected part, as in solar erythema, erysipelas, and other inflammations.

6. Overstimulation of the vasodilators through visceral irritation or some other reflex influence, as in cerebral congestion due to digestive disturbance or to pelvic disorder.

Each of these conditions requires a careful adaptation of special hydriatic measures, either palliative or curative as may be possible in a given case. According to the indications in each of these several classes of cases the following among other means may be suggested: —

1. Improve the heart tone by a cold compress to the pericardium for half an hour three times a day. Energize the peripheral heart and dilate the surface vessels by the neutral bath with friction, the effervescent bath, cold friction, and the rubbing wet sheet.

2. Stimulate the circulation of the liver by the broken douche to the chest (60°), the alternate hepatic douche (100° to 60°), and the heating compress, and drain off a portion of the portal blood into the lower extremities by means of the warm leg bath, the heating leg pack, or the Scotch douche to the legs.

3. In this class of cases, hydrotherapy offers small assistance in a curative way, but great relief may often be secured through the use of very simple measures, such as increasing the tone of the congested parts by means of cool compresses, thus enabling them better to resist the disturbing cause. Constipation, if present, must be combated by special means.

4. Spasm of the vessels of the feet and legs, causing congestive headaches, may be relieved by the Scotch douche, the prolonged hot leg or foot bath, and the heating pack to the legs. Fomentations to the abdomen, followed by the heating abdominal compress, will remove the cause of the vascular spasm of the legs by relieving the irritation of the sympathetic ganglia in which the disturbing reflex influence originates.

5. Prolonged cold compresses (60° to 70°), alternate hot and cold applications, or very hot compresses or douches, are measures by which the vascular tone of the affected part may be raised, and the stagnated blood moved on to make room for an influx of pure blood with its supply of normal nutrient and healing properties.

In changing the hot and cold compresses, great care must be taken to avoid the slightest delay, as the occurrence of reaction between the applications will destroy the effect obtained by the cold application and cause a return of the pain and swelling. A freshly cooled compress should be

ready to replace the warm one the instant it is removed, or the desired temperature may be attained by irrigation, the cold water being trickled in a small stream upon the affected part protected by a suitable compress of cheese-cloth or linen. Make changes with the greatest care, to avoid irritating the inflamed or congested surface.

6. Cold to the congested part by means of the frequently renewed cool compress or the evaporating compress, while at the same time soothing applications are made to the affected ganglia by the abdominal fomentation, the heating compress, or a wet girdle; the prolonged neutral bath; derivative applications to the feet and legs, such as the leg pack, the Scotch douche, and the prolonged leg or foot bath at 104° to 110°, are measures applicable in this class of cases.

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, cold immersion, and the evaporating compress are the chief and most convenient methods for producing antiphlogistic effects by means of cold.

It must be always 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 antiphlogistic effect has been neutralized. Thus care should be taken to renew the cold compress as soon as it begins to approach the temperature of the skin. A large, thick, well-saturated compress may retain its efficiency for five minutes, or even a little longer; while a compress of two or three thicknesses of cotton or linen cloth 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 woolen cloth should generally be placed next the body to avoid excessive chilling of the skin. If this precaution is omitted, great care must be exercised

to prevent injury, and the application must be removed for a few minutes every half hour, so that partial reaction may be allowed to occur, thus maintaining the vitality of the part.

In cases in which there are acute inflammatory conditions involving the hands and feet, the proximal compress may be used to good advantage.

This compress has the advantage over direct applications to the part affected, in that it avoids irritation of the part. In the use of the proximal compress, cool applications should be made to the inflamed part, and cold or very cold applications applied between the part and the heart. For example, in applications to control inflammation in the hand, the arm should be wrapped in cloths wrung out of very cold water, while cool water is applied to the hand. Both applications should be made continuous by allowing a stream of water of the proper temperature to trickle upon the parts, or by frequently drenching the parts with water at the right temperature. The compress upon the hand may be kept cool by evaporation, if not too thick. No more than four to six thicknesses of cheese-cloth should be employed. These should be moistened as often as necessary, and should never be allowed to become dry. An ice poultice may be applied to the arm, or wet cloths may be laid next the skin, and the ice-bags laid over these. The ice-collar or ice-bag applied over the carotid in this manner is a most excellent method of reducing cerebral hyperemia. In cases of cerebral meningitis, the ice-collar may be used in conjunction with cold applications to the head.

In the case of organs lying within the trunk, as the kidneys, liver, and other viscera, a different principle must be employed. By the warm bath (92° to 98°), dilatation of the surface vessels with contraction of the internal vessels may be produced. This should be followed by an application of water at 60° to the affected part. If a very cold application is made, it must be removed at short intervals, particularly in

the treatment of visceral inflammation, so that there may be opportunity for full reaction and complete dilatation of the surface vessels in reflex relation with the interior. When this occurs, there is doubtless a reactionary contraction of the dilated vessels of the inflamed viscus; whereas, when a very cold application is continuous, the cutaneous nerves are benumbed, the reflex stimulation ceases, and the result is passive dilatation. For best effects apply compresses at 60° and change every 10 to 40 minutes, or when warm.

Revulsive measures may be brought into service in conjunction with other means by making cold applications to the reflex cutaneous area connected with the affected part. Cold to the feet causes contraction of the vessels of the brain, with lowering of the temperature of the mouth and of the axilla. The cold running hand-bath causes contraction of the vessels of the chest; cold to the lumbar region causes contraction of the uterine vessels, as do also cold applications to the buttocks, the perineum, the vulva, the hypogastrium, the inner portion of the thighs, and the soles of the feet.

For derivative effects in relieving congestion of a hyperemic part, the vessels of a large area in some remote part of the body are dilated by suitable hydriatic procedures, and thus the blood is drawn off from the congested part. It should always, when possible, be ascertained whether anemia does not exist in some part as the result of a disturbed distribution of blood; if so, the application should be made in such a way as to influence this anemic part, restoring to it its normal blood supply. For example, congestion of the brain is commonly connected with coldness of the hands and feet through excessive contraction of the vessels of these parts. The circulation should be restored by short cold applications followed by vigorous rubbing, the Scotch douche or hot baths, the partial vapor bath, the hot-air bath or the electric-light bath, dry friction, or the hot-blanket pack, followed by vigorous friction.

Lowering the temperature of the blood helps to diminish

congestion by influencing favorably the central nervous system and the heart. General or local refrigerating measures may be used for this purpose, as the cool enema, the cooling bath, the wet-sheet pack, the half pack, the cold precordial compress.

The mesenteric circulation is a blood reservoir which may frequently be used as a means of regulating the blood supply. The almost instant relief from headache which is sometimes experienced from taking food is due to dilatation of the mesenteric vessels under the stimulation of the food. The mesenteric circulation may be stimulated by massage, especially by hacking movements, by short applications to the abdomen or trunk, and by the enema. A very short cold enema results in reaction in the portal circulation and filling of these vessels. The large enema of water (100° to 104°), retained for a few minutes, produces dilatation of the portal vessels.

By bringing these various measures to bear in concert, most powerful effects may be produced, as, for example, in a case of cerebral hyperemia, a bath of 92° for a half hour to an hour may be administered, care being taken by gentle rubbing to keep the surface vessels well dilated, so as to avoid the slightest tendency to chilliness, which produces excitation of the central nervous system. This will reduce the temperature. The same may be accomplished by the wet-sheet pack of 30 minutes' duration or continued to the end of the neutral stage. Either of these procedures should be followed by a Scotch douche to the feet and legs, the patient afterward being put to bed with the heating abdominal bandage, and an evaporating compress to the head. The whole may be preceded by an enema of a pint and a half to two pints of water at 70°. The evaporating or cool compress should be applied to the head during the neutral bath, to insure lowering of the cerebral temperature.

Application of cold should be confined to the early stages of inflammation. Passive hyperemia, which appears after the most acute stage of the inflammatory process, favors exudate

and morbid changes in the structure and functions of the parts. A good supply of healthy blood is the best means of antagonizing this condition and bringing the part to a normal state. The blood is a sort of traveling physician, which, moving from part to part, repairs injuries by the same marvelous methods by which it builds up and maintains the body in health,— through normal nutritive processes. Recovery from diseased conditions is effected by means of the cell and tissue activities by which the ordinary functions of the body are maintained.

The cure for inflammation after the first stage is passed is accomplished by improving the circulation; hence continuous cold application should cease after the first stage, which in erysipelas and pneumonia never includes more than the first day or two, and in some cases but a few hours. Hot applications should be made once in two or three hours, with simply cool or tepid applications during the intervals to maintain active fluxion through the affected part. It is necessary to study each case carefully to know just when to cease the employment of antiphlogistic measures, and to introduce those calculated to induce active congestion or fluxion. After the first onset of the disease is passed, the heating compress may be applied. At first, change every hour; later, every three or four hours, increasing the intervals from day to day. Thus employed, the heating compress, by aiding the circulation in the diseased part, may aid in bringing the morbid process to a favorable termination without suppuration. The cotton poultice similarly employed still later may aid in establishing resolution. These measures are very valuable in the treatment of pleurisy, either with or without affusion, and in lobar- and broncho-pneumonia, greatly aiding the absorption of morbid products and in restoring normal conditions.

By the repetition of a cold application as soon as reaction begins, a new contraction of the small blood-vessels of the parts and of the internal associated area is produced. For this reason a frequently renewed cool or cold application

may sometimes produce better effects than continuous cold in the hydriatic management of deeply seated congestions or inflammations.

In the use of cold, care must be taken to avoid producing a harmful collateral hyperemia in cases of deeply seated inflammation by prolonged cold application to the surface (**672**).

To obtain the atonic antiphlogistic effects of heat (**642**), fomentations, the cotton poultice, the hot-water bag, hot irrigation, and hot immersion are the chief measures. The neutral pour or irrigation and neutral immersion are also highly useful. Fonssagrives 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. The dilution and hastened removal of these 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 disturbing elements present, whatever they may be.

Recent observations have developed the interesting fact that nervous irritability is notably lessened when a nerve is made to take up a quantity of water. This may be the true explanation of the relief always afforded by warm compresses, the neutral bath, and many other sedative hydriatic procedures.

It seems reasonable, also, that dilution of the blood may serve to lessen the activity of morbid processes in a congested or inflamed part, by diminishing the proportion 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 affords an excellent illustration of the antiphlogistic effect of hot applications.

Prolonged immersion (for several weeks if necessary) of a part in water at a temperature of from 95° to 97° F. 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 author was a student in that institution twenty-five years ago, made large use of the neutral 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 colleagues had condemned to amputation.

This is also a most excellent method of preventing inflammation and other complications in case of severe burns. Some seventeen years ago the author, while visiting the great Hospital for Skin Diseases at Vienna, learned of a patient who had suffered from a severe burn, and who had been kept immersed in a full bath for a number of months. He ultimately made a good recovery from an injury which, without the advantage of this measure, would probably have proved fatal.

699 **General Antiphlogistic Effects.**

For general antiphlogistic effects, that is, for subduing a condition commonly known as feverishness, but without actual rise of temperature, the neutral bath at 92° to 95° for 20 minutes to an hour or more has been 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.

Care should be taken to avoid friction in the bath or after it (**1130**), and the patient should also avoid exercise soon after the bath. Immediately on removal from the bath, the patient should be wrapped in a Turkish sheet and woolen

blanket, and dried by allowing the moisture upon the surface to be absorbed by the sheet, without any friction whatever. He should remain quiet for some hours after the bath, in order that the tendency to reaction may be suppressed.

Tepid sponging and the evaporating compress are antiphlogistic measures of value in feverish states, whether of inflammatory or non-inflammatory origin.

Use of Cold in Pneumonia, Pleurisy, and Other Acute Disorders.

700 In cases of acute inflammation accompanied by exudate, as in pneumonia the frequently renewed heating compress (**1284, 1318**) should be employed during the early stages of the disease; but after the acute inflammatory stage is passed, the cold application should be exchanged for intermittent hot applications. Fomentations and equivalent measures may be applied regularly every two or three hours, the heating compress being employed in the interval.

In the transition stage between the first and second periods of the disease, the cold applications may be interrupted every two or three hours by hot applications for 10 or 15 minutes. This method the author has found eminently successful in the treatment of pneumonia, erysipelas, acute arthritis, and similar conditions. Care must be observed, however, in making continuous cold applications at very low temperatures, not to destroy the vitality of the tissues 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 reaction for restoration of the circulation.

After the very first onset of an acute inflammatory affection; that is, after the first twelve or twenty-four hours, hot applications may be made for 3 or 4 minutes with advantage every two or three hours. The application of heat in such cases must be short, and the temperature as high as can be borne.

Of sedative measures especially applicable to particular regions of the body, the most useful are the following: —

701 *Applications for the relief of cerebral congestion,*— cold to the back of the head and about the neck; cold compress to the scalp and face; evaporating compress to the head and face; 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 3 or 4 minutes, followed by a cold douche for 15 or 20 seconds; heating pack to the trunk; heating half-pack to legs and hips; heating wet-sheet pack at 70°, followed by wet rubbing sheet, cold pour to the head or back of neck, .1 or 2 minutes, at 60° to 70°.

To diminish cardiac activity and blood pressure, ice-bag over the heart continuously. The heart's action may also be lessened by cold water drinking, the water being sipped slowly.

702 *Congestion of the stomach,* as in hyperpepsia and chronic gastritis, is best relieved by the prolonged hot douche over the stomach and the spine opposite, or by the revulsive circle douche or revulsive compresses.

As a general sedative measure, applicable to almost all classes of cases and all parts of the body, there is no better procedure than the cool compress, consisting of a folded linen towel or a half dozen thicknesses of cheese-cloth saturated with water at a temperature of 60° to 70° F. This compress should be changed about once in twenty to thirty minutes when much heat is present, or once an hour when the morbid process is less active. The effect of an application of this sort is to cause a maintained contraction of the vessels of the skin surface with which it is in contact, and of the corresponding internal visceral area. When applied to the chest, it causes contraction of the pulmonary vessels; applied to the abdomen, the mesenteric vessels are contracted; applied to the lower abdomen, upper thighs, perineum, and external genital organs, the pelvic viscera are de-congested; applied to the head and neck continuously, cerebral congestion is relieved; while application to the spine contracts the vessels of the cord; application to a congested or inflamed part

affords relief from pain, and controls inflammatory processes in a wonderful manner. The cool or cold compress applied over the heart is a heart sedative of inestimable value.

Ice-cold or very cold applications provoke powerful reaction effects, dilating the vessels; but cold and cool applications induce a sustained contraction.

Antithermic Effects.

When a procedure is such as to abstract heat, 703
it is *antithermic*. When it not only abstracts heat but lessens heat production, it is *antipyretic*. The effects of antithermic applications are often defeated by imperfect methods. A passive cold application, as a cold immersion bath, stimulates heat production to a greater extent than heat elimination, so that the temperature after the bath may be higher than before. Many persons have for this reason been led to renounce water treatment altogether, not understanding that the lack of success was due to the faulty method rather than to failure of the hydriatic principle.

In combating fever, the principal point to be borne in mind is so to manage the antithermic measures employed as to avoid the thermic reflex; that is, the automatic increase of heat production. The method of accomplishing this was pointed out by Winternitz more than twenty years ago, but has been too little appreciated, unfortunately, by those who have undertaken to use water in fevers. The method is simple: it consists in maintaining dilatation of the cutaneous vessels and active movement of blood through the periphery by means of friction. Thus accumulation of blood in the muscles and the thermic reflex set up by cooling of the nerves in the skin, which cause increased heat production, are prevented.

Whatever measure is employed it should be long enough in duration to produce a decided effect upon the patient's temperature. A single wet-sheet pack, for example, would certainly increase heat production, and elevation of temperature (**719**). A short cold bath has the same effect.

Winternitz has shown that the wet-sheet pack, continued for 30 minutes, the sheet being renewed every 5 to 8 minutes, reduces temperature more effectively than any other procedure. For example, in a test case, during the second week the average results obtained for the half-bath were .87°; for the wet-sheet pack, 1.21°; for the half-bath, followed by the trunk compress, .73°. At the end of five hours after the half-bath the patient's temperature was .4° *above* the original temperature, while after the wet pack and the half-bath, followed by cold compresses, the temperature was still *below* the original. During the fourth week the same results were obtained. The wet-sheet pack produced a much more decided and durable reduction of temperature than the half-bath alone or the half-bath accompanied by the trunk compress.

Next to the pack, the best measure is the graduated or the Brand bath, followed by the abdominal or trunk compress changed every half hour. By means of the trunk compress the refrigerating effect of the half-bath is prolonged. It is not sufficient to abstract heat at intervals in febrile cases. We must constantly maintain heat discharge by maintaining dilatation of the surface vessels. In combating fever, care should be taken to keep the temperature down during the whole course of the disease. Every threatened exascerbation of the temperature should be met with prompt measures. When neglected, the fever acquires a sort of momentum, so to speak, which greatly increases the difficulty of controlling it. The gastric secretion ceases when the temperature is very high, and the gastric juice loses its power to act upon albuminous substances during the existence of high fever (Winternitz). When the temperature is very high, the action of the salivary glands is also suppressed; the mouth is hot, dry, and parched; the lips and tongue are covered with dried secretion, while with the lower temperature which may be maintained by proper hydriatic procedures, the mouth is moist, the stomach continues to secrete an active gastric juice, thus changing the whole aspect of the case.

The antithermic or refrigerant effects of water are among the most important and valuable therapeutic uses to which this agent can be put. It has been recognized from the earliest ages, certainly since the time of Hippocrates, that the application of water at a temperature below that of the body is a most perfect means of antagonizing the elevation of temperature which occurs in connection with fevers of all classes.

From the time the value of water as an antipyretic was brought to the notice of the profession by Currie and Jackson in the latter part of the last century, up to the present time, no one has undertaken to deny that the death-rate has been uniformly lessened to a very marked degree whenever hydriatic measures have been systematically and intelligently used for reducing febrile activity, from whatever cause. A long list of eminent physicians, both English and Continental, as well as American, have given their adherence unreservedly to the use of water as the most valuable means known for this purpose.

In the treatment of a long series of cases of typhoid fever by the cold bath in the New York Hospital, the mortality was reduced to 7.5 per cent. The rate of mortality in over thirteen hundred cases previously treated by the usual method was from twenty to thirty per cent.

The author and his colleagues of the Battle Creek Sanitarium are able to report over two hundred cases of typhoid fever treated by these methods with a mortality of less than four per cent. In one series of thirty-six successive cases, all the patients recovered, although in several instances the symptoms were very grave, owing to delay in beginning treatment. The measures chiefly relied upon were water-drinking, the enema, and the cooling pack. No medicinal antipyretics were employed.

J. C. Wilson, a few years ago, reported 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, in which the treatment was entirely by cold applications, the mortality was only ten per cent.; while in another series of nine hundred cases in which the ordinary methods were employed, the mortality was twenty per cent.

Any of the various applications of water, used at a temperature lower than that of the body, may be utilized for combating a tendency to excessive heat production.

A few general principles should be borne in mind in the application of water for the reduction of temperature:—

1. *The greater the difference in the temperature of the body and that of the water, the more decided the effect, other things being equal.*

2. *The application, to be of permanent value, must be prolonged.* The length of the application may vary from ten or fifteen minutes to half an hour or even longer, according to the nature of the application. The average time of a cold bath for lowering the temperature, as in typhoid fever, is about twenty minutes. The time, of course, must be made to depend upon the condition of the patient, the degree of the elevation of his temperature above normal, and the temperature of the bath. The tepid (88° F.) bath may be prolonged to the extent of from one to several hours, if necessary.

3. *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, unless there should be very pronounced shivering or other symptoms indicating the need of assistance to produce sufficient reaction to insure the viscera against injury from prolonged congestion.

4. *Friction should always be employed while the patient is in the cold bath*, as by this means the circulatory reaction is promoted, and, while the lowering of the body temperature is encouraged, shivering is prevented, and thus increased heat production is avoided. Winternitz has shown that friction in the cold bath increases the rate of heat elimination more than thirty per cent.

Antipyretic Effects.

704 The antipyretic effects of cold water are obtained by the systematic employment of antithermic measures. There has within the last few years been a very strong reaction against the use of antipyretic drugs, and in favor of this truly physiological and rational remedy, and at the present time no respectable medical authority disputes the extreme value of water as an antipyretic measure. Modern observations have demonstrated that the danger from elevation of temperature is not so great as was formerly supposed, that in fact the rise in the body 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; and it has been clearly shown by Winternitz, and by many others, that the mere lowering of the body temperature by means of antipyretic drugs is not only not in any way beneficial to the patient, but, on the contrary, is decidedly detrimental, since the system is thus compelled to struggle not only with the toxins which are produced in connection with the special morbid processes present, but with the toxic drug introduced with therapeutic intent.

In visiting the fever ward of a large city hospital some years ago, the author was particularly struck by the fact that patients whose temperature was normal as the result of the administration of large doses of antipyrin, had the expression of persons in a state of collapse or extreme shock, the evident result of the combined influence of the bacterial toxins and the toxic effect of the antipyretic drug.[30]

In the reduction of temperature by means of hydriatic measures, not only is no toxic substance introduced into the body, but the cold applications, which lessen to some degree the pathological thermogenic processes which are in operation, at the same time act as a true 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.

Effects of Cold on the Heart in Typhoid Fever.

Indeed, 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 the disease are mitigated, often to such a degree that the disease is scarcely recognizable from the symptoms as set forth in the text-books, which frequently describe not natural diseases, but maladies aggravated by artificial and irrational therapeutics.

705 **Antipyretic Effects of Hot Applications.**

From the practice and the teachings of most hydrotherapeutists, it would appear that antipyretic hydriatic means consist wholly in applications of *cold* water. It is probable that in the first attempts to combat febrile conditions by means of baths, cold water was exclusively employed; but modern laboratory researches and clinical experience have demonstrated the fact that hot water as well as water at a temperature below that of the body, may be employed in such a manner as to secure a considerable reduction of temperature in febrile states. Short, very hot applications stimulate the surface circulation, and thus aid heat elimination, while lessening heat production. By a judicious combination of very hot and cool or cold applications, the most energetic antipyretic effects may be produced.

It should be noted that in the febrile state the thermogenetic and thermotaxic mechanisms of the body are always profoundly disturbed, and in such a manner that they are influenced by causes which may have no effect whatever upon the body temperature in the non-febrile state. A rise of a few degrees in the temperature of the air of the sick-room, sitting up in bed, talking with a friend, reading, taking a slight excess of food, — these and other similar causes are sufficient to occasion a considerable rise of temperature in a febrile patient, and sometimes even to give rise to a relapse in a patient recently become convalescent.

Likewise, hydric applications which are not capable of

producing a marked lowering of temperature in a well person may have a decided effect in the febrile state.

Relation of Heat Production and Heat Elimination to Antipyretic Methods.

706 A general rise of the body temperature 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, or still other disturbances of the thermogenic or thermotaxic functions may exist (**227**).

In the majority of cases there are, in fact, both increased heat production and increased heat elimination, the rise of temperature being due to the fact that the heat production is greater than the heat elimination. In many cases, as shown by Rosenthal, Botkin, Leyden, and Winternitz, the rise of temperature is due to diminished heat elimination alone.

There is always a disturbance of the thermotaxic, or heat-regulating, function in fever. It is important in any given case to ascertain as nearly as possible the conditions present; and before making a hydriatic application of any sort, it should be determined, if possible, whether the rise of temperature in the case is chiefly due to increased heat production or to diminished heat elimination. The neglect to do this is responsible for many failures in the use of hydriatic measures in fever.

The temperature in fever may be reduced either by diminishing heat production or increasing heat elimination, or by both means combined, and by hydric applications either or both of these processes may be influenced.

Conditions are sometimes present in which there is a great increase in both heat production and heat elimination, and in which it is apparent that nature is doing all that can be done to combat the rise of temperature; therefore, interference on the part of the physician would be not only unnecessary, but possibly injurious. This is practically true in cases of fever in which there is profuse perspiration. In such a case, neither hot nor cold applications are needed for

temperature control. It is only necessary that the perspiration should be gently removed every few minutes by means of a soft linen cloth. By keeping the surface free from sensible perspiration or visible moisture, evaporation will be greatly promoted, and thus a cooling effect be produced. To apply a cold wet-sheet pack, a cold bath, a cold sponge bath, 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.

707 **Heat Elimination by Evaporation from the Skin.**

An enormous amount of heat is absorbed by the evaporation of water from the surface, the ordinary amount being about one to one and one-half ounces per hour. Suppose this to be increased to sixteen ounces per hour, as might possibly be the case; if the perspiration were completely evaporated, the result would be the removal by evaporation alone of nearly one thousand heat units. In case of a patient weighing 160 pounds, this would be equivalent to a fall of six degrees in temperature. The normal rate of heat production is about 1.8 calories, or 7.2 pounds Fahrenheit heat units, per minute, or 432 heat units per hour. If heat production were doubled, the total for the hour would be 864 heat units. Subtracting (1000—864), we have 136. Dividing by 160, we have .85. Hence there would be an actual reduction of temperature to the amount of nearly one degree.

Of course the rate of heat production may be more than doubled, and such profuse sweating can not always be induced; but when present, it must not be interfered with. When not present, we see how much may be accomplished by applying to the skin the moisture that nature fails to supply. It has been shown that in fever there is retention of water by the tissues, and that by friction the loss of water may be increased more than fifty per cent (Weyrich). Hence the value of this measure when the skin is cool and dry.

It should be remembered that cold applications, while aiding heat elimination in some ways, in other ways diminish

it, as by lessening the conducting power of the skin, by decreasing the blood supply, and by checking perspiration. It is consequently evident that to give a general cold bath in a case in which the surface is pale, cold, and dry,— in other words, when there is a decided diminution in heat elimination,— would be ill-advised, and likely to do harm. Indeed, the persistent application of such a measure in a case of that kind might induce a fatal result.

It is true that in persons possessed of considerable vitality, a very cold bath might awaken 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 would not always 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 forces 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 hydriatrist.

Indications of a Condition of Increased Heat Production.

708 In cases presenting an abnormally high temperature, the following symptoms may be regarded as indicating that the elevation of temperature is the result of *increased* heat production :—

1. A flushed face, with full pulse.
2. A warm, moist skin.
3. A hot, dry skin.

Symptoms Indicating Decreased Heat Elimination.

709 The following symptoms accompanying an elevation of temperature may be regarded as indicating that the rise in temperature is, at the moment at least, associated with decreased heat elimination :—

1. Cold, dry skin.
2. Cold, moist skin.
3. Goose-flesh appearance.
4. Blueness of the skin.
5. Chilly sensations.
6. Shivering.

Both heat production and heat elimination are often increased in fever, but heat production more than heat elimination. When heat production and heat elimination are equally increased or equally diminished, no change in temperature occurs. Winternitz has shown, however, that the deviations from the normal in febrile states may be almost wholly accounted for by disturbance of heat elimination.

Increase of both heat production and heat elimination, but with excessive increase of heat production, is a condition present in sthenic fevers and inflammations. In this condition the skin may be either flushed, hot, and dry, or warm and moist. A similar condition is found when an elevation of temperature results from violent exercise.

