corpse; sometimes, during life, in the expired air, or, after death, at the mouth; sometimes only after opening one of the cavities of the body, or the stomach, or on cutting into the lungs or liver.

When the odor has been *distinctly* recognized by more than one person, its existence is a factor of great moment in the evidence to prove the cause of death: but a failure to detect the odor is by no means of correspondingly great significance in the opposite direction. Several instances are recorded in which analysis has proved the presence of the poison, although the odor could not be distinguished either during life or after death.

3. *Was a person killed by hydrocyanic acid capable of certain voluntary acts?* Because hydrocyanic acid is capable, if taken in sufficient quantity, of destroying the power of voluntary motion almost instantaneously, within a few seconds after having been swallowed, it has been argued that death could not have been suicidal in a case in which the deceased was found in such a position as implied voluntary acts on his part after having taken the poison, or the presence of another person. Numerous cases are recorded, however, in which the person was capable of considerable voluntary effort after having voluntarily taken a dose of hydrocyanic acid sufficient to cause death.

4. *Was the hydrocyanic acid, detected in the body by analysis after death, introduced during life?* is a question which may arise upon a trial for murder by this poison. The defence may adopt either of the following methods of accounting for its presence:

(*a*) *It was introduced after death.*

(*b*) *It was given medicinally.* These claims, if false, are to be met in the same way whatever poison has been used, consequently they require no particular consideration in this place. It cannot be claimed that hydrocyanic acid was used for embalming.

(*c*) *Hydrocyanic acid is a normal constituent of the body.* The only cyanogen compound which has been shown to exist in the normal human body is the thiocyanate of the saliva and urine. If the precautions mentioned above have been taken, this substance cannot be mistaken for hydrocyanic acid.

(*d*) *Hydrocyanic acid is a morbid product of the economy.* Hydrocyanic acid has been, it is claimed, detected in the urine in dropsy (Brugnatelli), typhus, cholera, and hepatitis (Fourcroy, Osborn), and in the fluid of ascites (Goldefy-Dorhs). Although Buchner admits the possibility of the formation of hydrocyanic acid in certain pathological processes, Husemann very properly considers that, even if these somewhat doubtful observations be accepted, they have no forensic interest, as it is not in the urine or in pathological exudations that prussic acid is found in cases of poisoning.

(*e*) *Hydrocyanic acid is a product of putrefaction.* This argument was advanced by the defence in two English trials, cited by Taylor, and is based solely upon opinion. Several writers upon toxicology—Orfila, Buchner, Bonjean, Preyer—admit the *possibility* that hydrocyanic acid *may be* one of the numerous products of putrefaction, yet no writer has yet asserted that it *is* so produced, and numberless analyses of contents of stomach, blood, etc., in every stage of decomposition, have been made by many chemists without any evidence of its presence.

Rudolph A. Witthaus.

HYDROCYANIC ETHER.—This body, chemically *ethyl cyanide*, $C_2H_5.CN$, is a colorless ethereal fluid miscible with water, alcohol, and ether, and possessed of poisonous properties analogous to those of hydrocyanic acid. It is not used in medicine. *Edward Curtis.*

HYDROFLUORIC ACID.—Hydrofluoric acid is a pungent, corrosive gas, very soluble in water. The acid of commerce is an aqueous solution containing from thirty-six to thirty-eight per cent. of the anhydrous acid; it emits fumes which are extremely irritating. When applied to the skin it destroys the epithelium and underlying tissue, rendering the parts hard and structureless.

Hydrofluoric acid is an efficient bactericide and antiseptic, and for this purpose Dujardin-Beaumetz advocated its employment in the treatment of tuberculosis by inhalation. He vaporized one grain in an air-tight compartment of the capacity of 22 cubic metres. In this the patient is placed for an hour daily, the period being gradually prolonged. In some instances the results were very favorable, but in others it produced an irritation of the lungs and increased the pulmonary trouble. Inhalations have also been used in diphtheria and whooping-cough. In the latter much benefit is reported from the use of a tablespoonful in a quart of water, in an inhaler, every second day.

Internally, hydrofluoric acid is a marked depressant, acting upon the vaso-motors and lowering the force and frequency of the pulse. In excessive doses it causes death by profound collapse and failure of respiration.

