having acquired a dose of blue magnetism, attracts the north point of the compass, and produces the deviation observed. Now this magnetism, not being firmly fixed into the iron of the ship, is gradually shaken out when the ship is on another course. The amount of this error cannot be predicted at all. Captain Lecky has found it to amount in some cases to as much as 10 degrees after steaming in an easterly or westerly direction for six or seven days. The following rules have been given by Sir William Thomson as a warning regarding the sluggishness of ships' magnetism:

1. After steering for some time on westerly courses expect westerly error if you turn to the north, or easterly error if you turn to the south.

2. After steering for some time on easterly courses expect easterly error if you turn to the north, or westerly error if you turn to the south.

In conclusion, I may just give a few words of warning on a point of considerable importance in connection with the electric lighting of ships and the action of the current of electricity on the ship's compasses. During the last few years many passenger steamers have been lighted with electricity, and often only a single wire is used, the ship's side taking the place of the return wire. Now, in such cases it is quite possible that the wire may be placed in such a position and at such a distance from the compass that the current flowing through it will produce a large error.

Take, as an example, a main lead from the dynamo machine, to light up a saloon with 100 lamps, or more. It may run along nearly underneath the position of the standard compass. The current may be taken at 100 amperes. In such a condition of affairs, the error produced on the compass will amount to as much as 7½ degrees when the wire is at a distance of 30 ft. Now, this error will only be produced at the time that the current is flowing to light up the lamps, and it may never be detected by the officers of the ship. The observations for determining the error of the compass are usually made during the day, when the electric light is not required. The captain may therefore determine his compass error every day, and set his course quite correctly, but for some hours at night the ship may be going several degrees off her proper course, although she is being steered correctly by the compass.

This refers to a single wire system and a continuous current machine, but if an alternate current machine be used, no effect will be produced on the compass, even with a single wire, and the ship's side as a return. Also with a continuous current machine the danger may be entirely avoided by using a double wire system with the two wires close together. It is essential that both wires should be well insulated from the ship's side. A want of insulation in one of the wires, although there may be no change observable in the lighting, may produce as much error on the compass as if there were only a single wire. So far as I know, there is no great advantage in the single wire system over the double wire, except it be a slight saving in the first cost. It would, therefore, appear that for the safety of the ship, when a continuous current machine is used for lighting, two wires, well insulated, should always be employed, and that the insulation of the wires should be tested periodically to make certain that no fault has occurred.

THE DEVELOPMENT OF ELECTRICITY ON THE CONVERSION OF VAPOR INTO WATER.

By L. PALMIERI.*

DURING the course of some researches that I have been pursuing since 1850 upon atmospheric electricity, I have especially endeavored (1) to use only methods and instruments that were capable of yielding results which required no corrections, and which admitted of comparison, and (2) to so simplify the apparatus that they could be intrusted even to observers of very ordinary education.

I early ascertained that the electricity of the air increases with the relative humidity; and that strong tensions (during the continuance of which, conductors exposed to the free air furnish sparks) announce with certainty the near-by advent of clouds, fogs, and mists, and, with much probability, of falls of rain, snow, or hail, either at the point at which one is situated or at distances from such place, and which are capable of reaching several miles.

It is to be remarked that these exceptional tensions (which correspond to thousands of electro-metric degrees) follow the phases of the rain. They begin with it, last as long as it does, and end at the same time that it does, according to laws that I formulated in 1854. By reason of this, I believe that we can, without error, attribute the origin of atmospheric electricity to the condensation of vapor, as Volta appears to have suspected.

Desirous of supporting these theories (which I had emitted only in basing myself upon a long series of minute and direct observations) by facts, I undertook a series of experiments in 1862, which proved convincing, but which, for want of publicity, have remained nearly ignored; and no one has repeated them.

Other experiments were tried that led to no precise conclusions; and, finally, a number of theories that were often devoid of all experimental sanction succeeded one another, and were in some cases rejected as soon as accepted.