A condition of increased heat production, associated with normal or diminished heat elimination, exists in cases of fever in which the skin is cool and dry.

In the febrile condition resulting from sunstroke (thermal fever), the rise in temperature is in part, at least, due to the diminished heat elimination. A similar rise of temperature occurs in the Turkish bath and other sweating procedures before perspiration begins. The decrease of heat elimination is due to spasm of the small vessels of the skin, a condition which is best combated by cold friction or by a short hot application, as a hot affusion, for example, followed by cold friction.

When elevation of temperature occurs without increase of heat production, there must be an accompanying diminution of heat elimination. This condition sometimes exists in connection with an ordinary cold.

Exposure to an overheated atmosphere, as during a

prolonged period of hot weather, is often productive of a vast number of cases of febrile disease, especially in infants.

When a person is in a hot bath or a dry pack, although the rate of heat production may remain normal, there will be diminished heat elimination and rise of temperature.

An elevation of temperature may occur while both heat production and heat elimination are diminished, in case the heat elimination is diminished to a greater extent than heat production. This condition is often found in fever cases in which the patient is bordering on collapse, with a cold, pale, dry, or moist skin, and when present, calls for the immediate employment of vigorous measures, before the symptoms of collapse shall have reached so serious a stage as to render recovery impossible.

Principles that Govern the Application of Hydriatic Measures for the Reduction of Temperature in Fevers.

710 1. A general cold application increases both heat production and heat elimination. Which of these effects is dominant depends upon the duration and intensity of the bath.

2. A general cold application, if very brief, causes no perceptible loss of heat, and may occasion, by thermic reaction, a slight temporary rise of temperature.

3. A prolonged cold application lowers the temperature by increasing heat elimination, and also finally by diminishing heat production, through the general sedative effect upon the nervous system and the cooling of the thermogenic tissues in the muscles.

4. The prolonged tepid bath lowers the temperature, by increasing heat elimination without increasing heat production.

5. The appearance of chill and shivering marks the beginning of the lowering of the body temperature, and diminished elimination accompanies it as a conservative measure, while increased heat production begins.

6. Coldness and dryness of the skin, goose-flesh appearance, chilliness, blueness of the surface, are indications for

the use of measures to increase heat elimination; that is, means to encourage the cutaneous circulation.

7. A short general hot application ($\frac{1}{2}$ to 2 min.) diminishes heat production by its reflex effect upon the heat centers, and increases heat elimination by increasing the skin circulation and the production and evaporation of perspiration.

8. A long hot bath raises the temperature by heating the body and increasing heat production.

9. In general, tonic thermic reaction should be, so far as possible, suppressed in fever cases by avoiding short cold applications and measures involving mechanical effects, such as the douche.

10. Gentle friction during a cold bath increases heat elimination by stimulating the surface circulation, and controls heat production by maintaining the skin temperature and thus preventing shivering.

Laschkiewitsch showed that death after varnishing is due to excessive cooling from paralytic dilatation of the cutaneous vessels.

The notion that hydrotherapy is chiefly useful in fevers as a means of lowering the temperature is based upon a very superficial knowledge of the rationale of this marvelous therapeutic agent. Winternitz wrote nearly twenty years ago: —

"The hydriatic antipyretic method consists in an antithermal procedure, together with applications which act upon the nervous system and the circulation in a manner analogous to nerve tonics and sedatives, and in tonic-raising features which influence nutrition in a favorable manner as well as in local measures, or reducing hyperemia and congestion, whereby morbid processes may be controlled."

In view of this important fact, which is still quite too rarely recognized, it is evident that a routine practice, even in the treatment of fevers, is quite impossible. The procedure must be carefully chosen, and adapted to the needs of the individual case. In certain cases of fever, thermic

reaction must be wholly suppressed, or as nearly so as possible; in others a moderate amount of thermic reaction will prove beneficial. In threatened collapse, thermic reaction must be encouraged.

Methods that May be Efficiently Employed in the Various Morbid Conditions Accompanied by a Rise in Temperature.

711 Of the various measures which may be employed for the reduction of temperature, the following may be mentioned as having been tested in actual clinical experience, not only by the author, but by numerous able clinicians. All have been found useful and efficient, some being best adapted to one particular set of circumstances, others to other conditions, but each having its particular utility; for rational hydrotherapy gives no countenance to routine methods, and recognizes no panacea: —

1. *The Cold or Tepid Affusion.*—This method, first employed by Hippocrates, and in recent times revived by Currie and Jackson, is efficient in lowering temperature. The mortality rate in scarlet and typhoid fevers is reduced by its use from thirty or forty per cent. to almost nothing. The patient simply sits in a large tub, while several pails of water at the ordinary temperature, or about 70° F., are poured over him, this procedure being repeated as often as the temperature reaches 102° F.

Currie observed that the warm affusion (87° to 97° F.) is more effective in reducing temperature than the cold, offering in proof the following excellent reasons, which are certainly highly creditable to the sagacity and medical knowledge of this pioneer of rational hydrotherapy, considering the fact that his observations were made more than a hundred years ago: —

"I find that, in many cases at least, the heat of the living body is lowered as speedily by the affusion of tepid water as by the affusion of water that is cold. If I mistake not, in some cases the heat is lowered more speedily by the tepid water."

The principal reason for the greater effect of the tepid bath in lowering the temperature, Currie finds in the fact that it is "little if at all stimulating, and does not, like the cold affusion, arouse the system to those actions by which heat is evolved and the effects of external cold are produced. If the object is to diminish the heat, this may be obtained with great certainty by the repeated use of tepid affusions."

He further makes the following very wise observation: "I have accordingly employed the tepid affusion very generally in those feverish affections where the morbid actions are weakly associated, depending rather on the stimulus of preternatural heat than upon contagion, miasmata. . . . It is also applicable to every case of fever in which the cold affusion is recommended." *

Currie also used the "cool bath" (75° to 85°), but employed it most in chronic diseases. He preferred, however, the cold bath in contagious and infectious fevers, evidently for the reason that baths of this temperature are the most effective in arousing the vital forces of the body to resist and antagonize disease.

712 2. *The Cold Immersion Bath* (**1112**).— This bath was first systematically employed by Brand, who by its means reduced the mortality from typhoid fever more than two thirds. The method of Brand requires that the patient be placed every three hours, day and night, in a bath at 68° F. for fifteen minutes. Brand requires the administration of the bath whenever the rectal temperature of the patient reaches 102° F. At the beginning of the bath, he directs that an affusion of water at 59° F. should be slowly poured upon the back of the patient's neck for two minutes, and that the patient should drink freely of water during the bath.

After the bath, the patient is placed in a sheet in which he is wrapped and carefully dried, but without rubbing the abdomen. The patient is only slightly covered after drying,

* "Medical Reports on the Effects of Water, Cold and Warm," by James Currie, Vol. I, pp. 64, 65.

and may continue to shiver slightly for some time after the bath, as an indication of the actual lowering of the body temperature occasioned by the bath. Twenty minutes after the bath the temperature is taken and recorded.

The amount of reduction of the temperature by the cold bath may be from half a degree to three or four degrees, seldom more than one or two degrees, and not infrequently there is a slight rise immediately after the bath. This is especially true at the beginning of a fever. Later the effect is greater.

Therapeutic Substitutes for Alcohol.

The question of the use of alcohol in connection with the cold bath is one which is deserving of more than mere passing mention. Most German and some American authorities who recommend the use of cold water insist that just before putting the patient into the cold bath, at least in febrile cases, alcohol should be administered. The idea upon which this practice is based is evidently the supposition that alcohol is a stimulant, at least that it in some way sustains the heart or the vital powers. But this theory was long ago rendered thoroughly untenable by a multitude of carefully conducted experiments upon healthy subjects, showing that alcohol is always and in all doses a narcotic, and not a stimulant; that it depresses, and does not excite the heart and other vital organs; that it lessens vital resistance to disease; and that it is a toxic agent which the body must cast out, and not a food to be assimilated, nor a source of energy or aid to any vital organ or function.

The relation of alcohol to the heart and the circulation is a matter of most profound importance in the class of cases in which the cold bath is most frequently employed. In relation to this point the fact should be recalled that the heart is not the only force involved in the circulation of the blood. It is doubtless the great engine of the circulation, but it has been clearly shown by Schiff and numerous other physiologists that the movement of the blood is greatly aided by

a rhythmic action of the small vessels, both arterioles and capillaries. These contractions are not simultaneous with those of the heart, hence do not interfere with its action; but as the pressure in the veins is very much below that of the arteries, these contractile movements serve most efficiently in pushing the blood along toward the veins. The heart keeps the large arteries pumped full of blood, while by means of the contractile movements of the peripheral vessels, the blood is, so to speak, milked out into the veins. We may say, in fact, that there are two hearts concerned in the systemic circulation, the work of the central organ being supplemented by the peripheral heart,— the small vessels,— working at the distal end of the vascular loop, where the resistance is greatest.

Active congestion, or hyperemia, is simply a state in which the movements of the small vessels are very vigorous, and have a wide swing, so that a large amount of blood is passed through the tissues. In passive congestion there is dilatation of the small vessels without increased activity. One condition results from increased action of the vessels through stimulation of both the vasodilators and the vasoconstrictors; the other from paralysis of the vasoconstrictors or excitation of the vasodilators, or both, resulting in dilatation of the small vessels, with stagnation of their contents. In active congestion, the aid afforded by the rhythmic movement of the small vessels is increased. In passive congestion this action is greatly diminished or entirely lost. The difference in the rate of the movement of the blood gives rise to the difference in color,— scarlet in active hyperemia or congestion, cherry red in passive congestion. In the one case a rich supply of fresh, oxygenated arterial blood is passing through the small vessels into the veins, the movement of the blood is rapid, and all the vital processes are quickened; the heart, as well as all other organs, is thus better nourished and energized. In passive congestion and all conditions of the circulation in which a cyanotic appearance is present, the

usual condition in slowed circulation, the blood current is slow through cardiac weakness, or the lack of the active assistance of the peripheral heart; as a consequence, an insufficient amount of oxygen is introduced into the body, the blood is charged with CO_2 and other tissue poisons, and all the vital processes are depressed. To aid the heart and the circulation the thing needed is not simply an increased rate of activity of the heart, or an increased volume of the pulse, but an increased movement of the blood current throughout the entire system.

Pallor is due to contraction of all the vessels of the skin. 713
Local cyanosis is due to greatly slowed movement of the blood, either from passive congestion or spasm of the arterioles, resulting in excessive absorption of oxygen and accumulation of CO_2 in the blood.

In the application of any agent for the purpose of relieving conditions of this kind, the peripheral heart as well as the heart itself must be taken into consideration. In fact, the whole circulatory system must be regarded as one. The heart and the arteries are composed of essentially the same kind of tissue, and have practically the same functions. The arteries and capillaries as well as the heart are capable of contracting. Both the heart and the arteries are controlled by excitory and inhibitory nerves. These two classes of nerves controlling the heart and the vessels respectively are kindred in structure and origin, the vagus and the vasodilators being medullated and of spinal origin, while the accelerators of the heart and the vasoconstrictors of the arteries are non-medullated.

Winternitz and other authorities have frequently called attention to the value of cold as a cardiac stimulant or tonic. The tonic effect of this agent is greater than that of any medicinal agent which can be administered.

The cold compress applied over the cardiac area of the 714
chest may well replace alcohol, as a heart tonic. The thing necessary to encourage the heart's action is not mere relaxa-

tion of the peripheral vessels, but, as Winternitz has shown, increased activity of the peripheral circulation in the skin, muscles, and elsewhere. Alcohol paralyzes the vasoconstrictors, and so dilates the small vessels and lessens the resistance to the heart action; but at the same time it lessens the energy of the nerve centers which control the heart, diminishes the power of the heart muscles, and lessens that rhythmical activity of the small vessels whereby the circulation is so efficiently aided at that portion of the blood circuit most remote from the heart. A cold application to that portion of the chest overlying the heart reflexly stimulates and energizes the heart through the cardiac nerves. This reflex action is not confined to the heart muscle; the stimulation of the activity of the cardiac vessels improves the circulation through the heart structure, refreshing and energizing it in the same manner in which a voluntary muscle is energized by a cold application, as is so well shown by the ergograph (Exp. 50).

It is well to remember that the vasoconstrictor nerves are one in kind with the excitor nerves of the heart, while the vasodilators are in like manner associated with the vagus. With this in mind, it is easy to see that while alcohol paralyzes the vasoconstrictors, it at the same time weakens the nerves and the ganglia which initiate and maintain the activity of the heart. Cold, on the other hand, excites to activity these nerves and centers, and thus produces the opposite effect.

The apparent increase of strength which follows the giving of alcohol in cases of cardiac weakness is delusive. There is increased volume of the pulse for the reason that the small arteries and capillaries are dilated, thus lessening resistance and cardiac work; but this apparent improvement is very evanescent, as naturally results from the fact that while the heart is relieved momentarily by the sudden dilatation of the peripheral vessels, the accumulation of blood in the venous system through the loss of the normal activity of the peripheral heart, gradually raises the resistance again by in-

creasing the load of blood which has to be pushed along in the venous system. This loss of the action of the peripheral heart thus in the end more than counterbalances the temporary relief secured by the paralysis of the vasoconstrictors. This accumulation and sluggish movement of blood in the venous system is shown by the purplish hue of the skin in a person under the influence of alcohol,—a wide contrast to the ruddy glow presented by the skin in which the small vessels are actively engaged in pumping the blood out of the arteries into the veins, an action in which the whole body may be made to participate by a general cold douche or other suitable application of cold water to the surface. Cold applications, general and local, may be safely affirmed to be the true physiological heart tonic.

It is evident, then, that in the use of alcohol in connec- **715**
tion with the cold bath, we are not enhancing its effects, but are simply lessening its influence. If it is desired to mitigate the tonic or excitant effect of cold water upon the heart or vessels, this may be accomplished by employing water at a higher temperature, or, if it is desired simply to get the patient over the preliminary shock of the application, we may accomplish this much more efficiently by a preliminary heating of the skin, as by a fomentation to the spine, a hot-blanket pack, a hot enema, or even hot-water drinking.

3. *The Cold Friction Bath* (**1150**).—The utility of the cold **716**
bath as originally practiced by Brand can not be questioned; but Winternitz has shown that the rate of heat elimination may be very greatly increased by rubbing the patient continuously during the bath. At the present time Brand and his followers, who are adepts in the use of the cold bath in fever, uniformly employ vigorous friction during the entire bath. Those authors who forbid friction 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 a vigorous surface circulation the rate of heat elimination is increased out of proportion to the slight increase of heat pro-

duction, so that there is a decided gain to the patient by friction employed during the bath; and especially do these writers neglect the important fact that the greatest benefit derived from the cold bath is not the simple heat abstraction, but the general rousing of the vital powers, the increase of resistance, and the quickening of the recuperative and reparative activities of the body.

Another advantage of this method is that the patient is much more comfortable in the bath, and will tolerate the application for a longer time and at a lower temperature as well as more frequently than when it is administered without friction. As elsewhere shown, friction also averts increase of heat production by preventing shivering (**200, 1151**).

The claim made by some authorities that friction during the bath lessens the permanency of its effect in 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.

How, then, may we explain the good effects obtained by the method of Brand? The explanation is to be found, not in the subtraction of heat alone, but especially in the tonic effects of cold water, and in the sedative influence upon the nervous reflexes concerned in the febrile process and in the powerful diuretic effects of the bath.

717 4. *The Tepid or Neutral Bath* (**1130**).—A bath at 92° to 95° F. would produce little or no fall of temperature in a healthy person, but experience has shown that by the employment of the neutral bath 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. Riess made a special study of this bath (**1136**).

The late Professor Dujardin-Beaumetz, the eminent French

clinician, a few years ago expressed himself in very decided terms against the cold bath as a means of reducing temperature. He remarked: "Relying exclusively upon physiological experimentation, the method of cold baths applied for antithermic effects in the treatment of febrile phenomena is an irrational practice. It subtracts heat from the patient, but increases organic disintegration." *

Laur, of Lyon, in 1874, and later other French clinicians, showed the superiority of tepid baths over cold baths as a means of reducing temperature and relieving the nervous phenomena characteristic of typhoid and other continued fevers. The temperature of the bath was 86° to 95° F., or ten or twelve degrees below the temperature of the body, continued for a half or three quarters of an hour.

A bath administered at a temperature of 88° to 92° is highly effective in reducing temperature if sufficiently prolonged, and a bath of this temperature has the decided advantage that it does not provoke thermic reaction to any considerable degree, and hence does not increase heat production, either during or after the bath. A temperature of 88° to 92° F. is often tolerated without difficulty by a feeble typhoid fever patient who could not support a more vigorous application, and is found to be most effective in lowering the body temperature. It must be remembered, however, that a temperature of 80° or 85° makes upon the hot skin of a nervous fever patient an impression very little different from that produced by water at a temperature five or even ten degrees lower in a normal person. In other words, the neutral zone is raised in febrile conditions. If the temperature is three or four degrees above normal, the neutral zone is raised to about the same extent.

5. *The Graduated Bath.*— Ziemssen first, and later Glen- 718
ard, recommended in high terms the so-called graduated bath, in which the patient is placed in an immersion bath, the

* "L' Hygiène Thérapeutique," by Dujardin-Beaumetz, Paris, 1888.

temperature of which is 3.5° to 4° below that of the body. The temperature is then steadily lowered at the rate of about one degree every three minutes, until a temperature of 86° is reached. This method has the advantage that no shock is produced, as when the patient is placed in water at 68°, by the Brand method. There is, accordingly, no marked thermic reaction. If desirable, the temperature may be lowered still more, or until the patient becomes slightly chilly, but he should not be allowed to shiver. The bath should be accompanied by gentle friction for the purpose of preventing chill and to increase heat elimination (Exp. 51).

With feeble patients who chill easily, the lowest temperature of the bath may be made 90° or 92° F. in the first application, the bath being more prolonged than when the lower temperature is employed. In such cases the temperature of the bath should be lowered one or two degrees at each application until the temperature of 70° or 75° is reached.

The graduated bath obviates the danger from syncope, which is one of the inconveniences of the cold bath. It may be employed in cases in which the cold bath is contra-indicated, as in cases of typhoid with serious renal or cardiac complications.

The results in temperature reduction obtained by the graduated bath are more permanent than those obtained from the cold bath of Brand or the cold affusion of Currie; and after several years' experience with this bath, the author considers the graduated bath 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.

719 6. *The Cooling Wet-Sheet Pack* (**1189**).—When employed for the 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 of the body, being tucked in closely around each limb and about the neck. The patient should be covered very lightly if at all. In a few moments the temperature of the sheet will be raised to nearly that of the body, when it should be renewed, a fresh pail of cold water being employed each time for wetting the sheet, which should be wrung out as dry as possible, in order to remove the warm water which it contains, before dipping into the cold water for the second application. It is better to use two sheets, having the freshly prepared sheet on another couch.

The application may be renewed in this manner five or six times in succession, or even more. When the temperature of the body is very high, the sheet is so rapidly heated that it must be renewed every five to seven minutes, to make the cooling effect continuous. The applications should be renewed until the temperature has been lowered one degree or more, or until reduced to 101° or less, each successive application being longer than the preceding. There should be good circulatory reaction to maintain an active cutaneous circulation. It is often well to secure this by friction with the hand outside the sheet.

7. *The Cold Shower Pack* (**1190**).— Instead of removing **720** the sheet from the patient, the same effect may be accomplished by opening the sheet and sprinkling the body 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 back and whole body may be exposed to the cold application.

A better method still is to place the patient upon a cot covered with oilcloth, so arranged in relation to a 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 poured over him either from a dipper or other convenient vessel. By this means the cooling effect of the sheet may be made continuous, and almost as intense as that of the cold bath.

The late Dr. Austin Flint introduced this form of cooling bath in 1874, when the author was a pupil under him in Bellevue Hospital. In a paper read by him before the Academy of Medicine at that time, he reported several obstinate and protracted cases of remittent malarial fever with very high temperature, that were rapidly cured by this measure repeated daily.

Water at any desired temperature may be used. If the patient does not well tolerate cold applications, water at a temperature of 80° or even 85° F. 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 the sheet.

721 8. *The Cold Compress* **(1318)**.— The cold compress may be efficiently used for reducing temperature in cases in which the 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 cheese-cloth. The fabric should be soft, so that it will fit the surface perfectly. It is necessary that the compress should be changed and recooled as soon as it approaches the body temperature. **It should not remain long without change.**

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. The compress must be large enough to cover more than one fourth of the skin surface, or about five square feet for a person weighing one hundred and eighty pounds. Several compresses may be used, one for the front of the trunk, another for the back, and one for each limb. Nervous patients and children often tolerate the compress better than the wet-sheet pack, and it may be changed more easily than the wet sheet. The compress may be covered with dry flannel, or, if desired, it may be left uncovered, and will thus cool by evaporation.

9. *The Cold Sponge Bath* (**1204**).— This is an exceedingly **722** useful measure in cases of fever in which the temperature is not very high, but the skin flushed and dry, and the patient restless and uncomfortable. 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 is increased if a large amount of surface is exposed at one time. If the patient is very sensitive to cold, and complains much of the disagreeable sensations produced, small areas, as a single limb, may be sponged in succession, each part being covered as soon as gone over with the sponge. When a stronger effect is desired, the whole body may be sponged, and left uncovered to cool by evaporation. In general this is not an efficient or satisfactory method of combating elevation of temperature. It is useful only when the skin is hot and dry.

10. *The Wet-Towel Rub* (**1213**).— The cold towel bath **723** 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, and spread out quickly over as large an area as possible. The hands are applied with a rubbing movement, outside, not under, the towel, first one part, then another, until the whole towel is slightly warmed, when it is quickly renewed by dipping in cold water and wringing slightly, and applied to an 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 but a slight rise of temperature, or where the patient is too feeble to be subjected to more vigorous measures. Each part must be quickly dried, rubbed, and covered after the application before proceeding to the next.

The cold-towel rub, the towel being wrung as dry as possible, is of great service in cases in which the patient is in an adynamic state, with cold extremities, pinched features,

and marked depression. Especial attention should be given to the limbs, and the application must be short and instantly followed by vigorous rubbing. Partial cold rubbings test the patient's reaction and preparation for more vigorous applications, such as the cooling pack and the graduated bath.

724 11. *Cold Wet Friction* (**1209**).— This bath, administered by means of the cold friction mitt, as elsewhere described, is a most useful measure in cases of fever in which the condition of the patient demands a cold application to lower the temperature, energize the heart, and increase vital resistance, but in which there are conditions that contraindicate the ordinary cold immersion, or Brand bath. It is a most valuable antipyretic measure, and is always indicated in fever, except in cases in which cold applications must be forbidden altogether, as when the patient is perspiring freely. It may even be employed when the skin is cold or cyanotic. It is possible to use water at a very low temperature, even ice-water, in administering this treatment. It is of the greatest possible service in the adynamic or ataxo-adynamic conditions of typhoid fever, in cases in which serious cardiac or renal complications have appeared, in intestinal hemorrhage, and in collapse from hemorrhage or perforation. It rouses the vital powers in a wonderful manner, brings to the surface the blood which is stagnating in the viscera, awakens the lethargic brain, slows and strengthens the fluttering pulse, and completely changes the aspect of an apparently desperate case, and that often in a very brief space of time, a few hours, even. The bath may be perfectly graduated. At first the mitt should be only moistened. As the circulation improves, it may at the next application be saturated, and later it may be filled.

725 12. *The Cold Evaporating Sheet* (**1200**).— 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 with an ordinary fan or by means of a current of air from an electric fan. By this means a degree of

refrigeration as intense as the patient is able to endure may easily be produced. It is only necessary to keep the sheet moist to continue the effect as long as may be desired. Moderate friction should be employed by the hands applied outside the sheet. Leyden has shown that the dryness of the skin and retention of water in fever is a cause of diminished heat elimination. Hence the value of this and other similar hydric measures.

726 13. *The Hot Evaporating Sheet* (**1200**).— 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 as high as can be borne, 130° to 140° F. 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 atonic thermic reaction, diminishing heat production, and 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. Repeat in five to eight minutes, or as soon as chilly sensations are felt. Apply gentle friction as the sheet is cooled.

This measure is especially valuable in cases in which the patient is very nervous, and dreads the contact with cold water. In one such case the temperature was lowered two degrees during an hour as the result of repeated applications of the hot sheet.

727 14. *The Hot Sponge Bath.*—The hot sponge bath is an application sometimes useful in febrile conditions. The brief impression of heat produces an atonic reaction, with diminished heat production, while the evaporation taking place from the moistened surface subsequently produces cooling effects. This method is of comparatively limited value, but it nevertheless often proves useful in special conditions, as in cases in which there is cyanosis, shivering, chilliness, or a dread of cold water, and in mild febrile cases.

The hot sponge is of the greatest service in connection with cold friction or the cold-towel rub. It should be applied to each part just before the cold application, as a preparation for it. It promotes the reaction whereby the surface vessels are filled, and thus encourages the antipyretic effect desired, also reflexly acting to reduce heat production. The water employed should be as hot as can be borne, 130° to 140°. The sponge should be squeezed quite dry, and should be applied quickly, and to a small area, as an arm, a thigh, or a leg. The hot sponging should be continued, rewetting the sponge every half minute, until the surface reddens slightly. Then the cold application should be instantly applied with rubbing, allowing no interval for chilling.

728 15. *The Hot-Blanket Pack* (**1197**).—This is a very useful means for reducing temperature in certain cases in which cold applications can not be employed without serious risk, and hence are contraindicated. The hot-blanket pack acts, of course, by producing an atonic reaction, thus lessening 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.

The hot-blanket pack is of the greatest service as a means of aiding the reduction of temperature in cases in which there is decreased heat elimination (**237**). The duration, however, should be brief—3 to 10 minutes—and as hot as can be borne.

The following instance illustrates very clearly the advantages of the hot-blanket pack in cases requiring increased heat elimination: A number of years ago the author was called in consultation in the case of a child of four years, who was 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 had fallen to 102°. The recovery was rapid and

excellent. 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 compresses, the wet-sheet pack, and allied means.

It must be remembered, also, that heat is a sedative of great power; hence the presence of cardiac weakness, a condition very commonly accompanying the adynamic state in which the hot pack is indicated, must be most carefully considered in making an application of heat of any sort. Fortunately, short hot applications are depressing only in very slight degree, and very short applications (1 to 3 min.) are stimulating in their effects. Any depressant effect arising from the hot-blanket pack may be overcome by means of the cold precordial compress, or an ice-bag over the heart during the application.

16. *Fomentation to the Spine* (**1328**). — It would perhaps **729** be more proper to describe this measure as a fomentation to the back, as the application should not be confined to the spine, but should extend to the whole posterior surface of the trunk. A fomentation to the spine acts in a manner similar to the hot-blanket pack, but its effect is of course less intense. The application often produces profuse perspiration, whereby a considerable amount of heat is carried off. The hot pack is also a good preparation for a cold application, and is especially useful when the cold bath is contraindicated.