As a vaso-motor dilator its employment has been suggested in chronic rheumatism, epilepsy, and goitre. In the latter condition it was thought to be of especial value by Woakes, of London, but it has not proved to be of much service.

The alkaline fluorides are selected for internal administration. The fluoride of sodium or of potassium in doses of one grain are quite unirritating, and may be used for a prolonged period.

Locally, solutions of the strength of one part in three thousand may be used for ordinary antiseptic purposes. Under the title of *fluorol*, sodium fluoride has been used in a two-per-cent. solution to replace perchloride of mercury. The solutions are unirritating and free from any toxic action. A half-per-cent. solution may be used for the eye. *Beaumont Small.*

HYDROGEN DIOXIDE.—Hydrogen dioxide, H_2O_2, commonly called *peroxide of hydrogen*, is formed by reaction between barium dioxide and mineral acids in the cold. Obtained in concentrated condition, this body appears as a colorless, transparent, heavy, oily fluid, of specific gravity 1.452, neutral to test paper, remaining fluid at temperatures far below the freezing point of water, but rapidly and even explosively suffering decomposition into water and gaseous oxygen upon even a slight elevation of temperature, or upon contact with charcoal and certain metals and oxides. Even at ordinary temperatures the same decomposition occurs spontaneously to a greater or less extent.

Hydrogen dioxide mixes in all proportions with water and dissolves also in ether. As a medicine, it is used in solution in one or other of those fluids, the aqueous solution being commonly known as *oxygenated water*, and the ethereal as *ozonic* or *ozonized ether*. The *aqueous* solution in common use contains three per cent. of hydrogen dioxide by weight, a strength representing a charge of ten volumes of oxygen to one of the water of the solution. Such a solution is official in the United States Pharmacopœia under the title *Aqua Hydrogenii Dioxidi*, Solution of Hydrogen Dioxide. It contains a little sulphuric acid, purposely allowed to remain, as a preservative, from the charge of acid used to clarify the solution. This solution is a sparkling, clear, colorless aqueous fluid, odorless, but having an acidulous and disagreeable chlorinous taste, and producing a curious sensation and a soapy froth in the mouth, through evolution of oxygen. Its specific gravity ranges from 1.006 to 1.012 at ordinary temperatures. It tends to decompose spontaneously into water and oxygen, and accordingly will deteriorate by age, especially if exposed to light or to warmth. If subjected to evaporation at a temperature not exceeding 140° F. the solution will gain in strength through loss of water, but if heated rapidly it is liable to decompose at once and with explosive violence. Because of these various properties, the solution should be kept in dark amber-colored bottles, *loosely* stoppered and in a cool place. A tight stopper may be blown violently from the bottle, or the bottle itself may be burst, if the stopper be immovably seated. Furthermore, since deterioration by keeping is inevitable, a freshly made sample should be

procured always, when possible, for use. Old specimens will certainly be under standard in strength, and even may be wholly spoiled and inert.

Solution of hydrogen dioxide is neither corrosive nor poisonous, and is irritant only to especially sensitive parts, such as the eyes, the urethra, or raw surfaces. Its use in medicine is because of its ready decomposition, with yield of free oxygen. Such decomposition is determined by mere contact of the solution with many things, among which are the organic matters found in blood, mucus, pus, and other morbid discharges, diphtheritic membrane, the bodies of pathogenic micro-organisms, and decaying organic substances generally. It coagulates albumen powerfully. By virtue of the yield of oxygen the solution destroys, by oxidation, the morbific quality of animal secretions and excretions. When added to pus, brisk effervescence ensues and the pus corpuscles are quickly disintegrated. Similarly, when washed over a secreting surface, frothing occurs, crusts of dried secretion are loosened, and foul odors disappear. The foaming will continue till all adhering pus or mucopus is destroyed, when, after washing, the surface will be found to be perfectly cleansed and of healthy appearance. Solution of hydrogen dioxide is thus powerfully detergent and disinfectant to all styles of morbid surface conditions, whether of skin, mucous or serous membrane, or wounds or ulcers. The action, however, is evanescent and does not seem to include any intrinsic healing virtue, such as is shown by silver nitrate. For ordinary purposes, the pharmacopœial ten-volume solution may be used in full strength, but for application to sensitive surfaces such as the eye, the upper nasal passages, or the urethra, it should be diluted with from one to four or more parts of water. It may be applied by swabbing, by injection, or by spraying, but only instruments or utensils of hard rubber, glass, or porcelain should be allowed contact with the solution. To affect the surfaces of the stomach or intestines the solution may be given, without fear, by swallowing or by enema. From one to two or three teaspoonfuls may be given at a dose by the mouth. This dose should be well diluted with water and taken from a vessel of porcelain or glass. Other medicines should not be combined with the solution.