The analyses that Messrs. Kalischer, Gerland, Faye, Edlund, and others have very recently been pleased to make of the memoir in which I summed up my labors upon atmospheric electricity have again called the attention of meteorologists to this subject; but objection has been made to the difficulties and expense of my experiments of 1862. It has even been printed in France (through error, it is true) that the signs of electricity that I have been able to substantiate are insignificant. I have since been endeavoring to simplify my preceding arrangements as much as possible, so that it might prove easy and inexpensive to have my own experiments repeated in every cabinet of physics, and I have succeeded in this by arranging the experiment as follows: Upon a well insulated support, I place a platinum cup of about four and a half inches diameter, and put it in communication, through a platinum wire, with the lower disk of the condenser of a Bohnenberger electroscope. Upon operating as usual, the gold leaf is observed to remain immovable, and the result will be the same if we pour into the cup water of the temperature of the surrounding air. The cup is then filled with cracked ice, and the upper disk is removed after being put for an instant in communication with the earth, as usual. The gold leaf will then be seen to clearly show positive electricity.

In order to make the experiment more striking, it is well to break the communication of the lower disk with the platinum cup at the moment the upper disk is removed. In the face of such a result, I have thought it superfluous to use cooling mixtures in order to obtain much lower temperatures, believing it better not to rob the experiment of that character of simplicity which shields it against all debate.

As to complementary details, I shall add that the Bohnenberger electroscope (which I had modified for the occasion) was provided with a gilded-copper disk condenser, and constant dry piles; that the rod which supported the gold leaf was insulated by a sheath of "pecite;" and finally, that the experiments were performed with sensibly constant temperatures that varied only between 28° and 24° C. during the last days of August and the first days of September, 1885. As may be seen, nothing is easier than to repeat this experiment, which is much simpler than the one that I devised in 1862. It is allowable for me to hope that when the majority of physicists shall have acknowledged its accuracy, it will no longer be necessary to seek new hypotheses as to the origin of atmospheric electricity. I lay stress upon this last point: "The preceding hypothesis aims only at the direct origin of atmospheric electricity," and not at the movements thereof.

In a work that Mr. Edlund, of the Royal Academy of Sciences of Stockholm, has recently published, and has had the goodness to send me, the author maintains, it is true, that the electricity of the earth rises into the atmosphere under the influence of the unipolar magnetism of our planet, but, on another hand, he acknowledges that electrical manifestations in the air, or the return of electricity toward the earth, are derived from the condensation of vapor, and especially from its conversion into water.

I much wish that meteorologists would pronounce decisively upon that delicate point—the prime cause of atmospheric electricity.

For my part, I am convinced that the immediate origin of the latter resides in the condensation of atmospheric vapor, and although, as regards ascending and descending movements, I do not entirely agree with Mr. Edlund, I am glad to see that the eminent Swedish physicist is entirely of the same opinion that I am as to the facts and experiments which seem to prove undeniably that the conversion of vapor into water, or its condensation, is really the direct cause of the development of atmospheric electricity.

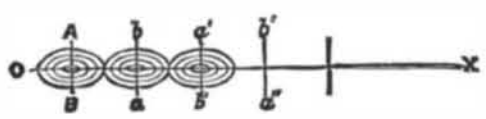
* Read before the Royal Academy of Physical Sciences of Naples, Dec. 5, 1885.

CLERK MAXWELL'S ELECTRO-MAGNETIC THEORY OF LIGHT.*

By Miss J. M. CHAMBERS, B.Sc.

THE following is how I have supposed the "series of oppositely directed magnetizations and electromotive forces" of C. Maxwell's theory to arise. I do not in the smallest degree pretend to comprehend his mathematics, and it is only from his verbal explanation that I have formed the following conception of what his meaning is.