In some cases, alternate hot and cold compresses to the spine are more effective in producing perspiration than fomentations alone, and hence greatly promote heat elimination. A hot application to the spine encourages heat elimination by stimulation of the sweat centers.

17. *Fomentation to the Abdomen.* — This procedure, in **730** combination with other measures, aids in reducing temperature. When the patient complains of chilliness or is inclined to shiver, the abdominal fomentation will at once dissipate these unpleasant symptoms, and prevent the increased heat

production which would otherwise result from the muscular action induced. The fomentation aids in maintaining the surface circulation, and is an excellent means of preparing the patient for the cooling pack and the cold bath. In cases in which the cold bath produces abdominal pain or cramps, the fomentation for ten minutes just before the bath relieves this inconvenient symptom. The fomentation may be usefully employed in connection with the cold enema when this measure causes unpleasant shivering. It is useful, likewise, as a means of increasing tolerance for the cool abdominal compress, for which purpose the compress should be removed once in two hours and the fomentation applied for ten or fifteen minutes at as high a temperature as the patient can bear. Used in this manner, the fomentation materially aids the compress as a means of combating visceral congestion.

731 18. *The Hot and Cold Bath.*— In many cases, and especially in persons in whom the surface circulation is sluggish, more pronounced antipyretic effects may be produced by immediately preceding the cold bath with a hot bath at a temperature of 105° to 107° for 3 or 4 minutes, than by the use of the cold bath alone. Galen treated fever cases by rubbing with cold water after a warm bath.

Vinaj claims that the hot bath for three minutes, followed by a bath at 95°, gradually lowered to 80° during 5 to 15 minutes, is more effective in lowering the temperature than the cold bath of Brand, and produces more permanent results. The author has confirmed this in certain cases.

Pflüger found that greater refrigerant effects were produced by the hot spray for one minute, followed by a short cold spray, than by the cold spray alone. Finkler confirmed these results in experiments upon febrile rabbits.

This result is doubtless attributable to the increased heat elimination due to dilatation of the surface vessels, and to the atonic thermic reaction.

The observers mentioned noted also that a greater effect was produced by a short cold bath, if the body was sprinkled

with very hot water at the moment of emerging from the bath than if the cold bath were prolonged. This may prove an excellent method. The heat impression made upon the skin induces lessened heat production, without communicating a sufficient amount of heat to the body to cause a rise of temperature.

19. *Cold Applications to the Head, Spine, Heart, and* **732** *Abdomen.*— The application of the cooling compress **(1318)**, ice bag or cap, or the cold coil to the head or abdomen or to both regions, is a powerful means of reducing the general temperature, and was successfully employed by Spencer Wells and others in the treatment of patients suffering from a high temperature due to peritonitis. Benjamin Rush used an ox-bladder filled with broken ice in yellow fever more than one hundred years ago.

Cold applications to the head should never be neglected in fever cases, care being taken to wet the hair thoroughly, 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, however, in the application of cold to the head, that too pronounced depressing effects are not produced.

Winternitz has shown that the prolonged application of an ice-bag or an ice-water coil over the heart cools the blood, and thus 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 means of lowering the temperature. The antipyretic effect of this measure is doubtless due, in part at least, to its influence upon the circulation, as it dilates the surface vessels of the extremities.

20. *The Cold-Air Bath.*— The temperature of the air **733** in the sick-room has a most decided influence upon the body

temperature in the case of a fever patient, an increase of a few degrees in the temperature being often responsible for a rise of temperature in the patient which could not otherwise be accounted for. The fever patient is somewhat in the condition of the so-called cold-blooded animal, whose temperature rises and falls with that of the surrounding medium; for the body has lost the power of regulating its temperature, as it does when in a normal condition.

It should be remembered that while atmospheric temperatures below 58° F. cause increase of heat production, air at a temperature above 60° has a like tendency. Air is practically neutral between 60° and 70°, while at 104° the heat production may be three and one-half times the normal amount. Whenever the body temperature is above normal, tissue metabolism and heat production are increased.

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. It is interesting to recall in this connection that Currie relates a case of fever treated in 1801 in which the temperature was reduced from 104° to 101° by an air bath at 65°. The patient's body was exposed uncovered to the air, being placed between an open window and a large chimney. The pulse fell in a short time from 120 to 114. He also relates the case of an Arab traveler suffering from the plague who escaped from a caravan during a violent delirium, and wandered naked in the desert for three weeks, until he finally recovered. He subsisted during this time on sorrel.

The lungs present a surface of about two thousand square feet, while the skin has a surface of only seventeen square feet. It should be noted, however, that the surface presented by the perspiratory ducts of the skin aggregates more than eleven 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 considerably increased, can not be very large. I have, however, succeeded in lowering the temperature in fever cases by means of re-enforced respiration, causing the patient to breathe deeply of cold air while the arms were raised above his head to aid the respiratory effort.

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 sixty cubic feet of air per hour. To raise this air from 5° to the temperature of the patient, supposing the patient's temperature to be 105°, would require the addition of about 120 heat units, representing an equal amount of heat abstracted from the body, or a lowering of the temperature of 1° F. in a person weighing 120 pounds. So good a result can not be obtained in practice, however, for the reason that the air inhaled at 5° F. does not reach body temperature before being exhaled, and ordinarily the temperature of the inspired air is much higher. Yet a considerable degree of cooling may be effected through the breathing of cold air, provided pains is taken to increase the volume of air inspired. It is apparent, however, that the breathing of cold air is by no means so powerful a refrigerative measure as the exposure of the surface to cold air or cold water. Its beneficial action is doubtless largely due to the stimulation of the pulmonary circulation and the tonic reflex influence upon the heart.

The human body obeys the same physical laws as do other bodies as regards cooling by contact with air or radiation of heat toward masses of lower temperature. The experiments of Peclet show that the body cools by radiation at the rate of about one heat unit for each square foot of exposed skin surface per hour for each degree of difference

between the temperature of the skin and the temperature of the walls of the room in which the patient is exposed, while the rate of heat loss by contact with moving air is about one-half heat unit for each square foot of skin surface exposed to each degree of difference between the temperature of the skin and the temperature of the air in contact with the body. From these facts one may easily deduce the probable amount of cooling which will result from the administration of a cold-air bath. Suppose the temperature of the walls of the room to be about 60°, the temperature of the air 70°, the average skin temperature 95°, and the amount of skin surface exposed 10 square feet. We shall have, by application of the above rules, a loss of 350 heat units by radiation and 125 heat units by contact with the air, or 475 heat units in all. Supposing the weight of the patient to be 160 lbs., there would be a loss of 3 heat units per pound, or a lowering of the general body temperature of about 3 degrees. If the patient lies upon a hard surface, the amount of skin exposure will be greater than if the body rests upon a soft mattress. By frequently changing the position of the patient, turning first on one side and then on the other, the cooling surface may be considerably increased.

If it is desired to calculate the amount of skin surface actually active in a given case, it may be done by means of a simple formula: A man weighing 180 pounds has a skin surface of about 19.6 square feet. Applying the well-known law pertaining to the relation of the contents of a solid body to its surface, we obtain the following proportion, in which W represents the weight of the patient under consideration, and S the skin surface:—

$$180 : W :: 19.6^{\frac{1}{2}} : S^{\frac{1}{2}}$$

This may be simplified into the following formula:—

$$87\ W = 180\ S^{\frac{1}{2}};\ \text{or,}\ \frac{W}{2.07} = S^{\frac{1}{2}}$$

Or, if we divide the weight by 2.57, and square this quo-

tient, and extract the cube root of the result, we shall have the number of square feet of skin surface in a person of given weight.

If the patient weighs 130 pounds, the skin area would be 15.5 square feet. Supposing the amount of surface exposed to be two thirds of the whole, or about ten square feet; we require to know further only the surface temperature of the patient, the temperature of the walls of the room, and of the air about the patient, to be able to determine the rate of heat loss during an air bath of one hour's duration. This rate of cooling may be sufficient to compensate for heat production of nearly double the normal rate.

Since the heat production, as shown by the experiments of Winternitz, is rarely or never increased to this extent in febrile conditions, it is evident that the continuous cold-air bath, accompanied by rubbing to prevent chilling, is a most efficient antipyretic means.

Continuous moderate rubbing greatly enhances the effect of the air bath by maintaining a vigorous surface circulation. If the skin becomes cooled, the rate of heat elimination is greatly lessened. Under ordinary conditions, the skin eliminates 66.6 per cent. more heat with a surface temperature of 95° than with one of 85°. The employment of olive-oil, cocoa butter, or vaseline as a lubricant facilitates the rubbing, and increases the rate of radiation to the extent of perhaps forty or fifty per cent.

21. *The Graduated Compress.*—The compress (**1313**), as well as the full bath, may be graduated. The first application should be made at a temperature a few degrees below that 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 130°. Apply for 3 minutes. Such a compress, by producing an atonic thermic reaction, prepares the way for the fullest effect to be derived from the cold applications to follow. **734**

735 22. *Water-Drinking* **(1423)**.— The free drinking of cold water is an efficient means of lowering the temperature. Drinking two or three pints of water at a temperature of 40°, within ten minutes, has caused a fall of temperature of one and one half to two degrees. This method, first empirically used by John Hancocke nearly two centuries ago, has been 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 absorbing heat, but by diluting the blood, and thus promoting evaporation from the surface and exciting the kidneys to increased activity, thereby encouraging the elimination of the 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. Cantani considered water-drinking superior to all other means of reducing the temperature, and Beverly-Robinson, after an extended experience, highly recommends it, directing that the patient should swallow not less than six or seven quarts every twenty-four hours.

736 23. *The Tepid or Cold Enema* **(1405)**.—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 tepid or cool water may easily be 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 from 5 to 10 minutes, or as long as the patient does not suffer great inconvenience. The amount introduced should not be so large as to produce uncomfortable fulness 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 (Exp. 52). A long rectal tube should be used in introducing it.

The principle of graduation may be employed with the enema as with the cold bath. Beginning with a temperature of 98°, the water introduced may be steadily cooled until it is reduced to 70° or even lower. As a rule, however, a temperature of 80° is sufficient to accomplish the desired result.

A simple illustration will show the efficiency of the enema as a means of lowering the temperature. Suppose, for example, the quantity of water introduced to be five pounds (pints), and its temperature 70°, the patient's temperature being 105°, and his weight 150 pounds. If, on the withdrawal of the water, its temperature is found to be increased to 85°, the water has absorbed 75 pound Fahrenheit heat units (5x15=75), which would be an equivalent of one-half heat unit to each pound of the body weight, or .5° of temperature fall for the whole body. In other words, if there had been, in the meantime, no increase of heat production, the temperature of the body would be lowered .5°. By repeating the enema every fifteen minutes for an hour we may remove in four applications three hundred heat units, whereby the temperature of the body would be lowered 2°; but as the effect of a cool application of this sort is to stimulate heat production to some extent, we should not always expect quite so great effects as this, but rather a reduction of one to one and one-half degrees, which would certainly be an excellent result.

If water of a higher temperature — say 80° to 85° — is employed, which is sometimes necessary to avoid shivering and other discomforts to the patient, the rate of heat abstraction would be less; but on the other hand, the increase of heat production would also be less, and the measure may be continued for a longer time, and thus the net result may be equally great. On the whole, the results of clinical experience are decidedly in favor of long applications of moderate temperature, rather than short applications at a low temperature, as a means of temperature reduction.

Halm and Stolz reduced the temperature 3.6° and the pulse twenty-five beats per minute by using the cold enema in quantity of one liter, at a temperature of 46°, repeating eight times in succession, at intervals of from 5 to 10 minutes. Jacques employed the cold enema and water drinking in fever cases in 1839 with great success.

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 may be easily disconnected. It is better 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 5, 10, or 15 minutes if possible. Then, by disconnecting the short tube and without removing the rectal tube, the water may be allowed to escape into a suitable vessel, and another portion of cool or tepid water may be immediately introduced. In a fever case under the author's care 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 at the beginning of the treatment between 105° and 106°, and had proved refractory to every other measure, was reduced to 102°, and was thereafter readily controlled by a repetition of the same procedure.

The author has constantly made use of the enema at different temperatures in the treatment of fever patients during the last twenty years, and finds it, when properly used, one of the most efficacious of all antipyretic measures.

The larger the quantity of water introduced, the greater will be the cooling effect, for the reason that it will come in contact with a larger extent of surface. With the patient lying on his back, it is generally difficult to introduce more than one or two pints of water; but by placing him upon the left side, with the limbs drawn up, or by elevating the hips six or eight inches, a much larger amount of water may

be introduced, as by this means the liquid may be made to enter the transverse colon and even the cæcum. It is thus easy to introduce two or three quarts of water. If no more than one quart of water is used, the amount of surface with which the water is brought in contact is so small that comparatively slight effects are produced.

737 24. *Partial Cold Applications.*— When the general febrile action is the result of a local inflammatory process, as in many pelvic inflammations, appendicitis, pneumonia, pleurisy, peritonitis, acute arthritis, phlegmon, felon, 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, the cold compress, and the ice-bag are among the most suitable measures in these cases, employed either alone or in combination with fomentations or other hot applications, used either as a preliminary measure or at intervals, as special conditions may indicate.

In certain cases, as in compound fracture 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, the principle of the "proximal compress" (**1327**), so much used by Priessnitz, may be employed. In head injuries, apply the ice-collar. In injuries of the hand, employ the cold elbow bath. In injury or inflammation of the foot, apply an ice-bag to the groin or the bend of the knee. This method is based upon the well-known fact that an application of cold to the trunk of an artery causes contraction in all its branches beyond the point of application.

738 **Conditions Giving Rise to Elevation of Temperature.** As previously pointed out, elevation of temperature may occur in five different cases as regards the condition of the heat-regulating functions (**237**).

In the application of measures for the reduction of temperature, it must first be ascertained to which of the several classes the case in hand belongs. It may be that no hydriatic application of any sort should be made, or that hot

instead of cold applications are required. It may be profitable to note briefly the special indications in each of these classes of cases: —

In cases in which there is very great increase of heat production, with heat elimination increased, but to a less extent, by noticing the skin, the condition of which gives the best indication of the state of the patient as regards heat elimination, we may find any one of the following conditions: (*a*) Perspiring skin; (*b*) warm, moist skin; (*c*) hot, dry skin. We certainly would not find a cold skin, for heat elimination is increased.

What is to be done in cases of this sort? Certainly, if the skin is hot and the patient is perspiring freely, heat elimination is taking place as rapidly as possible, and usually no hydriatic applications should be made. We should simply dry the skin by wiping frequently with a soft warm cloth. If the skin is cold, even though it may be covered with moisture, elimination is not increased, for water will not evaporate quickly from a cold skin. The application of a cold bath, a cold enema, or any other refrigerating measure would be in the highest degree detrimental in cases of this sort, for it would check the perspiration and thus further diminish heat elimination, and would probably produce a chill, with internal congestion. This is a matter of great importance, especially in the treatment of pneumonia, and other fevers accompanied by an internal inflammation, and in dealing with such disorders as sweating sickness, which has prevailed so extensively in the southern part of the United States, in the West Indies, and in many other countries. Wiping frequently with a soft linen cloth promotes the cooling process by removing the surplus water and thus increasing the amount of radiating and evaporating surface.

In cases in which the skin is warm and slightly moist, but not perspiring freely, perspiration may be promoted by hot-water drinking, by hot sponging of the spine, and by a

small hot enema. The patient should otherwise be treated the same as when perspiration is profuse. If the skin is cold and moist or perspiring, hot applications should be made. The hot application may consist of a fomentation to the spine, a hot enema, a short hot-blanket pack, or an immersion bath at 102° for 3 or 4 minutes. Cold friction may be applied with great advantage immediately after the hot application in most cases.

739 Heat elimination may be encouraged by two general methods: (1) By the application of cooling measures; (2) by employing measures to induce perspiration. It is by no means easy to induce perspiration in cases of continued fever, the condition of the perspiratory glands being such that it is generally impossible to induce active sudation. When the patient does perspire, it is generally an indication of an improved condition, usually of a lowered temperature, except when other grave symptoms appear coincidently. On the other hand, the skin may be cooled at will, and to any extent desired; no matter how active may be the production of heat in the body, it is possible to apply to the skin cooling measures of such intensity that the heat produced within the body may be eliminated as rapidly as it is generated. The thick stove-cover becomes red-hot, but the temperature of the boiling kettle does not rise above 212°, the rate of heat elimination in the boiling kettle keeping pace with the rate at which the heat is communicated to its bottom.

740 Three different methods may be conveniently employed for the encouragement of heat elimination by cooling the skin. These are (1) the application of cold water; (2) the application of cold air; (3) evaporation of moisture from the skin.

Cold water may be applied by various hydriatic measures, of which methods 1 to 19 (**744**) are most appropriate and convenient for a case in which there is fever, with increase of both heat elimination and heat production.

The method of cooling the body by contact with cold air has been elsewhere described (**733**).

To cool the skin by evaporation it is only necessary to substitute ordinary water for the perspiration which nature is unable to produce. The evaporating sheet (**725**) and the sponge bath are the most efficient means of accomplishing this.

In cases in which there is an increase of heat production with normal heat elimination, there is evidently a greater need for an increase of heat elimination than in cases in which there is less active heat production, and consequently less necessity for the application of vigorous cold procedures. The first indication in cases of this sort is to stimulate activity of the peripheral circulation. This may usually be accomplished by friction of the skin; but if the temperature is high, vigorous friction will not be desirable, as mechanical irritation of this sort may stimulate heat production as well as heat elimination. Those measures most serviceable are the graduated bath, the tepid bath, the cold friction bath, and the graduated compress.

741 Friction should accompany all cold applications made in a case of this sort, as it is desirable to produce circulatory reaction, while thermic reaction should as far as possible be suppressed. The graduated bath and the tepid bath, with friction, are especially to be commended in cases of this class. The cold friction bath and cold immersion bath, cold affusion, the cooling shower pack, and other cold applications may be employed, provided a hot bath of some sort, as the hot-blanket pack for 5 minutes, hot immersion for 3 to 5 minutes, or some similar procedure is administered just before the cold application. The hot application must be short and intense (105° to 110°), and must be instantly followed by the cold application before the skin has been chilled by evaporation or contact with the air.

In cases of increased heat production with diminished heat elimination, the most important indication is to increase heat elimination. Heat production can not be so easily controlled, but heat elimination is entirely under the control of the physician, if the proper measures are employed.

At the same time that heat elimination is increased, thermic reaction must be avoided, or there will be heat increase. However, the elevation of temperature in a given case of this kind may be due as much to diminished heat elimination as to the increase of heat production. The most suitable measures to be employed for restoring the normal temperature are essentially the same as those recommended above. Care must be taken, however, in cases of this sort, to avoid too long-continued cold applications. The patient should be well covered after the bath, and must be well rubbed in the bath to insure vigorous surface circulation.

In cases in which heat production is normal, with heat elimination decreased,—a condition comparatively rare,—the skin is always cool. A hot skin generally implies increased heat elimination, although Herz, of Vienna, has shown that dryness of the skin greatly lessens heat elimination. Clamminess of the skin may be present, but this does not necessarily involve an increase of heat elimination by evaporation. The measures most serviceable in cases of this sort are, the Scotch douche, the hot-blanket pack followed by a short cold immersion bath with friction, or fomentations to the spine, followed by general cold friction.

In cases in which there is diminished heat production with 742
diminished heat elimination, but to a lesser degree, a hot bath (5 to 10 min.) followed by a short cold bath ($\frac{1}{2}$ min.) will be found a most efficient means of restoring the temperature equilibrium. The cold bath should be accompanied by vigorous rubbing, to secure thorough circulatory reaction. Rubbing should also be practiced in the bath to encourage both circulatory and thermic reaction. If the bath is continued too long, thermic reaction may be suppressed. In cases of this sort both thermic and circulatory reaction are to be encouraged. The hot enema, or fomentations to the spine, followed or accompanied by cold friction and dry friction afterward, are also valuable measures. The important thing is to increase the surface circulation. Pallor, blueness, or coldness

are always indications for the application of heat and friction to the skin. The effect of hot applications in stimulating the surface circulation, however, is transient; hence the importance of following the hot application by a very brief cold application, thereby exciting circulatory reaction, by means of which the blood is more permanently fixed in the skin and heat elimination encouraged. No harm is done if the application is carried to the extent of slight chilliness, provided the patient is afterward quickly warmed up by rubbing. Reaction must necessarily be encouraged by wrapping the patient warmly for a few moments after the cold application. Cold friction is a measure well adapted to cases of this sort, the pack following a fomentation to the spine or abdomen, the short hot full bath, or any other measure whereby the general surface of the body has been thoroughly heated.

743 In the treatment of febrile disorders it is important to take into account in each case and on each occasion, whether or not the dominant condition is increased heat production or diminished heat elimination. Winternitz has shown that variations in heat elimination may be sufficiently extensive to account for all changes in body temperature; nevertheless, it is quite certain that variations in heat production are also an important determining factor in deviations from the normal temperature mean.

In addition to the subjective and objective indications relating to the processes of heat production and elimination, there are calorimetric and other means by which more definite and exact information may be obtained. For example, by means of the formulæ given elsewhere (pp. 315, 316), we may determine the rate of heat elimination by radiation and air contact. Let us suppose, for example, in the case of a febrile patient, that the surface of the skin feels cold, and has an average temperature of 80° F., while the temperature of the walls of the room is 70° and that of the air 70°. By the formulæ the heat loss per hour for each square foot of surface will be 15 heat units. The weight of the patient is 120

pounds. By the formula already given (p. 316) we find the skin area to be 15 square feet (180: 120:: 87: S^2; $S = 15$). At the rate of 10,000 heat units' daily loss for a skin area of 19.6 square feet, the normal heat loss for a skin area of 15 square feet would be about 7,650 heat units. But the actual loss is only 5,400 ($15 \times 15 \times 24 = 5{,}400$), a diminution of 2,250 heat units, or 30 per cent. less than the normal rate of heat elimination. By this simple mathematical calculation it is possible in any case to determine approximately the rate of heat elimination to normal; and if the loss is found less than normal, while the rectal temperature is above normal, it will be at once evident that the febrile temperature may be readily accounted for by the retention of heat, and that the therapeutic indication is for the use of such measures as will increase heat elimination. In such a case, the Brand bath would of course be contraindicated; the measures required would be dry friction, or short hot baths followed by partial cold applications with vigorous friction. The use of the friction mitt with water at 50° to 60° would be especially indicated.

Let us suppose, on the other hand, that the patient's surface temperature is found to be high, the skin hot to the hand, and 100° by the surface thermometer. The heat loss will be at the rate of 16,200 heat units *per diem* ($45 \times 15 \times 24 = 16{,}200$), or an increase of 112 per cent. The rectal temperature being above normal, it is evident that there must be at least an equal percentage increase in heat production; and vigorous measures to diminish heat production and to increase heat elimination are required.

The use of the author's calorimeter and of the bath calorimeter first employed by Liebermeister more than thirty years ago, have been referred to elsewhere (**225**, **226**).

744 *Hydriatic Applications to be Employed in Cases in which Both Heat Production and Heat Elimination are Increased.*—In the following list the aim has been to arrange the various therapeutic measures suggested in the order of their greatest efficiency, naming the most valuable first:—

1. The graduated bath (**718**).
2. The cooling wet-sheet pack (**719**).
3. The Brand, or cold friction, bath (**716**).
4. The prolonged tepid immersion bath (88° F.) (**717**).
5. The cold immersion bath (**712, 731**), followed by a short hot immersion, affusion, or sprinkling.
6. Tepid affusion (**711**).
7. Cold affusion (**711**).
8. The shower pack (**720**).
9. The cold compress (**721**).
10. The graduated compress (**734**).
11. The evaporating sheet (**725**).
12. Cold to head and neck (**732**).
13. Cold to spine (**732**).
14. Cold to abdomen (**732**).
15. Cold over heart (**732**).
16. Cold irrigation (**1294**).
17. The tepid or cold enema (**736**).
18. Cold water drinking (**735**), a measure that should be combined with all the other measures named.
19. The cold air bath (**733**).

745 *Hydriatic Measures to be Employed in Cases in which Heat Elimination is Diminished or not Increased.*—The following list comprises the most serviceable measures for increasing heat elimination when fever is present and the cold bath contraindicated:—

1. Hot bath (2 to 3 min.) followed by a cold bath with friction (1 min.) (**731**).
2. Hot-blanket pack (**728**).
3. Hot evaporating sheet (**726**).
4. Hot sponge bath (**727**).
5. Fomentation to the back (**729**).
6. Fomentation to the abdomen, followed by the cold enema (**730, 736**).
7. Fomentation to the back, followed by a cold wet-sheet pack (**719**).

8. Hot-blanket pack, followed by graduated bath (**718**).
9. Hot-blanket pack followed by prolonged tepid bath.
10. Hot-blanket pack followed by cold friction.
11. Dry friction.
12. Cold friction.

Suggestions and Cautions Respecting the Use of Water for Antipyretic Effects.

746 Cold applications alone are contraindicated in fever cases in which the skin is cold, the lips or skin blue, when goose-flesh, perspiration, general shivering, or chilliness are present, and when cold applications are particularly disagreeable to the patient. In most cases of this sort, however, the contraindication may be made to disappear by a short general hot application, by which both the skin and the nervous system are prepared to receive beneficial effects from refrigerant measures.

When the cold enema produces colic pains or chilliness, a fomentation over the abdomen may be employed at the same time.

The same measures may be employed after any application the refrigerant effects of which appear to be more intense than was desired.

General cold applications, especially prolonged applications, must be avoided in cases in which there is a general febrile condition due to some internal local inflammation, as in acute ovaritis or salpingitis, or other pelvic inflammations, gastritis, nephritis, etc. The inrush of blood produced by the cold application in cases of this sort increases the congestion which already exists in the affected parts, and thus adds to the intensity of the inflammatory processes. Prolonged neutral and tepid applications or local revulsive applications are to be preferred in these cases. The general temperature may be most efficiently lowered by controlling the local inflammatory processes by appropriate measures.

Currie well recognized the importance of avoiding general cold applications in cases of general fever due to some local inflammatory affection, and recommended the tepid bath in

these conditions, with careful avoidance of the cold affusion or other applications likely to produce excitation or stimulation, remarking, "It appears to me probable that in the proportion of this stimulation is the difficulty of reducing the actual temperature." *

747 In the employment of the hot-blanket pack, fomentations, and the hot bath, care must be taken to avoid too *prolonged* applications. In an experiment, one of my assistants, a healthy young man, found that his temperature rose two degrees in half an hour in a hot-blanket pack. In a full 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 long hot bath in causing elevation of temperature will 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 was already elevated. For example, if a patient with a temperature at 105° 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° or 108°, with serious if not fatal results. The writer has known of several cases in which, under similar circumstances, the patient became delirious from the hyperpyrexia, and though quickly restored by the withdrawal of the heat and the application of cool sponging and cold compresses, was greatly excited for some time, remaining in a state of very great exhaustion for several hours.