Attempts have been made to utilize the solution of hydrogen dioxide as an oxidizing agent within the system for the cure of disease. But when given by swallowing, a dose of the solution is almost wholly decomposed in the stomach, and, when administered hypodermatically, similar decomposition takes place at once in the juices of the part receiving the charge. In either case, therefore, but little of the solution can enter the blood unchanged, so that there is at best but small chance for a constitutional effect of any moment. If injected into the veins, the solution is instantly decomposed by the blood, and, in cases in which this procedure has been tried upon animals, it has often been followed quickly by death from embolism, due to coagulation of the blood by the disengaged oxygen.

Aqueous solutions of hydrogen dioxide stronger than that of the Pharmacopœia are to be found in the market (so-called "hydrozone"), and also solutions with glycerin as the basis (so-called "glycozone"), and solutions in ether ("ozonic ether": "pyrozone"). The ethereal solution is, naturally, highly inflammable.

Solutions of hydrogen dioxide *bleach* powerfully, and are much used for such purpose. *Edward Curtis.*

HYDROPERICARDIUM: DROPSY OF THE PERICARDIUM.—By hydropericardium is meant a collection of non-inflammatory fluid in the pericardial sac. It is distinctly a transudate and not an exudate. Some authorities include all collections of fluid in the pericardium, inflammatory and non-inflammatory, under this one term. By general consent, however, hydropericardium and hydrothorax are understood to mean transudates. A few cubic centimetres of fluid are practically always found in the pericardial sac after death. The fact that the amount varies with the lapse of time before the autopsy,—the longer the wait, the larger the amount of fluid,—suggests that most of this fluid is a post-mortem transudate. It may amount to even two or three ounces. Not until the fluid exceeds 100 c.c. (about three ounces) is the condition spoken of as hydropericardium.

Anatomic Alterations.—Like transudates in other parts of the body, this fluid is light yellow, or slightly greenish-yellow in color, usually clear, of low specific gravity, and containing few formed elements. There may be some floccules of coagulated albumin. It may contain urea or bile, especially in renal and hepatic diseases. The percentage of albumin, according to Reuss, is less than in pleural transudates, and greater than in peritoneal transudates. The quantity of fluid varies very much, depending on many circumstances. It may reach from 500 to 750 c.c. Corvisart has reported the enormous quantity of eight pounds—about 4,000 c.c.

The pericardial sac is distended according to the amount of fluid; in the large collections the lungs are compressed and the diaphragm is forced downward. The pericardium proper is thinned, or if the case is of long duration may be thickened. In chronic cases, the subserous fat about the heart disappears, the subserous cellular tissue appears œdematous, and the endothelia are relaxed, swollen, and of granular opacity. The muscular substance of the heart is pale and flabby.

Scientific opinion is as yet divided in the explanation of the presence of transudates. By many transudation is considered a process of filtration; others hold that the capillary walls are to be regarded as living organs, with a capacity for secretion, under the stimulating influence of irritating substances in the blood.

Etiology.—Hydropericardium is never a primary disease, but always secondary to some other disease. In comparison with the frequency of similar collections of fluid in the pleural and abdominal cavities, and the subcutaneous tissues, it is a rare condition. The explanation of this fact probably lies in the incessant activity of the heart. It occurs occasionally as a very rapid collection of fluid in some cases of acute nephritis, as in scarlatinal nephritis. Most commonly it is a part of a chronic dropsy associated with diseases of the heart and kidneys. Less commonly it is found in the various cachexias which produce an anæmic condition of the blood, such as tuberculosis, cancer, scurvy, and the severe anæmias. In these diseases the pericardial dropsy almost always follows transudation into the pleural cavity. Very rarely the dropsy has a predilection for the pericardial sac, rather than for its usual locations. Probably some local alterations in the pericardium would explain this. It may occur as a result of some local interference with the circulation, which hinders the return flow in the pericardial or cardiac veins. Atheroma of the coronary arteries, aneurism, disease of the lungs, pleura, or the heart itself, tumors and inflammations of the mediastinum, all may impede the circulation in these veins. In rare cases the sudden development of a pneumothorax is followed by hydropericardium.