Suppose we have a straight linear conductor, A B, in which from some cause or another a quantity of electricity is continually bobbing up and down. We know



that the lines of magnetic force arising from these alternate up and down currents will be circles having the linear conductor for axis. Suppose we have a row of these conductors parallel to one another.

When the magnetic force lines cut the next conductor, *ba*, an electromotive force of opposite sign to that in A B will be engendered, in accordance with Lenz's law, and a current will ensue which will in its turn be surrounded by magnetic force lines. When the current in A B is reversed, the induced one in *a b* will be so too.

The action of *a b* on *a' b'* will be the same as that of A B on *a b*; and the same effects will be propagated along the whole line of molecules. We have here the electromotive force and the magnetic forces acting in directions perpendicular both to one another and to the direction of propagation, O X, as the theory requires. Of course, this explanation would be for a plane-polarized ray.

It seems to me that this explanation presents to the non-mathematical mind, in a tangible form and in accordance with well-known electrical phenomena, what may be the manner of production of the "series of oppositely directed magnetizations and electromotive forces."

It is not necessary that the conductors should be linear; we may suppose them globular and touching one another, without interfering with the idea of the action above explained. We may, in fact, suppose them merely portions of the ether.

Perhaps it may be objected that my conductors are not circuits; but a current which keeps passing backward and forward from a condenser acts in precisely the same manner as a true current (see Art. 776, Maxwell, etc.), and why not also without the condenser?

Note.—Perhaps this idea is nothing new, and has occurred to others as well as to me. I have been told, however, that C. Maxwell himself would never precisely define the action by which he supposed light and electro-magnetic induction propagated.

* "A Simple Way of explaining Clerk Maxwell's Electro-Magnetic Theory of Light." From the *Phil. Mag.* for February.

KEPHYR.

KEPHYR (ke'fyr, gypy, kehapu, kapyyr) is prepared with cow's milk and a special ferment known as *Dispora caucasica*. This ferment was first described by E. Kern. It is a white, compact mass, elastic, covered with mucilage, resembling in aspect a cauliflower. It is found on mountains, below the snow line, on a certain kind of bush. The Russians call it gribki, signifying mushroom. The fungus (kephyr) consists of two parts—bacilli and yeast cells; but the principal part is composed of bacilli; these give it its mucilaginous appearance and its elasticity. According to Kern, each cell contains two round spores, whence the name he has conferred on it, *Dispora caucasica*. Kephyr is an effervescing drink, always greatly esteemed from time immemorial by the natives. It is prepared by mixing 30 grammes of the ferment with two glasses of milk from which the cream has been removed. The next morning it is poured into another receptacle, more milk without cream is added to it, and it is then bottled. It is kept at a temperature of 10° or 12° R. (54·5° to 59° F.) for twenty-four hours, and often shaken. Fermentation takes place more rapidly when milk sugar is added. Good kephyr is fluid, like oil, and pleasantly acid. The following table shows the comparative composition of kephyr and koumiss, and of milk—the basis of both—in one thousand parts:

	Milk.	Kephyr.	Koumiss.
Albumen	48	38	11·2
Butter	38	20	20·5
Lactose	41	20	22
Lactic acid	—	9	11·5
Alcohol	—	8	16·5
Water, salts	873	904·9	918·3

Kephyr is more agreeable than koumiss, and does not disturb the digestion; it is likewise cheaper. In order to succeed in preparing kephyr, the milk ought not to be too fat, nor the temperature too high nor too low during fermentation. Kephyr is an active analeptic; it is especially valuable in combination with iron for treating chlorosis, anæmia, and all affections of the respiratory organs. At the commencement of phthisis and dyspepsia, kephyr ought to be taken fasting—two glasses the first thing in the morning; later on, six, eight, or ten. Mandowski has found that it produces good effect in all kinds of dyspepsia, anæmia, catarrh of the stomach, chronic ulcer of the stomach, plumonary catarrh, phthisis and cancer. Pains in the stomach and vomiting were calmed in a few days by the use of kephyr. It stimulates the appetite, and is highly nutritious. In itself it forms sufficient sustenance for a few days.—*London Med. Record.*

CHOLESTERIN FATS.