The duration 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 or ten minutes.

Hydrotherapy, to be effective as an antipyretic, must be employed with vigor and unremitting perseverance. An ordinary sponge bath two or three times a day may afford a little comfort to a patient burning up with fever, but it is of no

* "Medical Reports," 4th edition, p. 204.

value whatever as a means of lowering the temperature or of combating the causes of the disease.

748 The readiness with which a high temperature yields to an application will depend upon the time of day and the stage of the disease, as well as upon the thoroughness of the application. The regular typhoid fever curve shows a rise of temperature from 7 A. M. to 3 P. M. After 3 P. M. a decline occurs, with another rise having its maximum at midnight, and followed again by a decline. It is evident that a bath given when the temperature is rising may have no other effect than to lessen the rate of the elevation of temperature and to lower the maximum point reached, while a bath given while the temperature is naturally falling will have the effect to accelerate the fall, and thus seem to be more efficient and beneficial, when the actual influence of the bath may be precisely the same in the two cases. This fact must be taken into account in estimating the value of any particular mode of treatment or any particular application.

749 The effect of the treatment upon the temperature must be judged not only by the immediate effect, but by the effect upon the daily curve, which should be carefully watched. A case rightly managed ought to show a steady decline in the maximum temperature for each day, after the first week, and the physician and nurse should consider it their duty to see that the temperature of the patient does not at any time rise above the maximum for the day on which treatment was begun. This result is nearly always possible except in those rare cases in which the patient is under observation from the very beginning of the malady, when there may be a gradual rise for the first few days, in spite of all measures to the contrary, due to the development of the disease. But every case seen at so early a period ought to be brought to a favorable issue.

750 Most authorities resort to the bath whenever the temperature reaches 102°, even though this may require the application of the bath six or eight times a day. This rule

may be a good one for the first week, but after that time, in the author's opinion, the temperature may easily be kept at a lower point by the intelligent employment of efficacious measures, in harmony with the principles which have been pointed out, with less frequent applications.

By the end of the second week, the temperature is much more easily controlled than during the first week, and if the fever continues for three or four weeks, the heat-producing powers of the body may be so much reduced that the more vigorous applications must be employed with the greatest care, if not wholly interdicted, because of the readiness with which the patient's temperature may be made to fall. In these cases the prolonged graduated bath lowered to a temperature of 92° or 88° is sufficient to control the temperature. The cold enema, the hot evaporating sheet, and the wet-sheet pack are often to be preferred to stronger measures.

The temperature is more easily controlled in mild than in severe cases. Unnecessarily extreme or severe measures should not be employed.

When hydrotherapeutic measures are properly directed and efficiently administered, the effect upon the temperature will be not only to lower it at the time of the bath, but to cause it to fall for half an hour or more after the bath, the effect being apparent for two or three hours. When the temperature is excessively high (104°-106° and above) and when normal or nearly normal (99°-100°), it is very difficult to lower it; but febrile temperatures between 100° and 104° generally yield quite readily to the persevering application of suitable measures.

As a rule, one need not expect to see all the characteristic symptoms of typhoid or other grave fevers present when hydriatic measures are thoroughly employed from the beginning, since the course of the disease is likely to be so favorably modified that the worst symptoms will not appear. This is especially true of coma, delirium, and other adynamic and atonic symptoms.

Hemorrhages sometimes appear as the natural result of the separation of the sphacelated structures when the ulceration happens to involve vessels of considerable size, but the danger of hemorrhage is in nowise increased by hydrotherapeutic applications, neither is it a contraindication for the use of these measures, except as regards certain of the more severe general cold applications.

The influence of hydrotherapy in lessening the frequency of grave symptoms is clearly indicated by the fact that when the bath has been systematically and efficiently used in cases of extensive epidemics, the mortality has uniformly been reduced to a small fraction of the usual rate.

Hydrotherapy is entirely safe when judiciously employed, 751
and its use is free from serious objections; while the use of medicinal antipyretics is attended by many objectionable features, of which the following are but a few: —

1. In the use of antipyrin and other temperature-lowering drugs, the depression is usually followed by an elevation to a point higher than before.

2. The depression of temperature is short, and the patient's condition while under the influence of the drug is often one closely bordering on collapse. When the use of quinine as an antipyretic was advocated by Dr. Austin Flint, some twenty-five years ago, the author made trial of its use in comparison with baths, and found that though it produced a fall of temperature, the effect was very transient. Bouchard pointed out a few years later that after obtaining an antipyretic effect with quinine, the second dose, even though a large one, produced practically no effect unless a period of three days was allowed to elapse after the first.

Hydrotherapy shortens the duration of febrile disease, renders grave cases mild, and lowers its mortality from twenty per cent. to three or four per cent., or even less.

The numerous other advantages of the hydriatic method of dealing with all febrile disorders will be further discussed in other chapters of this work.

752

Conditions in which there is Disturbance of the Heat-Regulating Functions with Depression of Temperature.

As conditions of temperature depression are occasionally encountered in connection with the treatment of fevers, it is important to know their significance and the remedies which should be employed to combat them.

In conditions in which there is a depression of temperature while heat elimination is increased, it is evident that heat production must be, if not normal or less than normal, at least increased to a less extent than heat elimination. This is a condition which naturally results from exposure to a low temperature without proper protection. Prolonged profuse perspiration from any cause, particularly night sweats and the perspiration following the chill and fever of ague, is often a cause of subnormal temperature.

There may be a lowering of temperature with diminished heat production, and with either normal, diminished, or increased heat elimination. All these conditions are sometimes encountered in cases of starvation from obstruction of the esophagus and in cases of semi-starvation due to chronic indigestion with anorexia.

In surgical shock or severe vital collapse of any sort, we may find both heat production and heat elimination diminished.

In every case a careful inquiry should be made to determine as nearly as possible the relation of heat production and heat elimination to each other, to the normal degree of activity, and to the abnormal rise of temperature. All the symptoms and the conditions of the patient should be carefully considered, so that a correct judgment may be formed with reference to the therapeutic indications of the case, and that the appropriate remedy may be employed.

If a patient's temperature is subnormal because of excessive heat elimination, nothing more may be required than additional protection, a few blankets, hot water bottles, an elevation of the room temperature, hot drinks, the hot

enema, and dry rubbing. The application of oil to the surface is a measure not to be neglected as one of the most efficient means of lessening heat elimination, so long as the body is covered.

If the temperature depression is due to colliquative sweating, hot saline sponging is indicated.

If the subnormal temperature is due to diminished heat production from the results of starvation from any cause, the remedy here again is clearly indicated, — such food must be selected as will furnish heat-supporting elements in abundant quantity and in a form easy of assimilation; nutritive enemas may be employed; and the patient should be given absolute rest, with sufficient protection, hot water bags, etc., to restore the balance between heat elimination and heat production.

Temperature depression from shock requires artificial heat, internally and externally. A large hot enema (**736**), fomentations to the spine (**729**), hot bags, hot blankets, and rubbing of the surface are especially indicated.

Contraindications for the Cold, or Brand Bath.

753 The cold bath is a measure capable of much mischief as well as much good. It is of the highest importance to understand its limitations and contraindications. The conditions which forbid its use or which render necessary the most extraordinary caution and circumspection in its employment, may be briefly stated as follows: —

754 1. *Sweating.* — Under ordinary circumstances the presence of perspiration is evidence either that the febrile action is subsiding or that nature is doing all that can be done to lower the temperature and eliminate the toxin which is the disturbing element.

In the disease known as sweating sickness a persistent high temperature long continued renders necessary the use of cold as a heart tonic and to promote vital resistance; it is not best, however, to resort to so severe a measure as the Brand bath. The desired effect may be secured by means of cold

friction (**1209**). At first, water at the ordinary temperature (70° to 75°) should be employed, and the mitt should be moistened only, not filled with water, as in ordinary cases of fever. Care should be taken to apply the friction to small areas successively, and to secure reaction as quickly as possible, and to avoid provoking general chilliness. The application may be repeated every two or three hours, but two or three daily applications will be found sufficient in ordinary cases. If the application of cold friction to the whole surface is not well tolerated, it may be confined to the back and chest. The application to the chest stimulates the heart action in a most powerful manner, while the application to the back arouses the central nervous system, and promotes general vital resistance almost as much as an application to the general surface. The surface should be dried and rubbed before the cold mitt is applied.

755 2. *Goose-Flesh Appearance.*—This physiological evidence of chill and a lowered temperature of the blood is sometimes present when the internal temperature is several degrees above normal, as the result of the action of toxic substances in the circulation. This symptom indicates that there is a persistent contraction of the small blood-vessels of the skin which directly antagonizes heat elimination. To put a patient in such a condition into a bath at 65° F. or even at 75° is not only an irrational but a hazardous proceeding, and is as unnecessary as it is unwise. Every indication which would be met by the cold bath can be better answered by other perfectly safe and efficient means. Rubbing with the friction mitt moistened in water at a temperature of 60° to 70° is usually sufficiently exciting, but ice-water may be used when more powerfully excitant effects are required. The same precautions must be observed as when perspiration is present. It is always desirable to precede the cold friction by a fomentation or some other hot application to the spine. Cold friction produces reaction by a powerful thermic impression combined with the mechanical effect.

3. *Cyanosis.*— Here again the cold bath of Brand is 756
decidedly contraindicated. This symptom is an indication that the movement of the blood is slowed as the result of cardiac weakness, and the heart is not prepared to sustain the shock of sudden and prolonged contact of cold water with the whole surface of the body, while the internal viscera, already profoundly congested in consequence of the cardiac inefficiency, would be endangered, especially the lungs, liver, and spleen. Administer a short hot bath, a hot enema, or a fomentation to the spine followed by cold friction, beginning with the chest, then the back, and last of all the legs. In these cases applications of cold by means of the friction mitt are of the greatest service, not only in lowering the temperature, but in stimulating cardiac action, arousing the peripheral heart to activity, exciting increased renal activity, and promoting oxidation and increased vital resistance. By its use most of the advantages of the cold bath may be secured, with none of its disadvantages.

4. *Pronounced Cardiac Weakness.*— The dicrotic pulse, 757
marked weakening of the first sound of the heart, and especially the "pendulum" action of the heart, in which the two silent periods of the heart's action are equal or nearly equal, are indications of an asthenic state of the heart, in which it is wholly unprepared to meet the tremendous demands temporarily made upon it by placing the patient suddenly in a tub of cold water. By means of the cold precordial compress, hot and cold sponging of the spine, and general cold friction, the energy of the heart may be re-enforced and its work diminished by increased activity of the peripheral heart. Under this simple treatment the pulse rapidly improves, the temperature is lowered as the result of the increased movement of the blood, and the general improved appearance of the patient, his easier breathing, and the disappearance of various nervous symptoms afford evidence that he is better.

Areolar cyanosis following a local cold application is an indication of great cardiac weakness and impending

collapse, which may, by aid of this warning symptom, be foreseen and prevented by general cold friction and the
758 cardiac compress often repeated.

5. *Myocarditis.*— The remarks respecting cardiac weakness apply with added emphasis to conditions in which the heart is the seat of an inflammatory process, as in endocarditis, pericarditis, and especially myocarditis. The last-named complication, which is not infrequently encountered in typhoid and other continued fevers, especially requires circumspection in the use of the cold bath. The sudden inrush of blood attending a general cold bath may easily overwhelm a heart whose muscular structures are crippled by an inflammatory process, while its nerve centers are depressed by the toxins characteristic of the general maladies present. If such patients escape alive, notwithstanding the severe treatment to which they are subjected by overzealous disciples of the hydriatic method of dealing with febrile disorders, the fact must be attributed to the wonderful energizing properties of the cold bath, and the marvelous resources of nature.

759 6. *Intestinal Perforation.*— The cold bath, when employed from the beginning in typhoid fever, greatly lessens the liability to this grave complication. When begun late in the disease, however, perforation sometimes occurs in spite of the ameliorating influence of cold bathing. When the symptoms of perforation occur, the general cold bath must be suspended, as its use not only involves considerable disturbance of the patient, but powerfully excites intestinal peristalsis, thus increasing the dangers incident to the perforation. Cold friction to the chest, the cold precordial compress, and general cold friction, carefully applied, may be employed to meet pressing symptoms of heart failure or collapse, and to improve the patient's resisting powers.

760 7. *Peritonitis.*— It may be said of this complication, as of the preceding, that it rarely occurs in typhoid fever when the cold bath is systematically employed from the beginning. It is, in fact, practically unknown in such cases. When

present in connection with general fever, it is a contraindication for the general cold bath. Fomentations, revulsive applications, and the cooling compress may be applied to the abdomen, but the general cold bath is decidedly contraindicated. The prolonged tepid bath (88°)and the short hot bath followed by cold friction are suitable measures for meeting the indications to which the cold bath is applicable under other circumstances.

8. *Pleurisy and Pneumonia.*— Both of these conditions, **761** when occurring in connection with typhoid fever, smallpox, or any other continued fever, are a contraindication of the cold bath. The neutral bath, the hot bath followed by cold friction, the cooling pack carefully managed, and especially the cooling chest compress with fomentations to the chest every two or three hours, are proper hydriatic measures to be employed in connection with these complications.

9. *Tuberculosis.*— When this complication occurs in con- **762** nection with typhoid fever, as it occasionally does, or in connection with any other continued fever, the cold bath must be interdicted on account of the intense visceral congestion occasioned by it. The wet-sheet pack and cold friction with the mitt well filled with water when the temperature is high, are suitable measures for a case of this sort. The cooling chest compress should also be employed.

10. *Infancy.*— The immersion bath at low temperature is **763** contraindicated in infancy because of the small heat-making capacity of the young child and the large radiating surface as compared with the weight. The vital powers of an infant, that is, a child under seven years of age, are not sufficiently vigorous to react to the ordinary Brand bath. The tepid bath, the cooling pack, and cold friction are suitable measures for this condition.

11. *Old Age.*— The conditions in old age, while decidedly **764** different from those in infancy, also constitute a contraindication to the use of the cold bath. The presence of arteriosclerosis is always a contraindication for the cold bath, what-

ever the age of the patient. The condition of the arteries, rather than the number of years, constitutes the physical condition referred to in this connection by the term "old age." The inactive skin, the weak heart, the general sluggishness of the bodily functions, low vital resistance, the diminished heat-making capacity, — these conditions, characteristic of senility, afford sufficient grounds for forbidding the use of the Brand bath, even though the person is not advanced in years. The prolonged tepid bath, the repeated wet-sheet pack, cold friction, the rubbing wet sheet (reclining), cold water drinking, are the measures to be employed in old age. With proper management these procedures may afford as good results as those obtained from the use of the Brand bath, and without the danger involved in the use of this vigorous procedure.

765 12. *Late or Neglected Cases.* — While cold baths may be used with impunity in ordinary cases of fever in which the general resistance of the body is good, and before the vital forces have been depressed by the long continuance of the disease, this is by no means true in cases in which hydriatric treatment has been neglected during the first week or ten days of the malady; hence great care must be taken in the use of the cold bath in cases which come under observation at an advanced period of the disease. In these neglected cases the condition of the patient is generally one of great nervous exhaustion, with cardiac weakness, not infrequently beginning degenerations; the nerve centers are weakened through starvation and malnutrition and the long-continued action of the toxins characteristic of the disease; heat production is limited, while heat elimination is deficient through spasm of the surface vessels. Ataxia or adynamic symptoms are marked, and not infrequently these conditions are found associated. There is a tendency to hypostatic congestion of the lungs, and, indeed, this condition may be already present. The liver, spleen, and other viscera are intensely congested, their functions are thereby seriously impaired, and their structure

may be injured. To plunge such a patient into a bath at 65° to 70° and retain him there for 10 or 15 minutes will most certainly imperil his life. The tonic influence of cold is in the highest degree desirable, but the patient is too weak to react to so powerful an impression as is made by the contact of cold water with the entire surface of the body at the same instant. By means of partial cold rubbings applied to different portions of the body successively, the cutaneous circulation may be marvelously improved without increasing, even momentarily, internal congestion. By increasing the movement of the blood, and especially by producing a hyperemic condition of the skin, the internal congestion may be definitely relieved. The heart is reflexly energized at the same time its labor is lessened, by the increased activity of the peripheral heart accompanying the reaction resulting from the cold friction. Similar though vigorous effects may be obtained by rubbing the skin with dry, warm flannels. The prolonged neutral bath (92° to 95°) and a hot-blanket pack for 10 minutes, followed by cold friction, are the best measures for aiding heat elimination. Hot and cold sponging of the spine, or, better, the alternate hot and cold spray to the spine, produces an excellent effect upon the central nervous system. The bedsores likely to be present in these late cases render the full bath inconvenient, but do not interfere with the application of packs, compresses, cold friction, and allied measures. The hot enema followed by cold friction is a most effective means for aiding heat elimination, through stimulation of the kidneys and arousing of the depressed energies of the patient to resist the disease.

In the management of these grave cases, in which the life of the patient depends so much upon the exact and judicious employment of effective therapeutic procedures, it is important to remember that death in these cases, when attributed to so-called heart failure, is really due to general collapse of the vital powers. The weak condition of the heart is a true index to the condition of the body as a whole. The heart continues

its work until the body as a whole is ready to surrender, then fails with the rest.

It may be remembered with advantage, also, that cardiac weakness is not the only, nor always the chief, cause of the feeble circulation in adynamic conditions in fever. The blood movement depends upon several other important factors in addition to the cardiac activity: respiratory movements, rhythmical action of the small vessels, the caliber of the small vessels, the tone of the tissues, cell activity, the mass of the blood,— each and all of these factors may be modified by hydric applications over the heart and to the general cutaneous and mucous surfaces, as has been pointed out elsewhere.

A brief cold application to the skin stirs the whole bodily fabric to its deepest foundations. Every cell and fiber vibrates in response, so to speak, and quivers with a new life, a reinforced energy, which appears not only in the surface reaction which follows, but in the quickening of its own proper functions as well as improvement in the quality of the work performed. Tonic applications of water are the most effective of all known means for setting in motion and maintaining those renovating and restorative processes in which the recovery of the sick chiefly depends.

Secretory Sedative Effects

Cold applications made in such a way as to lower the temperature of the secreting structures of a gland, produce an important and very marked diminuation in secretory activity while heat produces the opposite effect. The activity of the mammary glands may be by this means controlled to a remarkable extent, and salivary activity may likewise be to some degree influenced. The most striking illustration of this action is seen in the instantaneous control of profuse perspiration by cold application to the surface. The activity of an internal gland is reflexly excited by cold applications made upon the overlying skin. The opposite effect, or sedation, is produced by neutral and hot applications (92°-104°). Very hot applications may produce excitant effects allied to those resulting from cold applications.

GENERAL RULES, PRINCIPLES, AND SUGGESTIONS RELATING TO THE PRACTICAL EMPLOYMENT OF HYDROTHERAPY.

IN the employment of water as a therapeutic means, it is first of all important to keep in mind the principle that it is the patient, not his disease, who is to be treated. The fundamental idea in hydrotherapy, as with all rational measures of treatment, is that the curative force resides in the body, and that the office of the physician, aided by intelligent and trained assistants and nurses, and by the co-operation of the patient, is to supply such conditions as will aid the natural forces of the body in combating the disease. It is hence of the utmost importance that the general plan of treatment adopted for the relief of any particular case shall first of all take into account the causes by which the patient's maladies may have been induced. These will usually be found to exist in some wrong habits of life, of which the patient himself may have been wholly ignorant, at least as regards their deleterious character.

All cases of chronic disease may be roughly divided into 766
two general classes: —

1. Those in which the seat of the disease is a local irritation of mechanical or other origin, such as eye-strain, catarrh of the nose, stomach, liver, or bladder; or in which there is a local mechanical or tissue injury, as in dilatation or prolapse of the stomach, floating kidney, displacement of the pelvic organs, ulceration of the stomach, etc.

2. Those due to a diathesis, or a constitutional condition, as in diabetes, obesity, migraine, neurasthenia, chronic uric acid poisoning, Bright's disease, and the various degenerations.

In order, then, to form an intelligent idea of the proper course to be pursued in the treatment of any given case, there

must be a careful scrutiny of the causes which have led up to it, and of the exact pathological conditions existing. For example, in indigestion we must ascertain with accuracy, in order to employ the proper measures, whether or not a patient is suffering from apepsia, hypopepsia, hyperpepsia, or simple dyspepsia, and whether or not there exists so-called chronic or subacute gastritis or a condition of increased or diminished sensory or motor irritability. Insomnia may be due to local irritation of some sort, to chronic toxemia, or to cerebral anemia or congestion. An anemia found present may be the result of a recent hemorrhage from a wound, of profuse menorrhagia, hemorrhoids, gastric ulcer, a surgical operation, a fever, tuberculosis, malaria.

767 **General Directions for the Use of the Bath.**

1. Before beginning a course of general applications of cold water, careful investigation should be made respecting the condition of the heart, the nervous system, the liver, the kidneys, and other viscera, so that all contra-indications may be at once apprehended and the proper allowance made therefor. It is also important to ascertain in each case a patient's reaction power by means of a partial cold bath of some sort, and by the dermographic test.

In very feeble patients, there may be sufficient nervous energy to react well when an application of cold is very limited in extent, but not enough to secure prompt and vigorous reaction when the application extends to the entire surface of the body; in such cases, the effects produced by the first bath should be carefully noted, and the prescription should be arranged in accordance with the indications thus obtained.

If any of the symptoms of imperfect reaction occur, those measures necessary to encourage reaction should be adopted, as elsewhere indicated (**443**). If the reaction is excessive, less strongly stimulating measures should be employed; that is, (*a*) raise the temperature a few degrees; (*b*) substitute a non-percutient form of bath for the douche, as a cold friction bath, a wet-sheet or a towel rub, a sitz, immersion, or affusion;

(*c*) have the patient exercise less long or vigorously before or after the bath; or (*d*) follow the cold application by a short cool or tepid non-percutient application, as a wet-sheet rub or affusion at 75° or 80° F., cover less warmly in bed, or otherwise modify the measures which promote reaction.

2. After short, very cold applications, watch carefully for the appearance of the bright-red color which indicates normal reaction. If this does not, under vigorous friction, appear within one minute or less, it will usually be found wise to precede the cold application by the hot rain or jet douche, hot bath, steam bath, or some other general hot application. The hot application should be continued from three to five minutes, followed by a cold application, when a good reaction will be assured, even in patients whose power in this direction is quite limited. The application of heat in this manner greatly diminishes the unpleasant impression of cold applications, while at the same time promoting to a high degree the circulatory reaction. After a very hot bath it is sometimes well to diminish the shock resulting from the contact of very cold water by an intermediate tepid or cool application.

3. *The Duration of Applications.*— The lower the tem- 768
perature of the water, the shorter should be the application.

For very cold applications, the duration should be 1 to 5 seconds. The duration of the cool douche may be 10 to 30 seconds.

Tepid, warm, and hot douches may be much more prolonged, especially when moderate pressure is employed. The duration may be from 1 or 2 minutes to 10 or 15 minutes.

Very hot applications should be of moderate length, rarely more than one minute.

When employed to reduce the temperature in fever, and for antiphlogistic effects, non-percutient, cool applications may be prolonged to 15 or 20 minutes.

The neutral bath may be continued as long as circumstances require. It may be made practically continuous for several months, if care is taken to regulate the temperature

so carefully that thermic reaction is wholly suppressed. For sedative effects, from 30 minutes to 1 or 2 hours is the usual time required.

769 4. *The Temperature of Applications.*—In general, it should be the constant aim to train the patient progressively to react to water at as low a temperature as possible, the temperature of the water being steadily lowered day by day.

5. The best and most durable effects are produced by short cold applications, frequently repeated.

6. Long cold applications may be too exciting by producing a too strong reaction, or the effect may prove to be sedative or exhausting instead of tonic. This is especially true of emaciated and anemic persons, and those suffering from sclerosis. In emaciated persons the amount of fuel for heat production is diminished, and the amount of oxygen taken into the blood is also below the normal standard; hence the calorific, or heat-making, powers are deficient and easily exhausted, so that a too prolonged cold application may result in an excessive loss of heat, as indicated by delayed reaction, prolonged chill, or the frequent recurrence of chill or chilliness after the application.

7. In persons suffering from nervous exhaustion, especially, the reaction ability of the nerve centers is speedily exhausted; hence the importance of making cold applications very short in duration.

770 **The Therapeutic Significance of Reaction.** The phenomena of reaction under physiological and pathological states is a subject which must be thoroughly understood by the hydriatist. Elsewhere (**429–480, 577, 578**) the rationale of reaction under physiological conditions has been fully explained; here the subject will be considered briefly from the standpoint of practical therapeutics.

First of all, it may be remarked that a large share of the therapeutic applications of water require either the production or the suppression of reaction, or the production of atonic reaction effects. Hence it is of the utmost importance not

only that every patient should be carefully studied in relation to his ability to react at the beginning of a course of hydriatic treatment, but that the reaction of the system to each different procedure employed, and to each daily application, should be carefully noted, and any necessary readjustment of the prescription made at once. Hydriatic treatment must be under the immediate supervision of a competent medically educated person, and must never be left to the inaccuracies of a bath attendant, no matter how well trained.

Conditions that Control Reaction.

771 The intensity of the reaction effects following a given application depend upon —

1. The method of application, especially whether percutient or non-percutient (Exp. 53).

2. The temperature of the water.

3. The length of the application.

4. The condition of the patient, whether (*a*) febrile or non-febrile, (*b*) weak or strong, (*c*) fat or thin, (*d*) rested or fatigued, (*e*) warm or chilly.

5. The ability to develop animal heat.

6. The ability to repair quickly 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 the application.

8. Whether accustomed to cold bathing.

9. The mental state of the patient, whether apprehensive and fearful, or resigned, cheerful, and in a condition of mind to co-operate with the treatment.

It is well to recall that in cases in which a patient does not react well to low temperatures, the reaction effect desired may be encouraged by strong friction or by increased pressure if the douche is employed.

Oscillatory Reaction.

772 Several oscillations of reaction are sometimes observed following a cold bath, each recurrent reaction being weaker than the preceding. These oscillations are doubtless due to the swift rush

of blood to the skin during the first reaction, whereby it is rapidly cooled by evaporation from the moist surface which has perhaps been insufficiently dried, and also through the consumption of heat energy by its conversion into mechanical work by friction and exercise.

773 **Suppression of Reaction.** While it is usually the aim to promote reaction, there are cases in which the suppression of reaction (**432**) is of the highest importance. Sometimes reaction must be suppressed altogether,—when sedative effects are desired, as in cases of fever, inflammation, nervous irritability or insomnia, burns, wounds of various sorts, and hemorrhages. The means by which reaction may be diminished or increased have been fully described elsewhere (**443–459**).

EXERCISE IN CONNECTION WITH HYDRIATIC APPLICATIONS.