Symptoms.—These are very indefinite, and can scarcely be separated from those of the associated disease. The condition comes on insidiously and would not be recognized were it not for careful physical examination. A familiarity with the possible complications of chronic heart and kidney disease puts the physician on his guard. The dyspnœa and cardiac distress rarely may be chiefly dependent upon the hydropericardium. There is never any acute præcordial pain, as in inflammation of the pericardium. Pericardial friction sounds are never present. If the fluid is large in amount compression of the lungs may add to the dyspnœa.

Physical Signs.—The reader is referred to the article on *Pericarditis* for a discussion of these, as they are the same except for the fact referred to above—viz., that pericardial friction sounds are never present in hydropericardium, either before the collection or after the absorption of the fluid. The transudate is said to move more quickly with change of body position than the inflammatory exudate.

PROGNOSIS.—It is always grave because of the fundamental disease. The fluid in the pericardium adds an extra impediment to the already weak heart and thus hastens the fatal issue. In rare cases, as in the effusions associated with acute nephritis, there may be recovery.

TREATMENT.—This consists, in the majority of cases, in the treatment of the primary disease, with cardiac tonics and diuretics. Usually paracentesis only delays the fatal issue a short time. However, in rare cases it may be distinctly useful—*e.g.*, when the patient seems to be dying as a result of great local obstruction in the pericardium, which is overwhelming the heart. The operation is not difficult, but must never be undertaken, unless the diagnosis be certain. For a description of the operation see the article on *Pericarditis*.

James Rae Arneill.

HYDROQUINONE.—Hydroquinone, or *hydrochinon*, as it is called by German authors, is chemically *paradioxybenzene*, $C_6H_4(OH)_2$, one of a trio of isomeric diatomic phenols, of which resorcin and pyrocatechin are the other two members. Hydroquinone appears in transparent, colorless, rhombic plates or prisms, fusible at 169° C. (336.2° F.), and subliming without decomposition. The crystals dissolve readily in alcohol, ether, and hot water, but in not less than seventeen parts of cold water. The reaction is neutral and the taste slightly bitter.

Hydroquinone has been proposed as an antipyretic. It is capable of producing convulsions and other derangements in the lower animals, but in therapeutic doses, in man, operates as a speedy, but transient, antipyretic in fever. In such operation the medicine is remarkably well borne, even so large a dose as forty grains producing no derangement worse than a very transient feeling of fulness in the head and slight giddiness, and ordinary doses being free from even this effect. The fall of temperature begins, as a rule, within half an hour after administration of a single dose, reaches its maximum in from two to two and a half hours, and the ensuing rise attains the original temperature in from one to two hours additional. For a transient impression such as described, a dose of from 1.00 to 1.33 gm. (from fifteen to twenty grains) suffices, while for a continuous one, three or four such doses should be given during the twenty-four hours. During continuous medication with hydroquinone the urine may appear of a dark-brown color, due to the presence of products of decomposition of the medicine.

Edward Curtis.

HYDROTHERAPY.—In the present enlightened era of medicine the chief aim of the physician is to aid the inherent powers of the human organism to eliminate morbific agents and reinstate the disturbed equilibrium of the economy, by all means which enhance the patient's capacity to resist the inroads of disease. In the accomplishment of the latter water plays an important part The simplicity of this remedial agent and the neglect of precision in its application have been the chief obstacles in the way of its more universal acceptance. The fact that water is one of the few remedies which has survived since the day of Hippocrates and has been advocated and used by the most eminent physicians of every time, was the writer's incentive to its investigation twenty-five years ago. The clinical results obtained by him have won his highest esteem, especially since he discovered that its action is based upon recognized physiological principles. The latter must be clearly understood before the real value of hydrotherapy can be appreciated.