SINCE it is probable that the material termed "lanolin," to which Professor Liebreich has recently directed attention, may become of some importance from a pharmaceutical point of view, it will be useful to place before our readers some account of its chemical nature and the sources from which it is obtainable. The grease of sheep's wool has long been the subject of attempted applications of an economic character, either by the production of soap or by the extraction of potash from the crude material obtained in cleansing wool for textile manufactures. Its true nature was first ascertained in 1868 by F. Hartmann, who showed that it contained a considerable amount of cholesterin. In fact, the grease of sheep's wool, though presenting some of the characters of ordinary fatty substances, is in its chemical nature quite different from them. The true fats, which were studied by Chevreul, and shown to be compounds of the trivalent alcohol glycerin with acids of what is termed the fatty series, are really a class of compound ethers, and they are substances which are not only chemically analogous, but also have a close connection with each other from a physiological point of view. The term fat, however, has ceased to have a very definite chemical meaning, since it may, in a physiological sense, be regarded as comprising other ethereal compounds, such as spermaceti and wax. In like manner, the fatty material of sheep's wool appears to consist, to a great extent, of a compound of cholesterin or of an isomeride of that substance with an acid of the fatty series. A later investigator of this subject, E. Schulze, confirmed Hartmann's results, and published methods for extracting the cholesterin constituent from the grease of sheep's wool. As cholesterin is very frequently met with in the animal organism, it might have been expected that the observations of Hartmann and Schulze would have received greater attention from physiological chemists; but with the exception of Berthelot's work, pointing to the probable existence of cholesterin ethers of fatty acids in the animal organism, this does not appear to have been the case until the subject was taken up by Professor Liebreich. On the supposition that cholesterin ethers of the nature of fats may be of greater importance in the animal economy than has yet been ascertained, he has taken the trouble to investigate this question and to give an account of such facts as bear upon it. In the endeavor to trace the presence in the animal organism of fatty compounds containing cholesterin, Professor Liebreich has taken advantage of a reaction discovered by Liebermann, which admits of the presence of that substance being detected. This consists in the production of a pink color, quickly changing to a decided blue when concentrated sulphuric acid is added to a solution in acetic anhydride of the fatty material to be tested. Great care is to be exercised in adding the sulphuric acid so as not to have too much, which would obscure the reaction.

By means of this test, Professor Liebreich has examined a number of fatty materials, and he has ascertained that while cholesterin fats, in which no trace of free cholesterin could be suspected, invariably gave the reaction above described with perfect distinctness, glycerin fats, on the contrary, did not show the reaction at all. Various other substances, such as beeswax, spermaceti, lecithine, and protagon, also gave negative results. The first experiments made by Professor Liebreich were with animal tissues analogous to horn, such as tortoise-shell, whalebone, human epidermis, hair, the beak of the jay, feathers of the goose, hen, turkey, and pigeon, bristles of the hedgehog and porcupine, the hoof and warty excrescences on the leg of the horse, and the horny substance of the sheep's foot. In all these tissues it was possible to trace the presence of cholesterin fat by means of the above mentioned reaction, after the fat had been extracted by chloroform.

As a further means of recognition, the peculiarity of cholesterin fat in absorbing a very large proportion of water was taken advantage of. To this character Professor Liebreich has applied the name of "lanozation." It is shown in a very marked manner by the fatty material obtained from sheep's wool; and on testing the fats extracted from the above mentioned materials, it was possible in almost all instances to ascertain that they possessed this capacity for the mechanical assimilation of water. It was also ascertained that a mixture of glycerin fats and cholesterin did not lanolize. Fat obtained from superficial fascia was not found to show much, if any, reaction indicative of the presence of cholesterin; but, on the other hand, fat obtained from a kidney and from the liver, and the fat from the blood of a rabbit, gave very decided indications of its presence. The question whether it originates from the blood or belongs to the kidneys and other organs must be left for future investigation.