774 From the days of the earliest cold-water cures, the importance of exercise in connection with water 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, douchings, 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 from treatment under the old water-cure system was the result of the muscular activity required in connection with the routine of baths to which each patient was required to 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, those who were not able to exercise being 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 from five to fifteen minutes after a cold bath is continued and increased by exercise, so that the maximum diminution is fully half a degree greater with moderate exercise than without it.

Exercise before the Bath.

775 In persons able to take exercise, a sufficient amount of physical activity to produce slight perspiration before a bath favors the tonic effect of the application, and re-enforces 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 a secondary 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 must be 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 the heart or the 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, self-resistive exercises,* and moderate exercise with chest-weights.

* For description of a system of self-resistive exercises, see paper by the author, in *Modern Medicine* for December, 1898.

Persons who are unable to take exercise may be prepared for a cold bath by massage, by vigorous friction, by manual Swedish movements, or by an application of heat.

A preparation by exercise, either active or passive, is to be preferred 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 are apt to be quite exhausted by the too strong reflex activities set up, especially in feeble persons, resulting in incomplete reaction and depression.

776 **Exercise after the Bath.**

Imperfect reaction after the cold bath is in the highest degree injurious, and lack of knowledge as to how to avoid this exceedingly disagreeable and inconvenient accident is responsible for much of the prejudice existing against the employment of the cold bath as a hygienic or therapeutic measure.

Incomplete reaction not only frequently results in a secondary 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 pains, 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 the patient is sufficiently strong to walk.

Reaction may be favored by covering the patient with blankets or surrounding him with hot-water bags or other means of artificial heating, or by his remaining in a warm room; but the reaction effects obtained are far less beneficial than those which result from exercise. The reason of this will appear when it is remembered that exercise favors thermic reaction, and that thermic reaction means activity, not only in the nerve-muscular thermogenetic apparatus, but in every cell and tissue of the body, and an exaltation of function.

The application of artificial heat, on the other hand, lessens thermic reaction by the atonic reaction effect which is connected with hot applications of all sorts. Thus exercise promotes the most efficient element of the reaction following cold applications when tonic and reconstructive effects are desired, viz., the thermic reaction, whereas artificial heat diminishes this most important factor.

Exercise immediately following the bath favors regular and complete circulatory and thermic reaction, thus increasing the fall of temperature, and making the bath more thoroughgoing and efficient in its effects upon the system. The fall of temperature produced by exercise following a cold bath may amount to nearly one degree Fahrenheit.

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 stimulation of the heart and 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 the heart's 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, and protecting the parts, so far as possible, from the evil effects of refrigeration. When reaction begins, and the blood pressure falls (though not below normal) with the dilatation of the surface vessels, the heart's action is slowed — 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, for otherwise slight changes in the atmospheric temperature might result in excessive and exhausting perturbations of the nervous and vascular systems; as it is the purpose of therapeutic applications which promote reaction to produce 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 will be quickened and the blood promptly forced to the surface of the body.

The increased vascularity of the skin thus induced, encourages 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, in which case 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, in order 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 can not, however, 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 overexciting heat production, place the balance between

heat production and heat elimination on the wrong 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, in the author's opinion, that better results are obtained from reaction when the process takes place regularly and slowly, as has long been known to be the case from clinical observation.

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.

777 Occasionally cases are met in which the patient is so feeble that he can not react spontaneously, even by the aid of massage, and it is necessary to employ artificial means to assist the reaction. The patient should be wrapped in a Turkish sheet as quickly as possible after the bath, covered with blankets, and dried by vigorous rubbing underneath the blankets. The moist sheet should be removed, the woolen blanket placed next the body should be tucked carefully around each limb and close about the neck, and hot bags 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 carefully withdrawn as reaction sets in, so that excessive reaction with sweating may be prevented, as this will destroy the tonic effect of the cold application.

Avoid Excessive Heat.

778 A rule which was insisted upon by Priessnitz, and which is quite universally followed by hydrotherapeutists, is that the sun, excessive clothing, heated rooms, and especially stove heat or other artificial heat, should be sedulously avoided after a bath. 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 depends, are arrested before being fully developed by atonic thermic reaction.

Great care should be taken after a cold bath to avoid any circumstance or condition which will cause perspiration, which, when produced in any manner after a cold bath, 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 times patients imagine that they have taken cold in a bath from the application of cold water, when the untoward effects are really the result of either incomplete reaction after the bath or a reaction accompanied by perspiration.

A THOROUGH SCIENTIFIC EXAMINATION NECESSARY AS A FOUNDATION FOR A HYDRIATIC PRESCRIPTION.

779 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, in cases of anemia, to note the relative proportion of the different varieties of white 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. 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 leucomains, either from diminished excretion, as from cold, or from overproduction, as in exhaustion or 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. Every case must be carefully investigated with reference to the existence of pathological changes, either functional or structural.

(1) The functional disturbances which it is especially important to note are hypopepsia, apepsia, or hyperpepsia; local congestion or irritation of the bowels, bladder, uterus, or ovaries; irritability of heart or lungs or sympathetic centers; 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 the measures of treatment employed so as to avoid untoward effects which might at least discourage the patient, and not infrequently be the cause of more serious damage.

(2) Structural changes, such as those which are commonly found present in advanced cases of lithemia, in arteriosclerosis, Bright's disease, hepatic enlargement or 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 or 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 or a thick skin? Is he a person of resolution and strong will, or a weak-willed, irresolute individual? Is he of a persevering, reliable disposition? or is he unstable, vac-

illating, easily discouraged? The treatment must be carefully planned with reference to all these considerations.

780 **Physical Coefficients.**

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, more may be learned at a glance respecting the general vital capabilities and the physical peculiarities of a patient than by weeks of "cut-and-try" experience.* The chief practical deductions 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 measures, if otherwise indicated.

(2) A *low height-weight* coefficient gives contrary indications as regards the prolonged use of tissue-wasting measures, though not forbidding their temporary or careful use.

(3) A *high strength-weight* coefficient may indicate either a deficiency of fat or an unusual muscular development. This coefficient must accordingly be considered in connection with the height-weight and strength-weight coefficients.

(4) A *high strength-weight* coefficient with *normal height-weight* coefficient, indicates a good foundation for thermic reaction to cold applications, a constitution not greatly impaired, nutrition well sustained.

(5) 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 combated by frequent sweating baths, followed by cold baths.

(6) A *high strength-weight* coefficient, with *low height-weight* coefficient, indicates that with a deficiency of reserve tissue and hence lack of ability for sustained resistance to cold applications, there is at least fairly good vitality and power to

*See paper entitled "Physical Coefficients," by the author, published in *Modern Medicine*, July, 1895.

effect a good reaction; but the cold applications must be short and not too frequent.

(7) A *low strength-weight* coefficient with a *normal height-weight* coefficient indicates diminished muscular and nervous energy and 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 at high pressure.

(8) 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 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, and provided also that the strength-weight coefficient is nearly normal.

(9) 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 the sedative effect of hot baths or the calorification required by cold baths. Strongly tonic measures are needed, with careful avoidance of spoliative procedures; but the patient will tolerate cold badly and will be easily overstimulated. The very short hot douche will be 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).

(10) The *strength-height* coefficient is a good indication of the general neuro-muscular condition of the patient. A normal or *high strength-height* coefficient indicates a good store of nerve energy and good power of circulatory and thermic reaction, the muscles being the seat of the most active heat-making processes. The nerve tone and muscular development are good, and, unless otherwise contraindicated, all kinds of rational hydriatic means will be well tolerated.

(11) A *low strength-height* 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 hydriatic 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 percutient measures must be used, or in the absence of a douche apparatus, cold friction or the 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.

781 **Adaptation to Individual Cases.**

7. The patient's physical aptitudes or temperament must also be carefully considered. 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 a test (**480, 596**). 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. Although an empiric, he was a remarkably sagacious one, and his success was largely due to his acute powers of ob-

servation. For example, he reasoned that if chilling the feet will cause congestion and inflammation of the internal organs, there must be some important relation existing between these parts capable of use in the treatment of diseased parts. This he accomplished by studying and utilizing the principle of reaction.

8. It is impossible to make a routine prescription of hydriatic measures. These powerful agencies must be regulated with even greater nicety than medicinal agents, as the difference of a few degrees 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.

9. The patient's habits of life,—whether he has been accustomed to cold bathing and regular active exercise; what have been his habits as regards clothing, especially whether or not excessive clothing has been habitually worn; the length of time he intends to remain under treatment,—these and other kindred matters must be carefully considered.

Organotherapy and Symptomatic Treatment to be Avoided.

10. Before making a prescription in any case, 782 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 from distressing and annoying symptoms, even though the measures employed therefor may not be radically curative in their character; at the same time, there must be a systematic employment of those measures which, if perseveringly used, may ultimately result in abolishing the symptoms altogether. It is above all things important to avoid falling into the error of making the course of treatment merely a running fight with the ever-changing symptoms presented in most cases of chronic disease.

Of all the so-called systems of treatment which have appeared and disappeared within the last century and which have been so prolific with novel medical ideas, "organopathy" has perhaps the least to commend it to rational consideration. Dyspeptics never get well by the treatment of their stomachs only; neurasthenics never get well by the treatment of their nerves alone. Equally futile is the exclusive treatment of the skin in most forms of cutaneous disease. It is the patient himself who is sick, not some circumscribed portion of his anatomy. The organ which seems to be the chief seat of the disorder is simply that portion of the body which, being the point of least resistance, suffers greatest disturbance of structure or function, or both, and thus becomes the medium through which the morbid condition is most distinctly expressed.

Patients usually clamor for the relief of those symptoms which most urgently obtrude themselves upon their attention, and judge of their progress toward recovery by the extent to which a chronic pain, a palpitation, a gastric acidity, a chronic discharge, or some 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 been aptly termed "nerve storms," sometimes become more frequent during the first few weeks of treatment, often presents a perplexing problem to the inexperienced hydriatist, 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. But that some patients under a course of treatment by physiological measures which are addressed to the removal of causes, the reconstruction of disordered tissues, and the reorganization of disordered functions, must thus pass through a period in which many symptoms and various functional disturbances appear to undergo a temporary exacerbation, is a matter of common observation.

Exaggeration of Symptoms under Treatment.

783 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 carefully studying this question in thousands of cases during a quarter of a century of experience in the use of hydriatic measures, the author feels confirmed in the view which he formulated many years ago; namely, that this 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 hydriatic applications. This being true, it is evident that the increased intensity of symptoms occurring within the first few 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, and that a reorganization of functions and forces is taking place.

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 paroxysms. This he explains by the supposition that a change in the character of the blood results in the dissolving out of the tissues of a larger 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 recurrence of the paroxysms.

This explanation seems rational, and the principle may aid us in explaining the exaggeration of other unpleasant symptoms which not infrequently occurs during the first few weeks of a systematic course of hydriatic treatment. Whatever the explanation may be, experience shows that if the patient can be induced to persevere, and the treatment is

properly managed, the unpleasant symptoms soon disappear, and usually do not reappear, although it sometimes happens that they disappear in an oscillatory manner, being less pronounced at each reappearance until they finally pass away entirely. This is likely to be the case with such disorders as epilepsy, hysteria, periodical migraine, chronic malarial affections with intermittent paroxysms, and other maladies in which periodicity is more or less marked.

It is well to encourage patients to dwell less upon symptoms and to consider more the fundamental morbid conditions out of which they grow. Symptoms are nothing more than the leaves and fruit of the pathological tree, the roots of which are deeply seated in the intimate recesses of the tissues, and consist in disturbed nutritive processes.

If too much attention is given to the treatment 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 thoroughgoing measures which look toward the actual eradication of his real malady.

Let us suppose, for example, that a patient is suffering from spinal irritation, a pain in the region of the liver, epigastric pain or tenderness, or from general muscular pain. He 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 seriously from the depressing effects 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 naturally feel very sure that hot applications do him good, and that cold applications do him harm; whereas, the former afford only temporary relief, while the latter, by increasing the general nerve tone, improving the character of the tissue processes and of visceral activity, are laying the foundation for ultimate cure. No small degree of tact, scientific knowledge, and

intuitive judgment are required so to 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 though symptoms are only the voice of nature declaring the existence of pathological conditions, yet 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 can not 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 encouragement even should be given unless there is some reliable diagnostic means or data at hand whereby the fundamental pathological condition in question may be measured, and an improvement definitely recognized.

There are also cases in which symptoms may be so urgent in character as to require, for the time at least, the principal or even exclusive attention of the physician, as in the hemorrhage of pulmonary tuberculosis, ulcer of the stomach, hemorrhoids, metrorrhagia, or menorrhagia. In many 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 should 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 on the premises.

Why Real Progress Must be Slow.

11. In the organization of a plan of treatment 784
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 the number of daily applications, and 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 during which the course of treatment is to be continued. If the patient can devote but a few days or a few weeks to treatment, the plan employed may be quite different from that which would be pursued if he were willing or able to devote a sufficient amount of time to render possible a more thoroughgoing 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 a flower. Recovery from a chronic disease is simply the 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.

It may be said, however, for the encouragement of patients, that in not a small proportion of cases, immediate relief is experienced from those symptoms which have occasioned the greatest distress and inconvenience. There is certainly no therapeutic agent, or class of agents, which so promptly affords such real and permanent relief as may be obtained from the diversity of the resources of hydrotherapy.

If there is at first an increase in intensity of symptoms, it is usually due to the leaving off of opiates, hypnotics, medicinal tonics, and other remedies which have simply obscured the patient's condition by hiding his symptoms; in other words, by silencing the voice of nature, of which pain and a vast number of other symptoms recognized as evidence of disease, constitute the vocabulary. An opiate may cure a pain, but it does not remove the cause of it; and when it is withdrawn, the patient will of course be made to appreciate his real con-

dition. The brief interval which elapses between the withdrawal of symptom-obscuring remedies and the amelioration of symptoms which come from the accumulation of hydriatic applications is sometimes a pretty severe ordeal for the patient to pass through; but with proper moral support and encouragement, he may be carried along until he begins to appreciate for himself that he is making real, not fancied, progress toward health, that the fetters of his morbid condition are being loosened, and that he himself is being reconstructed upon a sounder foundation — that he is growing out of disease into health.

If the patient can remain under treatment but a few days, or two or three weeks, perhaps the best that can be done for him is to teach him how to correct his wrong habits of life, how to adjust diet, exercise, work, etc., to the morbid conditions which exist in his system, how to employ such palliative means as will give him some relief, and encourage him to continue in a direction which may ultimately result in his cure. 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.

With 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.

12. Patients should be taught that they can not usually expect to realize 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 for some time, a fact which is often a source of great discouragement to the patient.

It is astonishing, however, how obstinate and distressing symptoms will in some cases seem to disappear all of a sudden, after many weeks in which there has been no perceptible change for the better. In many instances, a patient who has been under treatment for several months without apparent relief, will arise on a certain morning entirely free from annoying symptoms which have been incessantly present for months or even years. Sometimes this result will take place after only a few weeks of treatment. In one case, a patient who had suffered for several years with pain in the back, after a few weeks' treatment, while bending forward one day, felt, as he expressed it, a sudden "letting up" in the back, and from that moment he was entirely free from the pain which had obstinately resisted the efforts of the most eminent physicians of the United States and Europe. And this relief was permanent.

It is not easy to explain what happens in a case like this; nevertheless, in this instance something did happen which brought deliverance to the patient; and the thing which happened was without doubt the sudden culmination of the beneficial effects which had been developed during the preceding weeks of treatment. 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 upon the same spot, there may be no evidence of progress; but at the very next blow the rock may be shattered. It is true, however, that in a majority of cases gradually progressive relief from symptoms is experienced from the first.

It is very 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 his malady, and not only this, 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 pursue such a course of life

regarding diet, exercise, and other matters of regimen, as his particular malady may require.

13. 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. The symptoms may disappear, but the patient's constitution has been permanently weakened in certain directions, so that his condition is analogous to that of a steam-boiler which has been strained by overpressure. There is a weak spot somewhere, which is likely to give way, and it can not be safely used except at low pressure. A person who once succumbs to the causes of chronic disease will ever afterward 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 benefits to be derived from a course of hydro therapeutic or other rational treatment are the result of constitutional changes which require a considerable length of time for development, and consequently the best results of treatment are not experienced for some time, often many months, after it is begun.

Not infrequently, in fact, the patient does not really appreciate the full benefit which he has received until some months after the course of treatment has been discontinued. This, however, should not lead the patient to abbreviate his course of treatment, which is almost certain to be quite too limited, but should rather encourage him to lay a broad foundation in a prolonged and thoroughgoing course, which may be expected to develop large and excellent results subsequently, when the processes of regeneration of tissue and reorganization of function have been completed by those natural curative forces within the body which it is the purpose of rational hydriatic treatment to organize and set in operation.

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. Often patients feel so much improved, when such a suspension of treatment takes place, that they imagine that the treatment has been doing them harm, and that they are better off without it than with it. They should be made to understand that the improvement experienced after the suspension of treatment is but the legitimate result of the therapeutic applications made, and that it is simply a foretaste 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 maintain.

It is, most of all, important to keep always before the patient the great fact that disease is only normal vital energy manifested under abnormal conditions. When a sick person recovers, it is by the operation of forces within him, the same forces by which the ordinary processes of growth and repair are carried on. Nature, not the doctor, heals. The healing agency is within the man, not outside of him. No new force or principle comes into operation in the struggle of the body under the abnormal conditions which we call disease. The disease itself is not the thing to make war upon; it is rather the causes of disease which we should combat. The chief concern of the physician, then, should be to discover and remove the causes which have made his patient ill, and to aid, by supplying favorable conditions, the remedial effort which constitutes the pathological picture we call disease.

GENERAL INDICATIONS AND CONTRAINDICATIONS.

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 to see that the patient is warm when the treatment is applied. Long hot baths should not be administered, however, because of their exhausting effects. A short exposure of one or two minutes in the electric-light bath, just long enough to heat the skin thoroughly, is an excellent preparation for a cold application in the case of a pale, bloodless patient. The short hot shower and other heating measures may also be employed.

Nervous Disorders.

785 Feeble neurasthenics, patients who are exhausted by loss of sleep or other causes, chronic inebriates, and cases of hysteria with emaciation and general feebleness, require such moderate measures as the Scotch douche, cold friction, the wet-sheet rub, the affusion, or the full bath at a moderate temperature. Affusion constitutes an excellent method in these conditions.

An excellent measure in many cases is a bath at 92° to 96° F. for 10 minutes, 103° for 2 to 3 minutes, followed by affusion at 80°, four to six pails.

786 Cases of neuralgia, myalgia, painful congestions, chronic rheumatism with painful joints, require the Scotch douche or very short (2 to 3 secs.) cool douches. All douches must be avoided in cases complicated with neuritis, or tenderness. Such cases require fomentations, the heating compress, and half-baths at 85° to 78° F.

What is required is thorough circulatory reaction without thermic reaction; hence measures involving strong percussion should be employed. Cold baths should in these cases seldom be employed alone, but must be preceded by heat, the succeeding cold application being short, or just long enough to remove from the skin the surplus heat absorbed.

In the case of very sensitive and timid persons, treatment should be begun with the very short cold douche or the Scotch douche. An excellent plan of dealing with these cases is to make the patient stand in a hot foot bath while the temperature of the water is increased until the heat is almost unendurable, and 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 then be simultaneously made without occasioning much inconvenience or complaint.

787 If cold applications cause unpleasant after-effects in very sensitive patients, the method should be modified by employing less force, using non-percutient measures, or employing a higher temperature, as for example, 70° to 80° instead of 60° to 70° F., or a lower temperature. Some authorities recommend in such cases that the bath be prolonged, instead of moderated in temperature; but the author's experience has been that the longer the application in such cases, the more intense the unpleasant after-effects. Where the douche is not well tolerated, a wet-sheet rub, cold friction, a sponge bath, the graduated Scotch douche, or a tepid immersion bath may be advantageously employed.

788 Neurasthenics and persons suffering from enteroptosis with extreme irritability of the lumbar ganglia of the abdominal sympathetic can not endure a cold douche to the abdomen. A hot douche without pressure may be employed, and cold friction with the hand or with a towel, but percutient measures must be avoided.

789 Hypochondriacs are often very sensitive, and unable to bear the cold douche. In such cases the neutral bath should be employed, the patient being gradually trained to water at a lower temperature until a short cold application can be tolerated. Cold friction, the tepid affusion, the cool wet-sheet rub, and finally the Scotch douche may be applied. The same is true of opium habitués.

In very nervous persons 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 after cold treatment. In certain persons it is not infrequently difficult to avoid such effects altogether. 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 cold friction, the towel rub, the short wet-sheet pack, 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 of moderate temperature (60° to 80° F.), the Scotch douche, or the hot bath in some form for 3 or 4 minutes prior to the cold application, are other measures which may be recommended.

790 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-Barde and others; viz., to attempt to avoid the excitant effects of short, very cold applications by increasing the duration of the application, and 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 can not 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 and increase the pressure. This secures a good circulatory reaction, with a less intense sensory stimulation.

Cardiac Diseases.

791 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 overcompensation, 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° F.; but in administering it, care should be taken to begin at the feet, each day rising a little higher, until the upper portion of the body is reached. The chest, and especially the precordia, should always be avoided.

In cases of weak heart the general indication is for baths at 85° to 90° F. for 5 to 10 minutes, accompanied by friction, followed by the short Scotch douche at 104° for 1 or 2 minutes, a cold douche at 75° for 10 to 12 seconds, the water being allowed to fall upon the legs, back, and arms only.

792 In the treatment of cases of organic cardiac disease, it is important to observe which of the four phases of the disease the patient presents, and to this end the following queries should be answered; viz.:—

1. Is cardiac irritability present?

2. Is there incipient dilatation of the heart, as shown by loss of power in the cardiac muscle?

3. Have the small arteries lost, or are they beginning to lose, their contracting power, as indicated by edema of dependent portions of the body?

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 excessive compensation exists, exciting measures must of course be avoided; whereas in the opposite class of cases, in which the vessels have lost their power to contract, there is likewise a loss of ability to react; hence vigorous cold treatment can not be successfully employed except in a limited way.

Cold applications, when used, should be applied to small areas by means of the friction mitt or a towel 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.

Very hot and very cold applications should be avoided in cases of cardiac disease with aortic insufficiency, in which sudden death sometimes occurs, having 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 arteriosclerosis, and in apoplexy, the same precautions must be observed. Very hot baths should be avoided in aortic stenosis. Non-percutient measures are best in these cases, and moderate temperatures only should be used.

In *Bright's disease* and other forms of renal disease, very **793** cold treatment must be avoided; but short very hot applications are valuable, especially in acute nephritis.

Very *fleshy persons* do not at first react so well as lean persons, but they 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 the very cold douche and a very high pressure; that is, if no contraindicating symptom is present.

The Field of Hydrotherapy.

Cold water as a therapeutic agent is especially **794** adapted to the treatment of *acute maladies* in which fever or pain is present or in which diminished activity or overactivity of special organs is a fundamental condition.

It must be remembered that cold applications with percussion should be avoided when acute inflammation is present, as the strong reaction set up by an application of this sort will surely give rise to exaggeration of the condition. Very hot applications followed by tepid compresses are more serviceable in cases of this sort.

Hydriatic measures may always be employed with great advantage in *chronic disease*, the tonic effects of cold water being almost universally required in the treatment of these maladies.

795 Surgical cases involving *pain, fever, or danger of inflammation*, such as compound fractures and wounds of various sorts; burns, scalds, and many other kinds of accidents and injuries, afford most excellent opportunity for the therapeutic employment of water.

Those who have assigned to hydrotherapy a more limited sphere of usefulness than that here claimed for it have been led to this narrowness of view by the failure to recognize to the fullest extent the great advantages to be obtained by employing a wide range of temperatures.

Hydrotherapy is especially helpful in the treatment of *fevers* from whatever cause, there being no other means by which a febrile action may be more quickly or permanently controlled than by the scientific employment of water.

796 The modern science of *obstetrics* owes much to hydrotherapy in a variety of ways. The proper use of water during the lying-in period greatly assists in conducting both mother and child through the perils of this critical period, and in quickly restoring the patient to a normal condition. The author is hardly prepared to adopt the cold sitz bath immediately after delivery, as recommended by Pingler; but during twenty-five years of the practical use of hydrotherapy in obstetrics, he has found it of 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 cold friction as a general tonic.

797 *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 the degenerations which accompany locomotor ataxia, general paresis, etc., have been so entirely arrested as to be 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.

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.

Brilliant results could scarcely be expected in cases of hyperplasia or hypertrophy, and yet even in these conditions marked improvement has not infrequently been effected, atrophied parts having been stimulated to renewed development, so that functions almost entirely lost were restored.

There is no more useful agent than hydrotherapy in **798** dropsy due to *chlorosis*, *anemia*, and other *cachexias*. When caused by 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 combated by suitable applications of water, as elsewhere explained.

In *gastric disorders*, hydrotherapy affords more assistance **799** than any other remedial agent. The cold douche in hypopepsia and apepsia, and the hot douche in hyperpepsia 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, 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, and thus combats constipation.

Genito-urinary and renal disorders present many condi- **800** tions which are in the highest degree amenable to hydriatic treatment. The sitz bath, rectal irrigation, the vaginal and uterine douches, the pelvic pack, the fan or jet douche, and general tonic applications are invaluable in this class of disorders. It must be remembered, however, that general cold applications must be avoided or greatly modified when acute inflammatory conditions are present in the pelvic organs or any other of the viscera. Cold friction (**1209**) is about the only tonic measure permissible in these cases.

801 *Pulmonary disorders* present a large variety of conditions in which hydriatic applications are capable of rendering invaluable service. It is important to remember, however, that very cold general 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 where 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 a most valuable measure, which may be supplemented by cool sponging of the upper parts of the body, followed by vigorous rubbing.

802 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, thus producing the effect of a poultice, which is highly sedative and relaxing. A healthy skin is an indication of a healthy mucous membrane, and disorders of the mucous membrane may not infrequently be caused to disappear by the employment of tonic means calculated to bring the skin into a thoroughly healthy condition.

803 In *affections of the skin*, neutral baths are often of the highest service. In scaly eruptions, the curative value is enhanced by adding alkalies to the bath. The tepid douche may also be employed with advantage in many cases. Skin eruptions are usually due to general toxemia. 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 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 neutral immersion bath of Hebra may sometimes be employed with great advantage. In some cases of this sort patients have remained in the bath for several months.

The *diatheses* and *cachexias* especially require the alter-

ative and tonic effects of hydrotherapy, yet the lowered vital tone existing in these morbid states requires that great care be exercised.

804 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, deficient oxidation of fat.

The cold bath excites oxidation, and hence is especially indicated in these cases; but there being, at the same time, diminished vital resistance, lowered nerve tone, and lessened ability to react in consequence of the prolonged perversion of nutrition, through exposure to the influence of depressing toxic agents and retained excrementitious matters, tonic measures must at first be administered with great care, and the patient must be trained by carefully graduated applications to react to the contact of cool water.

Obese patients require cold baths, followed by prolonged moderate exercise, to energize the muscles and lower the body temperature. Rheumatics require hot, sweating baths, followed by very short cold baths and exercise.