The action of water upon the human organism is derived from its physical and mechanical effects.

The physical qualities of water are utilized in hydrotherapy because it is an excellent vehicle for conveying the thermic and mechanical effects aimed at. Water absorbs and gives up heat readily; it may be used in solid, liquid, or gaseous form, it may be applied to any limited part of the body or to its entire surface. Hence its physical property alone makes it a most flexible therapeutic agent.

Thermic agents affect living tissues in the most pronounced manner. Smooth muscular fibre contracts under cold and expands under heat, and its contractility may be entirely destroyed by an excess of either. By the conveyance of cold or heat by means of water we are, therefore, enabled to produce striking effects upon vital processes which depend upon muscular activity. As cold and heat are irritants, their reflex effects conveyed through the nervous system also become valuable therapeutically. Applying these axiomatic principles, we find that circulation, respiration, tissue change, and heat production may be positively influenced by the application of water as a medium of conveyance of cold and heat, and that abnormal conditions of the functions may be remedied and their healthy equilibrium restored. That such effects are really produced, laboratory experiment as well as observation at the bedside has again and again demonstrated.

In my book on hydrotherapy * many experiments are detailed showing the influence of hydriatic procedures upon the calibre of blood-vessels, the action of the heart, and even upon the composition of the blood, the respiration, and the secretions. All applications of cold involving the entire surface of the body, or a considerable part thereof, result in an increase of the number of blood cells; the percentage of hæmoglobin and the specific gravity of the blood are also increased when reaction, manifested by cutaneous hyperæmia, ensues. When reaction fails, the erythrocytes, and often the leucocytes also, are diminished.

That these effects may be utilized to explain the rationale of cold applications in disease has been often demonstrated. For instance, Thayer, of Johns Hopkins University, observed that the blood drawn from the lobe of the ear of a typhoid-fever patient after a Brand bath, contained three times the number of leucocytes, ascertained by actual count to be present previous to the bath. This has been confirmed by Winternitz, Breitenbach, myself, and others, in chronic cases and in healthy persons. Since this enormous increase could not be the result of new production during the fifteen-minute bath, the conclusion is inevitable that the increased activity of the circulation, induced by the changing anæmia and hyperæmia of the cutaneous surface resulting from the cold bath and friction, has driven these cells from their hiding-places on the outskirts of the blood stream and elsewhere, and has brought them into active service.

Cold improves the muscular tone of the vessels, *i.e.*, it increases tension; warmth relaxes, causing passive dilatation and loss of tone. Although both produce a hyperæmia, one is the result of reaction and is tonic, while the other is the result of relaxation and is atonic. This trite fact is sadly disregarded in practice. Its more general recognition will do much to neutralize and remove the fear of shock from cold applications in atonic conditions.

The reflex effect of cold and heat conveyed from the skin to the central and sympathetic system, thence to organs and tissues, is an important therapeutic factor, and demonstrates that the thermic action of water upon the human organism is capable of influencing its every part and function in the most pronounced manner.

By guiding and directing these well-ascertained effects of cold and heat, as conveyed by water to the skin, we may evoke changes in the circulation, remove stasis in one and fill another vascular area, deplete others, and thus aid powerfully in removing pathological states.

Water may be applied with accurate dosage by varying the temperature, duration, and pressure. A very high or a very low temperature produces destruction of tissue, while cold and moderately hot water produce a rubefacient effect. Water driven under high pressure destroys tissues, and under moderate pressure causes rubefacient or stimulating effects.

There are also various modifications in hydriatric tech-

* "The Principles and Practice of Hydrotherapy," William Wood & Co.

nique which must be clearly understood before we employ hydrotherapy in disease.

Technique.—It is the aim of this article to simplify hydrotherapy and render it accessible to the general practitioner. Minute attention to details is the first essential for the successful application of all hydriatric procedures; without this, failure is sure to ensue. The following procedures are best adapted for the application of water in disease: Ablution, affusion, sheet bath, drip sheet, compresses, wet pack, tub bath, douche. Their application in various diseases will be shown.