Professor Liebreich then proceeded to examine the question whether cholesterin fats belong to the various tissues as such, or whether they are produced by glandular secretions; and he is of opinion that in the case of birds the liquid secreted by the glands does not so much serve to oil the feathers as to free them from too great a profusion of fat, or at least to spread the fat evenly over their surface. In birds that have no coccygeal gland, such as the parrot and the fan-tailed pigeon, the feathers have a far less shining appearance; but on trial the feathers of the fan-tailed pigeon were found to contain a small amount of cholesterin fat, and it was inferred that birds without any coccygeal gland must be able to secrete sufficient fat from the feathers, and that in fact it is formed simultaneously with horny tissue.

In regard to the commonly received opinion that the fat contained in hairs is secreted from the sebaceous glands, these and the sudoriferous glands are in the case of sheep so numerous that these animals offer little aid in deciding whether intracellular fat ever occurs alone. But cholesterin fat was also found in the bristles of pigs and the prickles of the hedgehog, though both animals possess sebaceous glands only in a stunted condition. The sloth has not any sebaceous glands, but the hairs from this animal gave the cholesterin reaction. While therefore it is probable that the sebaceous glands furnish fat to keep the hairs supple, this fat is very different from that present in and formed by horny tissue. The fat of the coccygeal gland of the goose gives a very slight cholesterin reaction, and the fat of the superficial fascia surrounding the gland gives none, while in the fat obtained from the feathers the reaction distinctly indicates the presence of cholesterin fat. Abundance of it was also found in the hoof of the horse and in the warty excrescence on the leg of the horse, although there are here no glands to secrete fat. In the penguin an apparent exception is met with, and in its horny tissue there seems to be some other fat.

According to the view put forward by Virchow, the fat of the animal organism may be either the normal contents of cells or only transitory, as, for instance, in the intestinal epithelium cells, or it may be present, as in the case of milk, after the destruction of the cells. Cholesterin fat may be of this kind, and analogous in the mode of its formation to butter, if originating from the cells of horny tissue, which are destined to be exfoliated. There seems to be good reason for regarding it as present in many parts of the bodies of animals, and it is probable that it may be obtained from other sources besides the wool of sheep. It is mainly from the pharmacological point of view that the investigation by Professor Liebreich has been carried out, since he was of opinion that the peculiar characters of the cholesterin fats would render them available for the purposes of medical treatment by ointments, etc., in cases where there are well founded objections to the use of any of the hydrocarbon fats, such as vaseline and the various kinds of paraffin. One peculiarity of cholesterin fat is the ease with which it can be rubbed into the skin, and this ready absorption may be connected with the circumstance that it originates from horny tissue. Another important point is that cholesterin fat (of which the lanolin prepared from the grease of sheep's wool is a type) is perfectly neutral, and as it is very difficult to saponify, even with an alcoholic solution of caustic alkali, it may be expected that it will not be so liable to become rancid as glycerin fats.—*Pharm. Journal.*

THE DENSITY OF SATURN'S RING.

M. POINCARE supplies a short note on the stability of Saturn's ring in the November number of the *Bulletin Astronomique*. Laplace had shown that the ring could only be stable if it were divided into several concentric rings revolving at different speeds. M. Tisserand had confirmed this result, and had recognized that a single ring must, in order to exist, possess a much higher density than the planet, and had calculated the maximum breadth of each elementary ring in terms of its density and mean radius. M. Poincare has carried this investigation a step further, and shown that if the density of a ring be less than a certain amount, it will, under the influence of the slightest perturbation, no longer break up into a number of narrower rings, but into a great number of satellites, and that if the rings be fluid and turn each as a single piece, the density of the inner ring must be at least $\frac{1}{5}$, and of the outer ring $\frac{1}{15}$ that of the planet. For a ring of very small satellites (not for a fluid-ring, as M. Poincare erroneously states), Maxwell has shown the condition to be that the density should not *exceed* $\frac{1}{300}$ part of that of Saturn.