Diabetics, if emaciated, require long neutral baths. Very hot and very cold applications should be avoided. If the patient is in good flesh and strong, the Scotch douche, the short cold douche (4 to 8 secs.), short cold immersion (2 to 3 secs.), and other cold applications are admissible and advantageous, especially if immediately followed by moderate exercise.

In the training of feeble patients to the use 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. The first of these is—

The Method of Graduation.

805 If some form of douche is the mode of application selected, the water should be employed at a moderate temperature, as 80° to 85° F. The application should be 10 to 20 seconds, and followed by

energetic friction. From day to day, as the patient's nerve tone increases, the temperature may be gradually lowered to 65° or even 60° F. As the temperature is lowered, the time of the application should be shortened, until at 60° it should not be more than 6 to 10 seconds, and at 55°, 3 or 4 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 persons who are very sensitive to cold, we may begin with the tepid douche at 85° to 90°.

In cases in which the percussion effects of the douche are badly tolerated, non-percutient measures may be at first employed, such as affusion at 80° to 85°, the wet-sheet rub at the same temperature, the immersion bath for 3 minutes at 85° to 90°, with friction, the sitting shallow at 80°, the towel rub, and cold friction.

It should ever be borne in mind that in beginning a course of treatment it is better to commence with too moderate than with too severe measures, as otherwise the patient is likely to become discouraged and lose confidence. Moderate applications two or three times a day may be made to accomplish the same results as a more severe procedure daily.

806 **Training by the Scotch Douche.** A second method of training for the cold bath is preliminary heating of the skin followed by a very short cold application. This succeeds in some cases better than the method of graduation. Reaction as a rule develops more promptly and regularly after a short cold or very cold application than after a prolonged application of higher temperature. For many patients also an application at 75° to 80° is quite as disagreeable as a colder one. It is consequently advisable in some 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 application, as well as the untoward after-effects which occasionally occur. The hot application should be at a high temperature, usually 105° to 110°, and should be continued 3 to 6 minutes, or until the patient is so thoroughly heated that he experiences an intense desire for a deluge of cold water, which is an evidence that the system has been prepared to receive the 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 requiring preparation. The electric-light bath is to be preferred to the other measures mentioned, when it is accessible. Unless the patient is quite emaciated, the bath may without injury be carried to the point of slight perspiration; and in cases of obesity and rheumatism, when the patient's general strength is good, profuse perspiration may be produced without injury, and in most cases with benefit, but must not be carried to the point of exhaustion.

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 length of the cold application must be regulated by that of the hot one, the time of the cold application, however, being measured in seconds, while the hot application is measured in minutes. As a rule, the time of a cold or very cold application will be not more than 2 to 4 seconds after a hot application of as many minutes, and should not exceed 10 to 15 seconds, after a hot application of 6 to 10 minutes.

Cool or tepid applications, which are often required in diabetic and rheumatic cases and in chronic Bright's disease and neuralgia, may be continued 1 or 2 minutes in many cases. The required effect must be secured; viz., cooling of the skin until proper but not excessive reaction is secured.

807 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 apparatus may be advantageously placed in the same compartment in which the vapor or Russian bath is administered, so that the patient may receive a stream of cold water upon his body immediately, thus avoiding the preliminary chill, which, if it does not altogether spoil the effect desired, greatly lessens it.

808 The author 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 at the same time that 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.

809 In very sensitive persons the full jet 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, the amount of surface being increased at each succeeding application until the whole body is subjected to the influence of cold water under high pressure. The broken jet should be applied to the rest of the body, or cold friction may be applied before the douche. The applications should be made with great rapidity, however, and should not last more than 1 or 2 seconds at first, and later, 2 to 5 seconds.

810 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 hot shower bath, or a fomentation to the spine, or both. Care should, however, be taken in the application of the douche to avoid the lumbar and abdominal regions.

In anemia with amenorrhea, a general cold douche may **811** be administered, but should be preceded by a hot douche to the hips, thighs, and feet; or a short hot sitz and hot foot bath; or a hot foot bath, and a warm circle douche to the hips.

Incurable Maladies.

Even in disorders which are not curable, much **812** can be done for the patient by the palliation of the most distressing symptoms, 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 can not be wholly cured. Thus the vomiting of cancer may be checked and a very considerable degree of improvement secured; the consumptive cough may be controlled, and night sweats, fever, and other symptoms of this disease mitigated to a remarkable extent by suitable hydriatic measures; and if the patient can at the same time be so situated as to enjoy the advantages of a climatic change at an elevation of about five thousand feet, a cure can be effected in a large number of otherwise hopeless cases. By the prolonged hot douche or the revulsive douche, the lightning pains of locomotor ataxia may often be relieved with a promptness which seems truly magical; and out of the scores of cases of locomotor ataxia which have been under the author's care within the last twenty years, recovery from nearly all the symptoms present has occurred in a considerable number of cases, and great improvement in nearly all.

Thus no case of chronic disease, no matter how inveterate, unless it has reached an absolutely hopeless stage, should be abandoned as incurable without giving hydrotherapy, with the accompanying regimen of diet and exercise, active or passive, an intelligent and persevering trial.

THE UNTOWARD EFFECTS OF HYDROTHERAPY.

There is no remedy, however valuable, which is not capable of misapplication or abuse. That untoward effects sometimes result from applications of water is 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.

813 **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. This condition indicates that the application has been (*a*) too extreme in temperature — either too hot or too cold, (*b*) too long in duration, (*c*) that the reaction has been excessive, or (*d*) incomplete.

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 feet in very hot water will induce a severe pain in the head. In others, strong reaction induced by any form of cold bath will occasion this difficulty. In some instances, the headache thus occasioned is extremely violent, and may last for several hours.

The explanations of headache under these conditions are various. Some hydriatrists contend that it is always congestive, others that it is always anemic. The author's view is that the headache following hydriatic applications is sometimes congestive, sometimes anemic, and sometimes purely reflex or sympathetic in character, due to overstimulation of the sympathetic centers.

When the 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 either failed or was too intense, any of these conditions constituting sufficient cause.

The headache which sometimes accompanies or follows a hot bath is due to neither congestion nor anemia, but rather to a swelling of the ganglion cells or of the nerve endings in the brain under the excitation of heat.

Applications which are found to produce headache should be modified at once, as definite and serious injury may result from the prolonged employment of measures which induce an unpleasant symptom of this sort.

Vertigo. 814 Vertigo and sweating may occur either in connection with headache or without. Vertigo is due to the same causes which have been mentioned as productive of headache. Sweating of the head indicates too strong determination of blood to this part.

The three symptoms named indicate the necessity of some modification of the measures employed; as, for example, a towel rub or the wet-sheet rub, an affusion at 80°, or a short full bath at 85° to 90° should be substituted for the horizontal jet or other percutient measures. Too strong reaction to 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 and to the head; and by the hot foot bath just before, during, or after the bath.

Insomnia, Palpitation, etc. 815 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, or perhaps the douche should be suspended, the rubbing wet sheet, the towel rub, or the neutral bath being substituted. The last-named measure is one of the best of all known remedies for insomnia. In cases in which strongly tonic results are desirable, these applications should not be made in the evening, but in the forenoon. A

disposition to insomnia 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' tonic treatment, indicates a necessity for the substitution of dry friction, short electric-light baths, the wet-sheet rub, the neutral douche with little pressure, and similar measures in the place of the cold douche or other strongly excitant treatment, so that the central nervous system may have an opportunity to recuperate the energy which has been expended in reaction and reparative work.

816 **Neurasthenia and Hysteria.** In neurasthenia and in many cases of hysteria, in which pain is generally expressed chiefly at certain points, care should be taken to avoid exciting or tonic applications to these points. This precaution is sometimes rather difficult to carry out; nevertheless it is necessary to exercise the greatest care to avoid the so-called hysterogenous zones, and especially the abdomen in cases in which the patient complains of decided pain or tenderness in this region, as the application of cold water will sometimes precipitate an attack.

Hot and cold applications to the spine will usually give temporary relief from such an attack, if it does occur, 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° F., and the temperature systematically lowered from day to day, as the patient gains power to react.

817 When enlarged or ruptured veins are present, percutient applications to the affected areas should be carefully avoided.

Taking 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, however, passes off in a short time, for the

continued use of cold water hardens the skin and increases its resistance. Great care must be taken to dry the skin thoroughly after baths of all sorts, by removing not only all sensible moisture from the surface, but also that which has been imbibed by the skin, the subsequent evaporation of which may produce chill.

Colds, sore throats, and catarrh of the nose and throat are usually due to neglect completely to dry the skin, thus exposing the patient to secondary chill and resulting visceral congestion and acute catarrh, which very readily becomes chronic. For relief of the cold 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.

Rheumatic Pains; Skin Disease.

818 Rheumatic pains, which not infrequently follow hydrotherapeutic applications, are not due to taking cold, as is often feared, but to incomplete reaction, or to the setting free of uric acid, and the consequent effects of an excess of this irritating substance in the blood. Slow cooling by evaporation after incomplete drying, and the prolonged application of "dry cold" by means of rubber bags filled with ice, are often the cause of rheumatic pains.

Chronic skin disease sometimes presents a serious obstacle to the employment of hydrotherapy. If suppurating pimples 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 to the affected surfaces after each bath. The application of vaseline is also wise. Furuncles following the stimulating compress are due to infection by the compress. It may be prevented by daily boiling the compress and washing the parts well with yellow soap and hot water.

Crises or Fever of Reaction.

819 Priessnitz and the early water-cure doctors made much of so-called "crises," but the modern scientific study of hydrotherapy has shown that "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 is likely to give rise to eruptions and irritation of various sorts, boils, etc.; while excessive water-drinking may cause intestinal disturbances.

There are no salutary effects arising from crises which can not 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 this antiquated, inconvenient, and, happily, now obsolete measure.

820 Slight symptoms of general systemic disturbance, as malaise accompanied by indigestion, headache, weakness, and other indications recognized by the water-cure doctors of the last century as the beginning of a crisis, should not be regarded as unfavorable, but, on the contrary, as affording positive evidence that the treatment is sufficiently vigorous in character to induce pronounced systemic effects. The symptoms should not be encouraged, however, but should rather be checked by some modification of the prescription, such as has been already suggested, and the patient may be encouraged that he will soon be able to realize that he is making rapid strides toward health.

821 In making hydriatic prescriptions, special care must be taken so to adjust the procedures as to produce just the amount and kind of reaction desired. In febrile diseases it is always desirable to repress thermic reaction as far as possible, and to encourage circulatory reaction. It is best also that the reaction should be developed slowly, as thus it will not be excessive. It is this feature that gives to the cooling pack its advantage over the Brand bath as an antipyretic. Applications for the relief of pain should always produce circulatory

reaction. In these cases it is best to develop the reaction as quickly as possible, so that the procedure shall not be fatiguing.

822 In applications for the reduction of temperature, a certain amount of thermic reaction can scarcely be avoided; but by employing cold applications accompanied by continuous friction, both the skin circulation and the temperature are maintained, and thus the cutaneous nerves are not cooled to a sufficient degree to set up powerful thermic reflexes, and heat production is but slightly increased. Cold douches must, of course, be avoided in cases in which there is elevation of temperature. It is not desirable, however, to altogether suppress the thermic reaction in fever, as it is important to develop strongly the resistance of the body, and this can be done only by such an application as will moderately stimulate metabolism as well as other functions. The cooling pack accomplishes this in a most satisfactory manner.

823 In fevers, circulatory reaction must be encouraged, so as to aid heat elimination while thermic reaction is suppressed. In chronic disorders requiring tonic measures, quick thermic and circulatory reaction must be secured; and after all general procedures, complete reaction must be attained, or the results sought will not be secured.

824 The influence upon metabolism must be watched by noting constantly the effect of the treatment upon the weight, the muscular strength as shown by the dynamometer as well as by the patient's general feeling, the appetite, and by the urine. An excess of solids, especially chlorides, signifies excessive tissue waste. Urea in excess indicates too long or too frequent hot baths, or too much exercise.

825 The temperature must also be noted. Excessive temperature elevation after cold baths, or an elevation of temperature followed by perspiration, resembling a febrile movement, indicates excessive stimulation and thermic reaction. The procedures must be modified or treatment suspended, else an actual fever, the so-called hydropathic crisis, may result.

THE HYGIENIC OR PROPHYLACTIC EMPLOYMENT OF HYDROTHERAPY.

826 Rational medicine, as Dr. Horatio C. Wood, of Philadelphia, has so clearly pointed out, consists essentially in the application of prophylactic measures; that is, the employment of means which are capable of maintaining a normal individual in a state of health. It may be suggested as a corollary from this proposition, that by the employment of those physiological measures which are most effective in the restoration of a sick person to health, the individual may be maintained in good health.

However applicable this principle may be to other therapeutic means, experience has shown most positively that the cold bath, while one of the most powerful tonics and most efficient of restoratives, is at the same time one of the most valuable of all known prophylactic or hygienic measures. The cold bath acts powerfully upon the sympathetic nervous system, — that great regulator of nutrition. It likewise affords a gymnastic means for the vasomotor system of nerves and centers, and develops by exercise the contractile activity of the small blood-vessels. Cold water, in common parlance, hardens the skin; technically, we would say, it increases the vital resistance of the skin. If habitually employed, the cold bath protects against taking cold, not by closing the pores, but by increasing the activity of the cutaneous circulation and developing the vital resistance of the body in general, and especially the ability of the body to reheat the skin after it has been chilled by exposure or cold applications.

Through the influence of the cold bath upon the sympathetic nervous system, all the processes of nutrition and assimilation are quickened. The amount of hydrochloric acid produced by the glands of the stomach is increased, as the result of which appetite and digestion are improved; and the stomach, being provided with a better quality of gastric juice,

is better prepared to protect itself against injury from intruding microbes. Modern investigations have shown that typhoid fever germs, cholera germs, and, in fact, all varieties of germs, succumb to the attack of a thoroughly healthy gastric juice; hence the daily cold bath, by maintaining a sound digestion, as well as by increasing the general vital resistance of the body, serves as a most valuable protection against infectious disorders, even those which are communicated by virulent living organisms of various sorts.

One of the most interesting effects of the cold bath is the increased number of blood-corpuscles found in the surface vessels after the establishment of the reaction which follows these cold applications. The blood is the means by which oxygen is conveyed to the tissues, and carbonic acid gas to the lungs, whence it is discharged from the body. Certain of the blood cells are also useful in destroying the germs which may find their way into the blood-vessels, and in removing dead and useless particles of various sorts.

It is thus apparent that the number of corpuscles contained in the blood is a matter of the greatest importance in relation to the degree of vital resistance, or the ability of the body to maintain itself in health under adverse circumstances or against the destructive influence of disease-producing causes.

The total surface area of the blood cells contained in the body of an average man is 3,100 square yards. It has been shown by Winternitz and others that by the application of a cold bath the number of blood cells may be increased thirty and even fifty per cent. This means an increase of 1,000 to 1,500 square yards of surface available for use in conveying oxygen to the tissues, and removing carbonic acid gas. It means also an increase of thousands of millions in the number of active protective cells scattered throughout the circulation. This effect of cold upon the blood is one of its most valuable and important uses, and easily accounts for the freshness of

color, clearness of complexion, and general buoyancy and vigor which result from the habitual daily employment of the cold bath.

In the application of cold water as a hygienic means, care must be taken, however, to adapt both the temperature and the mode of application to the age, and also to some extent to the sex, as well as to the temperament and to individual susceptibilities.

827 **Cold Bathing in Infancy and Early Childhood.** Children under seven years of age do not well bear the application of very cold water; therefore, the douche in all forms should be avoided, cold friction, the rubbing shallow, or the immersion bath with rubbing being used instead, and never at a very low temperature. A temperature of 70° to 80° F. will produce sufficiently strong impressions to develop good reaction in children under seven years of age. After seven years of age, as the child advances in years, the temperature may be lowered somewhat, and more vigorous applications may be made, such as the affusion and the light douche with water at 70° to 75° F. in temperature. After fourteen or fifteen, lower temperatures may be employed.

The daily cool douche, or affusion, is an excellent means of relieving urinary incontinence in children, a difficulty indicating weakness of the inhibitory centers, which later may develop serious nervous disorders.

The daily cold bath is an important aid to general development in growing children, and increases not only muscular vigor and energy, but nerve tone. It prevents the development of neurotic conditions in young persons just entering upon manhood and womanhood, relieves so-called growing pains, and promotes vigorous and normal development.

828 **The Cold Bath for Adults.** Adults must adapt the form of the bath to their conditions of life, their special predispositions and individual susceptibilities.

Sedentary persons especially need the benefit of the cold bath. Such persons may advantageously employ, before the cold douche, a hot bath for three or four minutes.

Adults who are predisposed to rheumatism, gout, gravel, **829** migraine, Bright's disease, neurasthenia, and other maladies which for the most part are the result of the retention within the body of the products of nitrogenous wastes, will be greatly benefited by the employment of a cold bath daily, but it should be carefully administered. Very cold water must be avoided, and the cold application (68° to 80°) should be preceded by the hot bath for three or four minutes, or until sweating is produced. In feeble persons, cold friction should be employed instead of cold applications in which the whole surface is wet at once.

The Cold Bath for Women.

The daily cold bath is especially useful for **830** women of civilized nations, because of the deteriorating influences of their artificial life. The harmful customs of civilization, rather than nature, have made woman "the weaker vessel." The cold bath gives nerve tone, combats nervous weakness of various sorts, is a most excellent prophylactic against hysteria, and to a very considerable degree combats the unwholesome tendency of the indoor and sedentary life to which most women are subjected.

The cold bath favors the development of the menstrual function in young girls, and if habitually employed, affords great assistance at the menopause. A woman who has made regular and persistent use of the cold bath for some years preceding the "change of life" is very little subject to the vasomotor disturbances, the flushings, sweating, etc., which render the lives of so many women miserable for months, sometimes years, at this period.

The cold bath should be avoided during menstruation. Although several authorities recommend that the cold bath be continued during the menstrual period, the author believes it to be, on the whole, safest to suspend it at that time, and to

substitute the tepid bath. The cold bath taken at the beginning of the menstrual period may easily result in serious injury. In one reported case, a fatal hematocele was produced. In febrile diseases, cold bathing may be continued, but the intensity should be modified somewhat.

In cases of dysmenorrhea, menorrhagia, and relapsing inflammation, suitable hydriatic applications may be made at the menstrual period with great benefit. By the aid of proper measures of this kind, these disorders may be more profoundly and favorably influenced than by any other non-surgical means. Hot fomentations, the revulsive sitz, the hot vaginal douche, render most valuable assistance at this period, when appropriately employed.

In pregnancy, the cold douche should be avoided in all forms. Short cold frictions at a temperature of 60° to 70° may be employed with advantage, but the cold douche about the abdomen and lumbar regions should be avoided.

During lactation, the cold bath may be employed with good effect, but cold applications about the lumbar and abdominal regions should be avoided as likely to cause a premature establishment of the catamenia. It is on this account better to confine the application chiefly to the upper part of the body. Cold friction, in strong women even the shallow bath, is safer than the douche or any measure accompanied by percussion.

831 **The Cold Bath in Old Age.** Old age involves the liability to the existence of arteriosclerosis and allied forms of degeneration, in either an incipient or an advanced stage. The skin is inactive, rigid, and comparatively bloodless, and the heat-making powers of the body are greatly diminished, so that the thermic as well as the circulatory reaction is likely to be incomplete, thus giving rise to numerous untoward and distressing symptoms. On this account, great extremes in temperature must be avoided. The neutral bath, douches at a temperature of 75° to 85° F., the wet-sheet rub at the same temperatures, and the cold friction or towel

rub, are the most appropriate measures. Cardiac weakness, emphysema, and bronchitis are conditions so likely to be present in aged persons that they must be kept constantly in mind in the treatment of the old.

The cold bath affords one of the best means for reviving a person who has been exhausted by heat, and especially by heat accompanied by profuse sweating.

The hot sponge bath taken in the morning is sometimes preferable in very hot weather to the cold bath. As the result of a short hot application, an atonic reaction is produced, which lessens heat production, and thus enables a person better to endure exposure to a high temperature.

In the winter season, the habitual employment of the cold bath trains the skin to react promptly, and thus lessens the danger of taking cold or of suffering from pulmonary congestion, as the result of chilling the surface of the body. With a change of season, however, it is sometimes necessary to modify the form of the bath.

The importance of the daily cold bath is a matter of far greater moment than is generally comprehended. In the opinion of the author, every public school should have connected with it a shower-bath, a swimming-tank, and a gymnasium, and all pupils should be required to undergo physical training not only in the gymnasium but in the swimming and shower-baths as well, under careful medical supervision. By this means the physical development of the young may be greatly encouraged, and evil moral tendencies combated, and thus the present rapid deterioration of the race may be stayed. The universal introduction of these measures would certainly result, within a generation, in the production of a much more vigorous race of men and women than we now see.

The Sweating Process.

832 The sweating bath is a hygienic measure of the greatest value for persons of sedentary habits, constituting to some extent a compensation for lack of exercise. It is a noticeable fact that the people who inhabit very cold countries, as the

natives of Northern Russia, etc., are great devotees of the sweating bath.

The Finns, who for a considerable portion of the year are confined indoors and have little or no exercise, have been intuitively led to seek a compensation for the lack of exercise in the sweating bath, followed by a vigorous cold application. Every house in Finland has its sweat-room attached, in which hot steam is produced by pouring water upon heated stones. After remaining in the sweat-house until sweltering with heat and dripping with perspiration, the bather rushes out and rolls in the snow, thus producing a most vigorous reaction.

The sweating bath, followed by a cold application, though in no means a perfect substitute for exercise, does nevertheless to a very considerable degree relieve the system of the excrementitious wastes which accumulate within the body when a sufficient amount of exercise is not habitually taken. This it accomplishes by increasing oxidation and renewing the body by stimulating tissue changes.

Sweating softens the sebaceous matter which often accumulates in the ducts of the skin, and loosens the dry epithelium by means of which the outlets of the perspiratory ducts are often greatly obstructed, but its greatest benefit is through the stimulation of the circulation of the skin, the excitement of all its functions, and especially in the reflex influences upon the internal structures which are set in operation, and the vigorous fluxion of the blood which is created by the intense hyperemia of the cutaneous envelope produced by prolonged exposure to heat followed by cold.

The skin is capable of containing one half to two thirds of all the blood in the body. When its vessels are dilated to their fullest extent; mechanical displacement of the blood toward the surface causes a temporary anemia of the internal viscera, with contraction of their vessels. By this means, internal congestions are relieved. The cold application following the sweating bath causes an inrush of blood to the interior, distending the visceral vessels and stimulating their

functions by increased blood pressure and accelerated movement of blood. By the fluxion of blood between the interior and the exterior of the body, the various vital activities of the organism are stimulated to the highest degree, all the nutritive processes are accelerated, and the most powerful alterative and tonic effects result.

Sedentary persons should take a sweating bath of some sort at least once or twice a week, care being taken, however, to follow the sweating bath by a cold bath of some kind sufficiently prolonged to remove from the skin the heat imparted to it during the sweating process, and to produce vigorous circulatory and thermic reaction. By this means the skin is strengthened and protected from the disturbing influence of atmospheric changes, appetite and digestion are improved, blood pressure and nerve tone are raised, and the wheels of life, so to speak, are made to run more smoothly and quickly. The sweating bath should always be taken at night, and just before retiring.

The Neutral Bath.

833 The bath at 92° to 95° is of special value for business men, teachers, orators, physicians, and all engaged in professions which associate comparatively little bodily activity with an undue degree of mental and nervous strain. The temperature should be 92° to 95° F., duration 15 to 30 minutes, or even longer. This bath should be taken at bed-time, as it possesses soporific power to a wonderful degree, inducing sleep even when hypnotics fail, and by its timely use the employment of sleep-producing drugs may be avoided. The individual who finds himself unable to get to sleep on going to bed, or who awakens after two or three hours unable to continue his slumbers, will find in the neutral bath a sovereign remedy, which, by the sound sleep thus induced, and the accompanying vital recuperation, will enable him to maintain good health under conditions to which he must otherwise succumb. The loss of sound sleep soon results in complete nervous break-down, and not infrequently in mental

failure as well. The neutral bath at the temperature named may be taken every night for a prolonged period without injury, provided that the cold morning bath is habitually employed. When the rain douche or the horizontal jet is available, it may well take the place of the neutral bath, as good effects being obtained from the application of the douche for five to ten minutes as from a neutral full bath of three times as great duration.

834 **Precautions.** 1. When fatigued as the result of the loss of sleep or severe muscular exercise, a cold application should be preceded by a hot douche or immersion bath for 3 to 7 minutes.

2. If but slightly fatigued, a short cool or tepid douche, or cold friction may be substituted for the cold bath.

3. A very cold bath should always be short, and should never be administered when the body surface is cold or chilly. The hot bath carried to the point of gentle perspiration is an excellent preparation for a cold application.

4. The temperature of the air of the room in which a cold bath is taken should always be higher than that of the bath.

5. Avoid frequent hot baths at all seasons, and especially in winter, as they are depressing, and lessen vital resistance to cold and other disturbing influences. The best time for a hot or warm bath in cold weather is just before retiring.

HYDRIATIC INSTITUTIONS AND THEIR EQUIPMENT, AND THE GENERAL MANAGEMENT OF CASES.

IN the scientific use of water in the treatment of disease elaborate apparatus is not essential for effectiveness. Indeed, it is possible to secure the most valuable of the therapeutic advantages of water by the aid of sheets, towels, blankets, a pail, a bath-tub, and a thermometer, if coupled with the consummate skill which comes from long experience. There can be no doubt, however, that the best results of hydrotherapy are most readily and quickly attained by the aid of perfected apparatus especially designed and suited for bringing to bear upon the body the thermic and mechanical impressions which may be elicited from water. It may also be added in this connection, that, while it is true that no remedy lends itself so readily to all conditions and environments as does water, and while there are few morbid conditions which may not be greatly benefited by the use of such simple appliances as are usually found at hand, it is true beyond question that a very large number of cases, especially those of a chronic nature, may be much more satisfactorily treated and far more quickly restored to health by treatment in an establishment furnished with all the appliances for the most efficient use of water. It is not always necessary for the patient to live in such an institution, though he should be sufficiently near to make daily treatment possible without too great inconvenience; but in quite a large proportion of chronic cases it is important that the patient's whole life should be controlled,— the diet, exercise, and the entire regimen regulated in harmony with rational living,— in other words, that the patient should give himself for the time being wholly to the cultivation of health, in order to secure the desired results. Hence a few words may not be out of place in regard to the

900

equipment requisite for an establishment devoted to the use of hydriatic measures.

01 The most necessary thing is an abundant supply of water. Soft water is preferable to hard, because of its better effects upon the skin, but mineral water offers no real advantage over the purest soft water. The slight advantages which may possibly be claimed for certain alkaline mineral waters, especially those containing carbonic acid gas and chloride of calcium, in the production of circulatory reaction at neutral temperatures, may, when desirable, be easily attained by the addition of the proper chemical substances. Soft water is much more readily absorbed than hard water or mineral waters, as has been shown by laboratory experiment. This gives it greater value when used at neutral temperatures for sedative effects.