Ablution consists of the application of water by the hand, or with a wash cloth, over successive parts of the body. The method and the temperature of the water vary with the object in view. In febrile conditions the chest, the back, the abdomen, and the lower extremities as far down as the knees are successively bathed every two or three hours, beginning at 75° and reducing the temperature by one degree at each application until 60° F. is reached. It is important to avoid chilling and to bear in mind that reaction is aimed at.

FIG. 2756.—Drip Sheet Mode of Friction.

In chronic affections the ablution is a useful preliminary to the more active hydriatric procedures. The patient is first warmed by being snugly wrapped nude, in two long-haired woollen blankets, like a mummy, for one hour. The face is bathed in water of 60° F.; the blankets are successively opened over his chest, abdomen, back, lower extremities to the knees, and these are bathed with the hand, each part being immediately dried and replaced under cover. A general dry rubbing with a woollen cloth, or the hand, follows.

For the General Ablution the patient stands in twelve inches of water at 95° to 100° F., and is rapidly washed down with the hands, while water—of a temperature of 80° F. at first, but on each succeeding day of a little lower temperature until 60° F. is reached—is poured upon him with the hand or from a vessel. Afterward he should be subjected to gentle friction. Reaction must always be produced.

The *rationale* of the action of ablutions may be found in the gentle shock and reactive stimulus, which is refreshing. The superficial capillaries are dilated, as evidenced by the rosy hue of the skin following ablution with friction, the inspiration is deepened, and cardiac action is bettered.

Affusion.—Having a wet cloth around the head, the patient, sitting or standing in a tub containing twelve inches of water at 100° F., receives a broad stream of water poured with force from a basin, bucket, or pitcher. According to the height from which the water is poured and the lowness of the temperature will be the stimulating effect. The affusion is useful in coma and in stuporous delirium, indicating adynamia and nerve prostration. By this method Currie made his remarkable cures in typhus fever, using chiefly sea water, the patients lying on the deck. In *scarlatina*, when the system is overwhelmed by the poison, the circulation embarrassed, the skin pale or marbled or cyanotic, the respiration shallow, temperature high, pulse rapid and feeble, truly marvellous results may be obtained by the judicious use of brief affusions. Reaction occurs rapidly, and with it come an improved peripheral and general circulation, deepened inspiration, bright countenance, and roseate skin. Rapid affusions of water at a temperature of from 70° to 60° F., have, in my experience, saved lives in these desperate cases.

Sheet Bath.—A rubber sheet covered by a blanket is laid upon one-half of the bed. A linen sheet is now dipped into water having a temperature of from 60° to 70° F., according to the effect desired, and, *without being wrung out*, is laid upon the blanket; the patient, whose face has been bathed with ice-water, and upon whose head a wet cloth is placed, is moved over to the wet sheet, which is wrapped snugly around him. The first impression will be a surprise—called shock—to the cutaneous nerves. Reaction ensues from the patient's own temperature, and its establishment is aided by the manipulations of the nurse, who, with out-stretched hands, gently but firmly sweeps over the wet sheet, omitting the legs and forearms. So soon as one part of the body becomes thoroughly warmed, water from 50° to 60° is poured from a cup or squeezed from a sponge over it, until it again cools. These passes, or frictions, are alternated with the pouring on of small quantities of cold water, until the entire body feels cooled or the patient shivers. Rigor must always be avoided, because it is an evidence of contraction of the vessels. As the friction prevents this objectionable feature of all cold baths we have in the sheet bath an admirable roborant antipyretic, the effect of which may be greatly enhanced by allowing the patient to remain in it, after wrapping him in the blanket, for half an hour. Its mildness as compared with the full cold baths, for which it is an excellent substitute, renders it more acceptable to the patient and his friends, and it may thus be utilized as a valuable initiatory antipyretic measure. It is applicable in all acute diseases in which an elevated temperature is a leading manifestation.

Drip Sheet (Fig. 2756).—In chronic cases the sheet bath is a useful adjunct, and in many cases an important element of the treatment—as, for example, in phthisis, in neurasthenia, and in chlorosis. Here it is called a drip sheet, and is applied while the patient stands in water of 100° F.

The flexibility and simplicity of the method commend it especially. By wringing the sheet well out (cold rub),