02 A consideration of the greatest importance in relation to the water supply is the temperature, a low temperature being a very desirable quality. The summer temperature should not be higher than 55° F., and five to ten degrees lower is desirable. At a temperature above 60° it is difficult to obtain some of the most desirable hydriatric effects. It is not every case in which the powerfully tonic effects of water at 50° can be utilized, but means should be at hand for the production of the profound thermic and circulatory reaction which may be secured by water at this temperature, administered with proper pressure, in cases which may require it. In temperate climates there is no difficulty in obtaining water at a sufficiently low temperature during the cold months, but during the summer-time the temperature of water conveyed for some distance in pipes often rises to 70° or even 75°. In such cases artificial means of cooling may be employed. The accompanying cut (Fig. 28) shows a method of cooling which the author has found very satisfactory. Water at a temperature of 70°, after circulating through this apparatus, is delivered at a temperature of 50° or less. Water from deep wells and mountain streams is generally of a sufficiently low temperature for practical purposes.

In the empirical hydropathy of Priessnitz and his fol- **903**
lowers, cold water was the one thing needful; but in modern rational hydrotherapy water is employed at all temperatures possible without injury to the skin; hence some suitable means of affording an abundant supply of hot water is required. Water may be conveniently heated by means of such a water-heater as is commonly used in laundries; or when the bathing establishment is heated by steam, it is usually most convenient and economical to heat the water in a boiler through which the steam is made to circulate by means of brass or copper pipes. If an engine is used for running a pump, elevator, or other machinery, the exhaust steam may be utilized in heating the water. Another method recently invented is the heating faucet, into which a steam pipe and a cold-water pipe are connected in such a manner that by the proper adjustment of the valve the steam and water may be mixed at the moment of escape, and thus water at any temperature desired instantly obtained. Water may also be heated by passing a steam pipe directly into the tank of cold water. This method, however, has the disadvantage of being extremely noisy. The noise may be somewhat lessened by fastening a suitable head to the open end of the pipe, but can never be entirely overcome.

Live steam is needed for the vapor bath, the Russian **904**
bath, and especially for the vapor douche.

Adequate pressure is a matter of utmost importance for a complete hydriatic establishment, it being essential for the different forms of the douche,— the most powerful if not the most essential of hydriatic procedures. The pressure needed is at least thirty to fifty pounds, representing a water column seventy-five to one hundred feet in height. A higher pressure is in no way undesirable, though not often required. When city water pressure can not be utilized, water may be pumped up into a tank placed at an elevation sufficient to give the necessary pressure. Each foot of elevation gives a pressure of about .45 of a pound. The pressure required may be obtained by means of a closed steel tank and an air-pump,

an arrangement shown in the accompanying cut (Fig. 29). This device is much used in France, and is very satisfactory. In the absence of a better appliance, it is possible to administer the douche, and that in quite effective fashion, by means of an ordinary green-house spray pump. But in order to secure all the advantages of this most potent and admirable therapeutic agent, a complete and well-constructed apparatus must be provided. The douche apparatus being naturally the central feature of a well-equipped scientific establishment for the employment of hydrotherapy, it should not be clumsy or incomplete. The cost of a proper outfit, including a percussion douche nozzle with air-pump and tank to operate, need not be more than $500 to $600 at the most.

905 The apartments devoted to the administration of baths should be carefully constructed for the purpose, and when possible, should comprise the following distinct compartments: An office, a waiting-room (the office and waiting-room may often be combined), a series of dressing-rooms with cooling-room adjacent, general treatment-room, a room for douches of various sorts, a room for the administration of massage, packs, and fomentations. In addition to these there must be a water-closet, and provision for the administration of enemas and vaginal and rectal douches.

Special attention should be given to the ventilation of the apartments. The amount of air required per hour in living-rooms is estimated by Parkes at 3,000 cubic feet. In bath-rooms provision should be made for at least twice this amount of air, because of the great activity of the lungs and skin of patients during hydriatic treatment, and also because of the fact that the rooms are to be occupied by diseased persons, in consequence of which the air will become contaminated more rapidly than under ordinary circumstances. The maximum number of patients likely to occupy the rooms at any one time should be estimated, and provision made for 5,000 to 6,000 cubic feet of air per hour for each person. The air should be warmed before it enters the room. It may enter

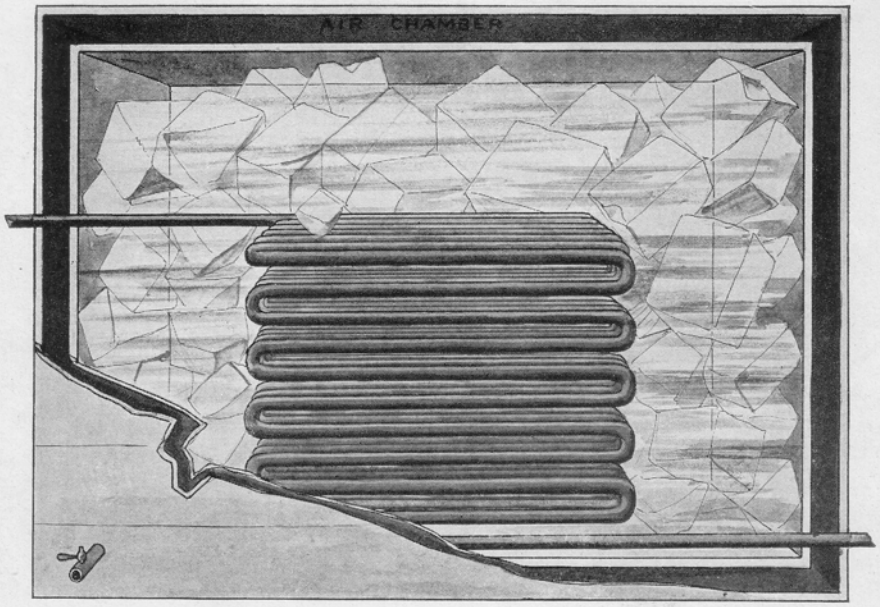

FIG. 28. WATER COOLING APPARATUS (p. 398)

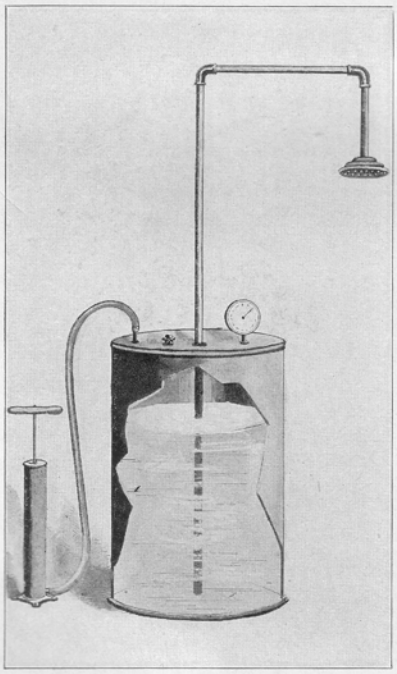

FIG. 29. COMPRESSION-TANK DOUCHE. APPARATUS (p. 400).

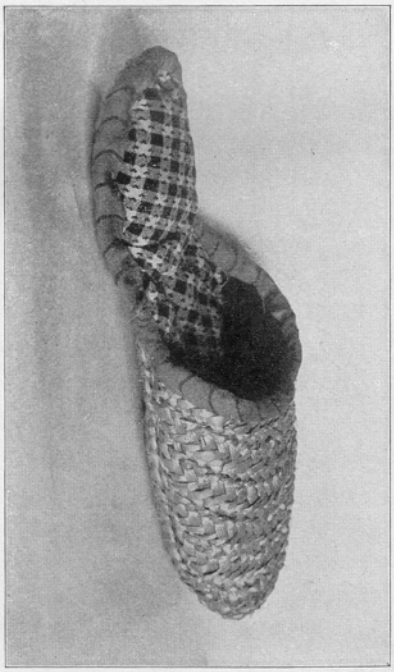

FIG. 30. BATH SLIPPER (p. 404).

at any rate desired, but should not leave the room at a rate of more than five to seven feet per second. The outlets should be numerous and located on, or at, the floor and beneath the windows, so as to prevent the cold air which falls along the outer walls from collecting at the floor, thus chilling the feet of the bathers. Ventilating shafts should be located in the inside walls, so that they will always be warm. If it is impossible to carry the shaft high enough to secure a strong draft, a suction-fan may be introduced, it being operated by steam, water, or electricity. Great care should be taken to avoid drafts, as the rapid evaporation from the skin produced by moving air readily gives rise to chill and most unpleasant effects. The temperature of the bath-rooms should not be higher than 75° to 78° F. A temperature of 65° to 70° is preferable for the waiting- and cooling-rooms; while a temperature five to ten degrees higher may be allowed for the general treatment-rooms.

The floors of the waiting- and dressing-rooms should be **906** made of hard wood, and waxed. If necessary, the floor may be covered with soft rugs, which should be taken out and shaken and sunned daily. The floors should never be covered with carpets, as these collect the dust, and often become musty, and contaminate the air. In apartments in which the floor is likely to be wet, as the douche and the general treatment-rooms, the floor, or at least a portion of it, should be covered with tile, marble, slate, or concrete. The walls should also be of impervious material, preferably marble, and no crack should be left into which the water can enter, or to become filled with decomposable material.

If gutters are employed for carrying off the water (these should be depended upon as little as possible), they should be along the outer wall, and should be deep enough so that they will not readily overflow, and should be readily accessible so that they may be cleaned daily. No pipes of any sort should pass through the gutters, and there should be sufficient fall so that they will empty themselves rapidly.

Partitions should, as far as possible, be made of waterproof material. No woodwork of any sort should come in contact with the floor.

For fully equipped bath apartments at least the following appliances will be required: —

907 Bath-tubs of proper construction for full, sitz, foot, running foot, shallow, and leg baths. An apparatus for administering douches of all sorts, including the vapor douche, is one of the most important necessities, and should be provided regardless of expense.

For good heat effects an electric-light bath and vapor or hot-air baths are needed, and for a large establishment it is well also to add the Russian bath. Electric-light apparatus should be provided for the administration of local light-baths to the spine, legs, abdomen, and other parts.

Several large dippers, and pails properly constructed for the pail douche, should be provided, and there should be an abundant supply of linen and Turkish towels, linen and Turkish sheets, large soft woolen blankets, double blankets for the wet-sheet pack, friction mitts, a shampoo slab, manila or excelsior for shampooing, fomentation cloths, cheese-cloth for compresses, hot-water bags, both square and long, hot-water bags for the throat, and properly constructed sofas and couches. Several thermometers should be hung about the bath apartments in various places, by which to regulate the temperature. The thermophore, when obtainable, may be employed instead of the hot-water bag.

It may be properly added, however, that the most elegantly equipped establishment for the administration of hydriatic procedures may be only the means for bungling and unscientific dabbling with human ailments, unless conducted under skilled medical direction and by the aid of attendants well trained in the versatile procedures of hydriatry. The hydriatrist must know not only that his apparatus and appliances are perfect and in perfect condition, but he must know exactly the condition of the patient to be

treated, and must have a clearly defined rationale for each application made. Every prescription must have a sound physiological basis. Empiricism is bad anywhere, but especially so in practical hydrotherapy. A profound knowledge of physiology and pathology is essential to success.

It may be profitable to note a few of those conditions of 908
the patient aside from distinct pathological states which have an important bearing upon the effects of hydriatic procedures.

The exact condition of the patient as he comes to the bath should be noted and taken into account, as it may be necessary to modify a procedure which was designated for him the day before or even the hour before. If he is in a state of exhaustion, for example, from overexercise or loss of sleep or other cause, any very cold application will probably be inappropriate. If the patient is chilly, he must be warmed. Simply warming the feet by a hot foot bath may be the only heating measure needed; but if necessary, fomentations to the spine, a short hot immersion bath, a hot-blanket pack, or a hot rain douche just before the cold douche, may be employed as most convenient or as may seem to be indicated. If the patient is able, a few minutes' exercise, until gentle perspiration is induced, will, in ordinary cases, be found a more excellent means of preliminary heating than any form of hot bath, for the reason that exercise brings into full action the heat-making processes which the cold bath is designed to stimulate. If the patient is unaccustomed to cold water, his feelings should be respected, and the cold applications graduated in such a way as to avoid so unpleasant a shock as to distress or discourage him. If a patient is too feeble to help himself without more than ordinary assistance, the method of application must be modified to suit his case; as, for example, the shallow bath should be used rather than the rubbing wet sheet. If the patient has little power to react, his reactive ability must be stimulated by thorough heating before the bath by means of exercise, perhaps supplemented with a heating bath of some sort, as a vapor or an electric-light bath.

909 It is important to remember that patients are as likely to take cold in the treatment-rooms as elsewhere. The patient generally attributes his cold to a cold application, because during such an application he has experienced sensations of chill or shivering; but in this he is in error. If he has taken cold, it is because of the slow cooling which takes place by evaporation from an imperfectly dried skin after the bath, or because of a secondary chill occasioned by improper administration of the treatment. He can not take cold from a short, vigorous cold application followed by rubbing and a good reaction. The secondary chill (**441**) must be carefully avoided. Chill is not infrequently produced by evaporation from the skin while the patient, who has perhaps had a heating procedure of some sort, is waiting for the completion of his treatment. The attendant should take care to see that such dangerous pauses in the treatment do not occur. The cold treatment must follow instantly upon the completion of the heating procedure. If from some accident or emergency a few seconds' delay occurs, the patient must be warmed up again by the administration of a hot rain or needle douche for a minute before the cold douche is given. Chilling of the feet by walking upon cold floors is doubtless in some cases the cause of taking cold. This may be obviated by the use of slippers. The heelless bath slippers, such as are generally used in the bathing establishments of Italy and Germany (Fig. 30), are very convenient.

The subject of exercise in connection with baths has been considered elsewhere (**774**). Suffice it to say here, that, in general, moderate exercise for 15 to 30 minutes should be taken both before and after a cold bath by patients able to exercise, but after a hot bath the patient should rest.

910 The training of patients to endure cold applications is a matter of the utmost consequence, and it requires considerable intelligence on the part of the attendant as well as the physician himself to conduct the process skilfully. While as a rule the temperature should be lowered a little each day,

there will be occasionally a day when the patient's nerve tone is not quite up to par, when it may be necessary to return to the higher temperature employed two or three days previously. The day following, however, with improved nerve tone, rapid advance may be made toward the goal constantly aimed at in the average case; namely, the administration of water at a temperature properly designated as cold or very cold.

911 This training is especially necessary in the case of sedentary persons, such as are represented by the average business or professional man, teachers, and the wives and daughters from wealthy homes. Americans are as a class less able to bear water at a low temperature than are the English, the Germans, or the French. The reason for this is that Americans generally maintain their living rooms at a higher temperature in winter, and load themselves with a mass of unnecessary clothing at night as well as during waking hours, so that the skin is generally relaxed, and possessed of little ability to react. The necessary reactive power may, however, be acquired by careful training, and the rapidity with which the patient comes to enjoy the most vigorous cold procedures is frequently very surprising. The exhilaration which comes with the reaction following the bath is soon recognized as more than ample compensation for the slight unpleasantness occasioned during its application, and indeed it requires only short training to bring the patient to a point at which the really unpleasant symptoms at first experienced are no longer felt, or are mitigated to such a degree as to be scarcely noticeable.

912 It should never be forgotten, however, that very old, very young, and very feeble persons are incapable of enduring the very cold procedures suitable for ordinary adults, as their heat-producing powers are much less. Very cold baths must also be avoided in rheumatism, cardiac weakness, valvular disease of the heart, organic diseases of the brain and spinal cord, and degenerations of the kidneys, liver, heart, lungs, and other internal organs.

913 Very cold or very hot baths should be avoided just before or just after meals. The sitz bath should always be taken with the stomach empty, and the moist abdominal bandage should be removed during the meal, except in cases of gastric irritation in which it may be specially indicated.

914 From Schüller's experiments * it is evident that the condition of the cerebral vessels should always be taken into consideration in the arrangement of a hydriatric prescription. Warm baths are contraindicated in cerebral anemia, for the reason that they would mechanically cause still further contraction of the cerebral vessels; while in pronounced cerebral congestion the application of very cold baths may be equally inappropriate in consequence of the intense though temporary cerebral congestion which they induce.

915 The success of hydriatic procedures depends as much upon the faithfulness and thoroughness of the attendant as upon the nature of the procedure itself. Every little detail must receive conscientious attention. No person can become qualified to administer hydriatric treatment in a satisfactory manner unless capable of following a prescription with absolute precision; and no person should be employed to administer treatment of this sort unless it is known that he can be fully relied upon to administer it in the manner indicated.

916 The attendant must never forget that nearly all procedures require a thorough cooling of the head, which demands bathing of the face and neck with cold water as well as complete saturation of the hair and wetting of the scalp. Women generally decline to have the hair wet, protecting it with a rubber cap so as to avoid the long delay necessary for drying the hair after the bath. This disadvantage may be obviated to a considerable degree by a thorough bathing of the face and neck with water colder than that of the proposed bath, and the application of a cold compress about the neck during the treatment.

* *Archiv für Klin. Med.*, 1874.

If the bath is one requiring rubbing, it must be faithfully done, but not overdone, and as a rule it must be continuous from the beginning of the bath to the end of it. Interruption of the rubbing for half a minute may be sufficient to spoil the effect of the procedure altogether. When the patient is able, he must be constantly encouraged to assist in the rubbing, as the physical exercise thus involved is relied upon as a means of assisting reaction, and is an important factor in securing the good results expected of the procedure. **917**

In procedures like the wet-sheet pack and the neutral bath, care should be taken to secure the greatest possible degree of quiet about the patient. Bright sunlight should be excluded by drawing down the curtains a little. Conversation, if allowed at all, should be suppressed. The patient should be disturbed as little as possible, no attention generally being required further than the changing of the cold compress applied to the head. If the patient is inclined to sleep during the bath, he should be allowed to do so. If the purpose of the bath is to obtain sleep, its duration may be extended beyond the usual limit, so long as the patient remains quietly sleeping, care being taken that no untoward effects are provoked by the accumulation of heat or other change in the conditions essential to the proper effects of the bath. **918**

Quiet should always be maintained in the bath-room. Noisy talking, whistling, singing, and a bustling manner are entirely out of place there. Patients should not be encouraged to converse while taking treatment.

Particular attention must be given to drying and rubbing the patient after the bath. This portion of the procedure is almost as important as any other, yet it is frequently neglected, even in the best-equipped and ably managed establishments. Attendants should see that the bath sheet is thoroughly dry, but it should not be heated for a tonic application, as the contact of the heated sheet with the skin is likely to produce an atonic reaction, thus antagonizing the tonic effects of the bath. **919**

The warm sheet may be applied after the neutral bath without harm, and the temperature of the sheet should at least be such that it will not produce the impression of cold when brought in contact with the skin. A Turkish sheet is to be preferred to the ordinary linen or muslin sheet for drying after the bath.

Extreme care must be taken to avoid chilling by evaporation after the neutral bath, as by this means the effect of the bath may be wholly destroyed. To this end the patient must be closely covered instantly when removed from the bath, special care being taken to avoid air currents about the neck and feet. Gentle rubbing over the sheet will facilitate the absorption of water by the sheet, and the patient may thus be rapidly dried without producing an undesirable reaction, either circulatory or thermic.

920 After a cold bath the patient must be thoroughly rubbed until a good reaction has occurred. Special attention must be given to the feet and legs, as these parts, particularly the feet, are very likely to become cold soon after the bath, through defective reaction, and may remain in this condition for several hours unless the patient's ability to react is good. When the circulation of the lower extremities is disturbed in this way, the cerebral vessels are dilated, and headache is likely to result. The patient should be first rubbed thoroughly with a towel or sheet, and afterward vigorously with the bare hand, the warm fleshy hand of the attendant greatly facilitating reaction. The patient is by no means dry when the skin ceases to feel wet. So long as the skin is soft and spongy, it still contains moisture which has been absorbed by the superficial layers of the epidermis. This absorbed moisture being left to evaporate after the bath, the patient becomes chilly, and contracts a cold, which he erroneously attributes to the bath, whereas the difficulty is wholly due to the ignorance or neglect of the attendant, or perhaps to the patient's own failure to observe the precautions suggested to him by his attendant or physician.

Rubbing, though thorough, should never be so vigorous as 921
to produce irritation of the skin or to bruise or exhaust the patient. Excessive friction depresses the heart.

It is necessary to exercise great care to avoid burning 922
patients when making hot applications. This accident is liable to occur in the treatment of patients who are in a state of insensibility from any cause, as from syncope due to chloroform, the stupor of fever, or sensory paralysis. In various forms of spinal disease there is a diminished sensibility and lowered vitality due to the presence of toxins, which greatly decrease the patient's ability to resist high temperatures, so that severe burns may occur from the application of a fomentation at a temperature which would produce no unpleasant effect when applied to sound tissue. The same is true of patients under the influence of an anesthetic, and in some forms of cardiac weakness on account of the slowed movement of the blood.

Equal care must be taken to avoid freezing parts to which very cold applications are made continuously for a considerable length of time, especially in the use of the ice compress, the ice-bag, or the carbonic acid gas compress, especial care being necessary in the use of the last-named measure. Parts which may be completely surrounded by the cold application, as the hand, the foot, the scrotum, the ear, and parts in which the bones are thinly covered by flesh, are much more likely to suffer than are other parts of the body. In some parts, as the face, the cutaneous circulation is so active that there is very little danger of injury from this cause. It should be remembered, however, that in patients who are in a low condition, as in the ataxo-adynamic state of typhoid fever, the circulation is so sluggish that freezing occurs much more readily than in normal individuals.

Before putting the patient into a continuous bath, the 923
skin should be oiled to prevent masceration and resulting irritation. The same precaution must be taken when fomentations are applied daily to a part, as for relief of pain in

sciatica and in chronic joint disease. Oiling of the skin is also essential as a protection against taking cold for patients who are under hydriatic treatment, especially during the cold season of the year. A little refined vaseline or cacao butter should be applied daily or every other day, after drying the patient.

924 Great care must be taken to keep the towels, sheets, and blankets employed about the bath-room in a thoroughly aseptic condition by frequent laundering. Towels should be boiled daily. The rashes resulting from the continuous use of the abdominal girdle on which the empirical hydropaths dote so much, are in large part due to neglect to properly cleanse the wet bandage, which, being used day after day, accumulates fetid matter from the skin, and affords a favorable culture medium for the various forms of pus-producing microbes which are always present upon the skin. These rashes are never desirable, and may generally be prevented entirely by taking the precaution to apply vaseline to the skin and to boil the bandage daily. If the bandage is worn both night and day, it is well to employ a fresh one each night and morning.

925 The hydriatrist should always be sharply on the lookout for untoward effects from the applications which the patient is receiving at his hands, and should be ready to apply at once the necessary remedy, whether in the form of a hydriatic antidote or such an adjustment of the prescription as will obviate these untoward effects, which have been dwelt upon more fully elsewhere, but may be here again briefly enumerated, with a few words of suggestion, as follows: —

926 *Loss of Flesh.*— If the patient's weight is normal, as indicated by the height-weight coefficient (the height-weight coefficient of the average man is 37; that is, he weighs 37 kilograms ($1\frac{1}{4}$ oz.) for each millimeter (one twenty-fifth of an inch) of height, as the author has elsewhere pointed out),* a loss of flesh probably indicates overtreatment or

* "A New Dynamometer for Use in Anthropometry," read before the American Association for the Advancement of Physical Culture, 1893.

advance of the disease. There are many cases, however, in which metabolism has been so sluggish, allowing an accumulation of imperfectly oxidized waste matters in the body, that the first effect of active stimulation of the nutritive processes is disproportionately to increase destructive metabolism. Under these circumstances there is necessarily a slight decrease in the weight. The rubbish must be removed and old defective structures broken down before new and more highly organized tissues can be deposited It is hence apparent that a slight loss of weight need not give rise to any apprehension; but if this loss is considerable, or continues for some time, especially if accompanied by a loss of strength or appetite, it is a matter requiring immediate attention, and there should be a readjustment of the patient's prescription.

927 As Bouchard has so clearly pointed out, a great number of chronic invalids are suffering from a slowed or enfeebled condition of the general nutrition, where there is deficient metabolism, either constructive or destructive. There are, of course, morbid conditions in which metabolism is accelerated. Hydrotherapy affords more effective means than any other known agent for the control of these tissue changes, as has been clearly shown in the chapters devoted to the physiological effects of water; but it is of course necessary that they should be intelligently applied, so that the loss will not be so rapid as to discourage the patient or reduce his strength unduly.

928 A very common cause of the loss of flesh referred to is the excessive employment of heating measures. When this is the case, these should be at once suspended, and short cold applications at 60° to 65°, duration 4 to 10 seconds, or as cold as the patient can bear, should be substituted. Long cold applications should be avoided. In some cases very vigorous cold procedures can not be tolerated, and only very mild tonic measures, such as cold friction, should be employed alone or alternated with neutral baths.

929 A gain in flesh is to be effected by means of neutral temperatures, as by neutral baths, the neutral pack, or the rain douche, combined with wholesome food and plenty of rest. In many such cases it is necessary to employ hydriatric measures in such a way as to produce activity of internal parts, as in hypopepsia with anorexia and emaciation. The increased movement of blood and diminished outflow of energy resulting from the application of sedative measures, with just sufficient stimulation by cold friction or wet-sheet rubbing to maintain active nutrition, are effects which may be advantageously employed in cases in which loss of flesh is to be combated. When pain or irritability exists, higher temperatures are required.

On the other hand, the failure of an overfat patient to decrease in flesh indicates the need of more vigorous procedures. Obesity may be best combated by the application of measures which will produce powerful stimulation of the nerve centers. The wet-sheet pack, vapor bath, or electric-light bath not too greatly prolonged, followed by the cold bath, cold shower bath, with affusions to the abdomen, constitute a rational treatment for persons who have been properly trained to the employment of such powerful measures.

930 *Loss of Appetite.*— The loss of appetite in hydriatric treatment is a matter requiring immediate attention, as the usual effect of the treatment is to increase the appetite at once. As a rule, short very cold applications made when the patient is fasting, powerfully stimulate the appetite. A cold bag applied over the stomach half an hour before meals is highly useful for this purpose.

931 *Loss of Strength.*—This, like loss of appetite, is a symptom which is indirectly of great significance, and one which should receive attention without delay. Tonic hydriatric procedures energize in a wonderful way both the nerve centers and the muscular system. Gradual loss of strength indicates the necessity for more highly tonic applications; or if the patient is feeble, it may be possible that the applications

are too vigorous, so that the patient's energies are overtaxed by the strong reaction induced. The employment of the author's universal dynamometer* in connection with hydriatric treatment furnishes a ready means for determining the constitutional effects of the measures employed. A study of the coefficients which may be obtained by the use of this instrument instantly furnishes a clue to the patient's vital condition, and affords a means by which any change, whether favorable or unfavorable, may be at once observed. The height-weight, strength-weight, strength-height, and respiratory-height and -weight coefficients are especially valuable. The significance of these coefficients and their use in hydriatic prescriptions has been dwelt upon elsewhere (**780**).

The blood-count and the percentage of hemoglobin may **932** be watched with great profit. A diminution indicates that excessive demands are being made upon the system in the stimulation of eliminative and oxidizing processes. The appearance of an excessive amount of uric acid or urates in the urine, while generally accompanied by unpleasant symptoms, such as headache, malaise, etc., is not necessarily a discouraging feature, though it is a symptom the significance of which the patient will often need to have explained. In cases in which this symptom appears there has been for a long time an accumulation or storing-up of uric acid in the tissues. The increased alkalinity of the blood resulting from tonic and alterative hydriatic procedures renders possible the solution and elimination of this toxic element, the product of the deficient oxidation of nitrogenous wastes, which accounts for the sedementary deposits referred to. This symptom should be welcomed as an indication that the treatment employed is accomplishing the results expected of it; and no matter how depressed in mind the patient is, he may be assured that he is making real progress toward recovery.

The appearance of *an excessive amount of urea or a trace* **933** *of albumin or sugar* may be an indication that the procedures

* "Physical Coefficients," Modern Medicine Pub. Co., Battle Creek, Mich.

employed are too intense. The temperature should be elevated and the pressure reduced. The possibility of the appearance of these symptoms should lead to a frequent examination of the urinary secretions. Such an examination should be made at least once a week. The author has arranged a scheme for graphically representing the several features developed by the clinical examination, together with the different coefficients which represent mathematically a number of important relations. A glance at the graphic (page 415) which may be prepared by the aid of this schedule shows instantly what is the effect of the treatment upon the general metabolism, and also reveals any untoward effects upon the kidneys.

934 An excessively active destructive metabolism may be at once suspected from the presence of an excess of chlorides, while an excess of phosphates indicates great excitation of the nervous system. In such cases the intensity of the treatment must be diminished, applications at a more neutral temperature being employed. Excessive nitrogenous waste usually results from too prolonged hot baths, leading to abnormal destruction of the proteid tissue elements. Such a waste is usually attended by a loss of nervous and muscular energy.

935 *Palpitation of the heart* indicates either that the application has been at too extreme a temperature,—too hot or too cold,—or that it has been managed in such a way as to produce an improper excitation of the heart. When this symptom is troublesome, more moderate temperatures should be employed, and with less pressure, and in making the application care should be taken to avoid the region of the heart and chest. In some instances, this unpleasant symptom may be entirely avoided by the application of a cold compress or an ice-bag over the heart during the procedure. The application of the Scotch douche to the legs at the beginning of a general cold application, by dilating the blood-vessels of the lower extremities, aids in lessening the tendency to palpitation of the heart, as does also the application of cold water

Sanitarium Laboratory of Hygiene.

ANALYSIS OF URINE. (Men.)

NORMAL CONSTITUENTS.											ABNORMAL SUBSTANCES.													COEFFICIENTS.						
Amount.	Specific Gravity.	Acidity.	Urea.	Uric Acid.	Total Nitrogen.	Chlorides.	Phosphates.	Fixed Sulphates.	Conjugate Sulphates.	Total Solids.	Albumen.	Sugar.	Bile.	Oil.	Ammonia.	Hæmoglobin.	Blood Cells.	Pus.	Bacteria.	Spermatozoa.	Epithelium.	Casts.	*Crystals.	Mucus.	Toxins.	Urea.	Uric Acid.	Relation of Uric Acid to Urea.	Total Nitrogen.	Fixed and Conjugate Sulphates.	Total Solids.	Urotoxic.
6000.	1.075	11.00	80.0	3.25	38.0	31.0	5.60	6.00	2.50	134.0	30.0	500.0	Great Quantity.	Great Quantity.	Great Quantity.	Great Quantity.	Very Numerous.	Very Numerous.	Very Numerous.	Very Numerous.	Very Numerous.	Very Numerous.	Very Numerous.	Great Quantity.	Great Quantity.	4.00	16.80	51.20	4.00	16.66	3.64	3.00
5200.	1.067	7.00	72.0	2.70	34.0	27.0	5.00	5.00	2.10	114.0	20.0	250.0														3.30	12.00	30.00	3.30	13.0	3.10	2.60
4400.	1.059	5.00	64.0	2.20	30.0	24.0	4.50	4.50	1.70	97.0	13.0	125.0														2.80	9.00	17.00	2.80	9.50	2.60	2.30
3700.	1.052	3.90	57.0	1.80	26.0	21.0	4.00	4.00	1.30	82.0	8.0	60.0	Strong Test.	Strong Test.	Strong Test.	Strong Test.	Many.	Many.	Many.	Many.	Many.	Many.	Many.	Much.	Strong Test.	2.40	6.50	9.00	2.40	6.75	2.20	2.00
3000.	1.045	3.10	50.0	1.40	23.0	18.0	3.50	3.60	1.00	69.0	5.0	25.0														2.10	5.00	6.00	2.10	5.50	1.90	1.70
2400.	1.039	2.40	43.0	1.10	20.0	15.0	3.00	3.20	.70	60.0	3.0	10.0	Several in Each Field.	Several in Each Field.	Several in Each Field.	Several in Each Field.	Several in Each Field.	Several in Each Field.	Several in Each Field.	Several in Each Field.	Several in Each Field.	Several in Each Field.	Several in Each Field.	Several in Each Field.	Several in Each Field.	1.80	3.75	4.00	1.80	3.75	1.70	1.40
1900.	1.034	2.00	37.0	.80	17.0	13.0	2.60	2.80	.50	54.0	2.0	4.0														1.60	2.75	3.00	1.60	2.75	1.50	1.10
1500.	1.029	1.60	32.0	.60	15.0	11.0	2.30	2.40	.35	50.0	1.5	2.0	Several in Several Fields.	Several in Several Fields.	Several in Several Fields.	Several in Several Fields.	Several in Several Fields.	Several in Several Fields.	Several in Several Fields.	Several in Several Fields.	Several in Several Fields.	Several in Several Fields.	Several in Several Fields.	Several in Several Fields.	Several in Several Fields.	1.40	2.00	2.00	1.40	2.00	1.35	.90
1200.	.026	1.30	28.0	.45	13.0	9.0	2.00	2.00	.25	47.0	1.0	1.0	One in Several Fields.	One in Several Fields.	One in Several Fields.	One in Several Fields.	One in Several Fields.	One in Several Fields.	One in Several Fields.	One in Several Fields.	One in Several Fields.	One in Several Fields.	One in Several Fields.	One in Several Fields.	One in Several Fields.	1.25	1.50	1.20	1.25	1.50	1.20	.75
1000.	1.024	1.10	26.0	.30	12.0	8.0	1.70	1.70	.20	45.0	0.5	0.5														1.10	1.20	1.20	1.10	1.20	1.10	.60
800.	1.022	.95	24.0	.23	11.2	7.7	1.46	1.50	.15	43.9	0.0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.00	1.00	1.00	1.00	1.00	1.00	.46
750.	1.020	.70	22.0	.20	10.0	7.0	1.20	1.30	.13	42.0																0.90	0.90	0.90	0.90	.90	0.90	.40
650.	1.018	.40	20.0	.18	9.0	6.5	1.00	1.10	.11	40.0																0.80	0.80	0.80	0.80	.80	0.80	.35
550.	1.016	.10	18.0	.16	8.0	6.0	.80	0.90	.09	37.0																0.70	0.70	0.70	0.70	.70	0.70	.30
450.	1.014	.0	15.0	.14	7.0	5.4	.60	.70	.07	34.0																0.60	0.60	0.60	0.60	.60	0.60	.25
350.	1.012	.10	12.0	.12	6.0	4.8	.40	.50	.05	30.0																0.50	0.50	0.50	0.50	.50	0.50	.20
250.	1.009	.40	9.0	.10	5.0	4.2	.25	.40	.04	25.0																0.40	0.40	0.40	0.40	.40	0.40	.15
170.	1.006	.80	6.0	.08	4.0	3.5	.15	.30	.03	20.0																0.30	0.30	0.30	0.30	.30	0.30	.10
100.	1.003	1.30	3.0	.05	2.5	2.0	.10	.20	.02	13.0																0.20	0.20	0.20	0.20	.20	0.20	.05
50.	1.001	2.00	1.0	.02	1.0	1.0	.05	.10	.01	6.0																0.10	0.10	0.10	0.10	.10	0.10	.02
0.	1.000	3.00	0.0	.00	0.0	0.0	.00	.00	.00	0.0																0.00	0.00	0.00	0.00	.00	0.00	.00

The accompanying figures represent averages based upon the exact examination of many thousands of urines, normal and pathological. By the line drawn across the chart is shown the relation to normal of the specimen, the details of the examination of which are given on the preceding page. The several quantities are indicated as follows:—

Amount:—In cubic centimeters.

Specific Gravity:—By Urinometer.

Acidity:—Phosphoric acid in grams, and when below 0 Sodium oxide in grams.

Urea, Phosphates, Uric Acid, Chlorides, Total Nitrogen, Total Solids, Sulphates, Albumen, Sugar, each in grams.

Coefficients:—See last page for explanation.

The figures running across the middle of chart between double lines are the average normal quantities. The points above the central line indicate the degree of excess over the normal quantities. The points below the line indicate deficiencies.

* This refers only to number of crystals and not to kind.

(OVER.)

to the head and chest, especially the precordial region, previously to the general application of the douche.

936 *Dyspnea* rarely occurs except in persons suffering from emphysema, or who are subject to attacks of nervous asthma. The indication is either that the application made is too intense, or that sufficient care has not been taken to avoid the region of the chest, especially the front part of it. More moderate applications or the employment of a somewhat prolonged (10 to 15 sec.) cold douche (65° to 70°), with low pressure, before the general application, will generally suppress this symptom; or it may be relieved by a neutral compress to the chest and a Scotch douche to the legs.

937 *Malaise*, *nervousness*, and *depression* are symptoms commonly resulting from overtreatment or excessive employment of heating procedures. The last-mentioned cause is most frequent. Depression and malaise may generally be quickly overcome by vigorous general cold applications or the cold dorsal percussion douche daily. The Scotch douche to the back or the prolonged neutral affusion to the spine (93° to 96°, 10 min.) relieves nervousness and other symptoms of excitation.

Vertigo and *fainting* are symptoms likely to occur in connection with hot applications when too greatly prolonged, but are quickly relieved by cold applications, especially cold affusion to the chest and shoulders. Their recurrence indicates the necessity for a change in the prescription by lowering the temperature or by increasing the pressure of the bath.

938 *Sleeplessness* may result from excessive stimulation by intense cold procedures or by the excitement arising from heating processes. When these procedures are necessary in persons subject to sleeplessness, they should be administered in the early part of the day instead of the evening, and if necessary, the neutral bath may be employed at bed-time to counteract any excitation which may remain from the treatment in the early part of the day. If the difficulty is not thus controlled, the exciting measures may be suspended for

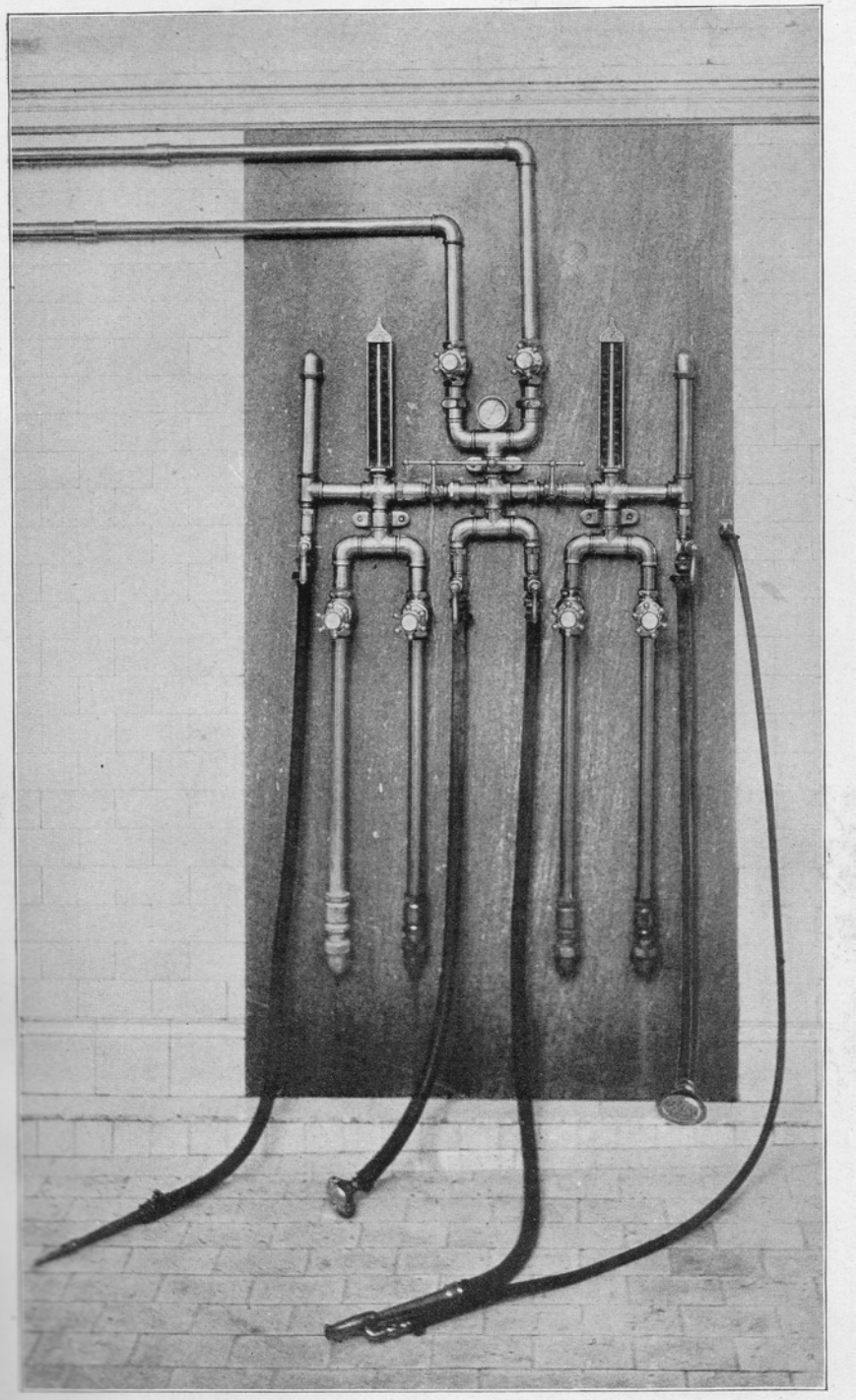

FIG. 31. GENERAL DOUCHE APPARATUS (p. 427). (Kellogg)

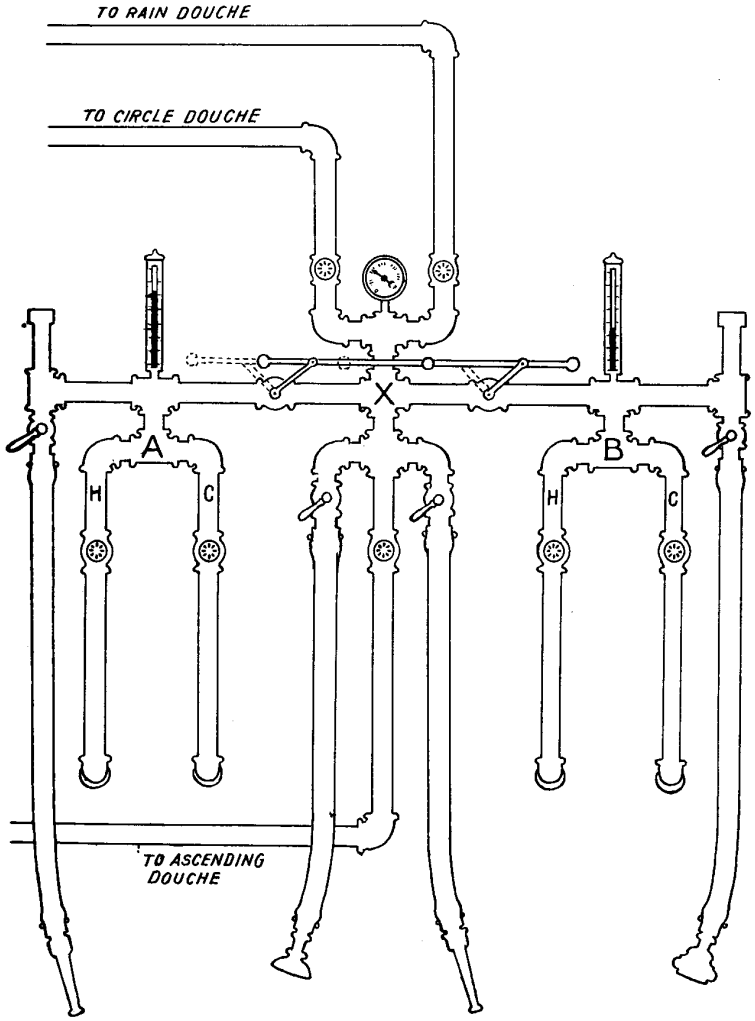

FIG. 32. DIAGRAM OF AUTHOR'S DOUCHE APPARATUS (p. 427).

a time, such quieting means as the tonic pack, the neutral immersion bath, the neutral douche, or cold friction being employed instead of the douche or the shallow bath.

Pain may be the result of excessive congestion of some 939
part induced by misapplied or mismanaged procedures, or it may be simply the awakening of some chronic neuralgic affection. The cold douche often gives rise to sciatic or intercostal pains in persons who have been subject to those difficulties. Pain is very likely to result from cold applications which have not been followed by complete and thorough reaction.

Headache is one of the most common results of mismanaged 940
or too intense hydriatic procedures. "The hydropathic headache" is a well-known phrase among the frequenters of Continental hydropathic institutions. Headache is very likely to result from excessively cold or excessively hot procedures, and may be due either to congestion from imperfect regulation of the circulation or to excessive excitation of the cerebrum.

Deficient reaction, as shown by long-continued pallor and 941
coldness of the skin, with chilliness, cold extremities, and generally headache, indicates that the duration of the application has been excessive, or that the patient was not properly prepared for the application. The last-named cause is perhaps the most frequent. The patient who is chilly or exhausted when the cold application is made, is likely to suffer in this way. Deficient reaction not infrequently occurs as the result of neglect to employ, after the bath, the proper measures to encourage reaction, the most important of which are rubbing and exercise. Exercise is by far the best means of encouraging reaction, as it sets in operation most fully the forces necessary for perfectly balancing the circulation, increasing heat production, and energizing all the vital functions.

Very short and very cold applications are most likely to be followed by complete and thorough reaction. Reaction is quite certain to fail, especially in feeble patients, when a succession of cold applications is made with an interval

between, as, for example, a rubbing wet sheet followed by a prolonged cold sitz bath, or the sitz bath followed by a cold douche. A patient not possessed of very vigorous reactive powers would be almost certain to suffer the evil results of defective reaction following secondary chill, if subjected to such a formula as the above. The author has known many similar and worse combinations to be employed, and yet wonderment was expressed that the results were not such as had been expected.

942 When the patient fails to react during or after a cold application, as the wet-sheet pack, the shallow bath, the wet-sheet rubbing, or the cold douche, a hot application should be made at once, the temperature of which should be about 100° F. at the beginning, being rapidly raised until a temperature as high as the patient can endure is reached — 108° to 110°. When the patient has become so thoroughly heated that he longs for some cooling drops to fall upon him (1 to 3 min.), the cold application should be renewed; but unless he has been accustomed to the use of cold applications, the temperature should not be lower than 65° to 75°, and the duration should be brief. If a douche apparatus is not convenient, the patient may be put into a hot immersion bath at 100°, the temperature being afterward raised to 106° or 108° until he is thoroughly warmed, as indicated by flushing of the face and a full pulse. The cold affusion (70° to 80°) may then be employed while the patient sits or stands in a partially filled tub. The patient should not be allowed to leave the hands of the attendant until good reaction has been produced and the circulation has become well balanced, as shown by a full, steady pulse.

943 *Excessive reaction*, as shown by overexcitation of the heart, perspiration, and prolonged sensation of heat, fulness of the head, perhaps headache, indicates a too intense or too short application. In the employment of the Scotch douche the symptoms named are very likely to occur when the cold application is not employed for a sufficient length of time to

allay the exciting effects of the heat, and develop the tonic-sedative influence of cold. Excessive reaction calls for a reapplication of cold at moderate temperature (65° to 80°), with little pressure.

Eruptions of the skin indicate excessive cutaneous excita- 944
tion, and interdict the use of the sweating pack and similar procedures. In some instances the vapor bath or the electric-light bath must be substituted for more exciting sweating procedures, or the prolonged neutral bath, followed by cold affusion, must be employed instead of more highly tonic applications; until the irritated condition of the skin is relieved. Cold friction, the rubbing wet sheet, the hot immersion bath, and similar processes must of course be avoided in cases of this kind.

Winternitz has made the interesting discovery that hydro- 945
therapy may be employed as a sort of diagnostic "reagent" to determine, in doubtful cases, whether or not syphilitic infection exists. In persons in whom this dyscrasia is present, the characteristic eruptions occur under hydriatic treatment, especially from the stimulating effect of the sweating pack and other sweating processes and cold shower baths.

The occurrence of *spasm* of the *voluntary or involuntary* 946
muscles is a symptom that may require special attention. Cramps in the muscles of the legs sometimes occur in the prolonged cold bath administered for antifebrile effects in continued fevers. This may be obviated by rubbing the parts with cold water before the bath or by wrapping the legs with flannels wrung out of very cold water just before the patient enters the bath. Special attention should be given to rubbing the legs in the Brand bath and the shallow bath to prevent the occurrence of this unpleasant symptom in persons especially subject to muscular cramps, in whom this symptom is very likely to occur whenever cold water is entered, or even water at a temperature of 70° to 75°, thus rendering swimming dangerous. In such cases the limbs must be rubbed vigorously and continuously during cold baths of any sort, special

attention being given to the muscles in which the cramp is most likely to occur.

947 Another symptom of excitation, which not infrequently occurs when very cold baths are employed, is increase of seminal losses in cases of spermatorrhea due to irritation of the spinal genito-urinary center. In these cases cold applications, if employed at all, should be exceedingly brief, — not more than one-half minute in duration, — and not infrequently cold applications must be entirely suspended, the neutral sitz bath for half an hour to two hours being substituted.

948 At the beginning of treatment, patients sometimes complain of a slight or even decided *exacerbation of morbid symptoms* as the result of the procedures to which they are subjected. This may indicate either that the treatment is not yet accurately adjusted to the patient's conditions, or that the curative processes employed are so powerfully alterative or perturbing in their effects that there is an intensification of the effort to restore the patient to a normal condition, the symptoms from which the patient suffers being simply an indication that such a remedial process is in operation. In the latter case an increase of these symptoms need not be considered in any sense discouraging, the patient being, on the contrary, thus assured that the measures employed are aiding nature in her curative work.

949 Measures which are radically curative in character by no means always produce an amelioration of symptoms as soon as they are applied. Time must be allowed for the healing processes of nature to proceed to completion. Recovery from disease is a thing which requires time, like the growth of a plant. Good judgment and good sense are necessary for interpreting the meaning of an exacerbation of the symptoms in a case under hydriatic treatment, whether they are what might be termed accidental, or merely functional symptoms, as, for example, pain, loss of appetite or of energy, or whether they are of a destructive character, as manifested by ulceration, suppuration, sloughing, etc. In any case they

can not be regarded as in any way favorable, and demand an immediate change of the prescription or the application of measures for their suppression.

On the other hand, the recurrence of biliary obstruction 950
in the attempt to discharge a collection of gall-stones or a similar recurrence of renal colic may indicate an advance in the curative process. The same may be said with reference to various remedial processes in which there is an evident effort to eliminate some foreign substance or to purify the tissues, as an increased frequency of the recurrence of attacks of headache, an effect sometimes observed in cases of chronic migraine soon after the beginning of a course of hydriatic treatment.

The hydriatrist, of all physicians, must be thoroughly acquainted with the language of disease, with all its pathological processes, and must especially be familiar with the conditions of health as expressed in human physiology. No hydric application for therapeutic purposes is safe or likely to prove successful unless made with the full knowledge of the patient's condition at the moment, and in harmony with the physiological and therapeutic principles involved in the particular case in hand. Routine treatment is always bad enough, but in hydriatic practice it is absolutely dangerous and destructive alike to the reputation of the physician and to the comfort and possibly even the life of the patient.

The application of cold water without friction is one of 951
the best known means of testing a patient's vital state. If reaction is slow, his vitality is at a low ebb. If a mottled, cyanotic appearance remains for some time after the cold application, the indication is proof of cardiac weakness, with possibility of impending collapse. This test should be frequently applied in cases of typhoid fever or other grave febrile disorders, and may be used with much advantage as a test for determining the advisability of administering an anesthetic in a case in which there may be some question of the ability of the patient to receive it with safety.

952 **The Average Temperature of Baths.** It will be helpful to the beginner in the use of hydriatic measures to find brought together in small space a statement of the average temperatures required for efficient results with the leading forms of baths. These may be briefly stated as follows, the extremes being indicated in ordinary type, the average in bold:—

Douche: cold, 50° to 70°, **60°**; hot, 104° to 125°, **115°**; neutral, 92° to 97°, **95°**.

Affusion: cold, 55° to 65°, **60°**; cool, 70° to 80°, **75°**; hot, 104° to 122°, **113°**.

Plunge: cold, 50° to 70°, **60°**.

Immersion: cold, 50° to 70°, **60°**; cool, 70° to 80°, **75°**; hot, 100° to 106°, **102°**; very hot, 104° to 115°, **108°**; neutral, 92° to 97°, **95°**.

Brand bath: **70°** F.

Shallow: cold, 55° to 65°, **60°**; cool, 70° to 80°, **75°**.

Cold wet-sheet pack: **60°** F.

Hot-blanket pack: **130°** F.

Sponge bath: 60° to 75°, **70°**.

Wet-hand rubbing: 45° to 75°, **60°**.

Cold friction: 32° to 70°, **50°**.

Cold towel rubbing: 40° to 75°, **60°**.

Wet-sheet rubbing: **60°**.

Hot-air bath: 110° to 180°, **160°**.

Local hot-air bath: 200° to 300°, **250°**.

Turkish bath: 140° to 250°, **180°**.

Russian bath: 110° to 140°, **125°**.

Vapor bath: 110° to 140°, **130°**.

Foot bath: cold, 45° to 65°, **55°**; hot, 105° to 120°, **115°**.

Sitz bath: cold, 55° to 65°, **60°**; hot, 106° to 120°, **115°**; neutral, 92° to 97°, **95°**.

Fomentation: 120° to 160°, **140°**.