We do not at present know the actual density of the ring from observation sufficiently accurately to make therefrom any certain inference as to its physical condition. Bessel's determination from the movement of the peri-saturnium of the orbit of Titan gave the reciprocal of the mass of the ring as compared with that of Saturn as 118, which, since the volume of the ring—adopting Bond's value of 40 miles for its thickness—is about $\frac{1}{400}$ that of the planet, would make its density about 3·4 times greater than the planet's. Bessel's value is, however, clearly too great, as he neglected the influence of the equatorial protuberance of Saturn on the movement of the apsides. Meyer's determination of the secular variation of the line of apsides of Titan, viz., $d\pi = 1726{\cdot}5''$, gives the reciprocal of the mass of the ring as 26,700, but from all the six brighter satellites as 1,960; the latter value closely agreeing with Tisserand's. It does not, however, seem to have been noticed that even the smallest value for the mass considerably exceeds the highest permissible in accordance with Maxwell's result, since that would make the mass of the rings only $\frac{1}{12,000}$ part of the planet's, an amount we cannot hope to detect with our present resources.—*Nature.*

THE RELATION BETWEEN THE PHYSIOLOGICAL AND THERAPEUTIC EFFECTS OF REMEDIES.

THIS relation is generally very imperfectly understood. It is well known that many of our therapeutic agents in common use produce entirely different and even opposite results according as they are given in large or small doses. It is usually supposed that this is due to their having different properties corresponding to the quantity used. It requires but little reflection, however, to see that this view is absurd. Quality does not depend on the quantity. No substance has ever yet been discovered which is not capable of exhibiting all the properties it possesses, in the most minute as well as in the largest quantity. Yet the fact remains that drugs capable, when used in sufficient amount, of producing injurious and even fatal consequences will, in medicinal doses, have an entirely opposite effect. The explanation of the various phenomena thus shown lies in the fact that medicines possess no curative powers whatever, excepting that they are able to arouse the vitality of the tissues with which they come in contact, this vitality being itself the source of all the remedial qualities drugs are supposed to possess. How otherwise can we account for the healing properties of substances the mere contact of which is sufficient to cause the death of the tissues with which they come in contact? Strong solutions of the sulphate of zinc, chloride of zinc, nitrate of silver, and many other similar remedies, are capable of causing inflammation of the urethra and other membranes; they are capable of producing the death even of the tissues with which they are brought in contact, yet when applied in lotions of suitable strength will cure urethretis, as well as inflammations of other mucous membranes, such as those of the eye, vagina, etc. It is nonsensical to suppose that the remedial effects herein exhibited depend on a difference in the qualities of the drugs, according to the amount used. Tested in large or small quantity, their properties will be found to be the same; but in a solution of proper strength the injurious effect of the drug simply excites the vitality of the part, which overcomes the poisonous properties, that in sufficient strength would produce injury or death. There is not a drug used by the medical profession which will not, when used in excessive quantity, cause poisonous symptoms; and the immediate effect is injurious, whether the dose is large or small, the difference being that in one case the vitality of the tissues is excited or stimulated, while in the other it is overcome. The bitter vegetable tonics afford us an example of the fact that therapeutic agents, which are able in poisonous doses to cause morbid symptoms, will, when properly used, cure the disease thus set up. Gentian, calumba, cinchona, and the other remedies belonging to the same class as these, will relieve dyspepsia, yet, in excessive quantity, or when too long continued, they will produce the same disease. Arsenic, corrosive sublimate, nitrate of silver, together with many other metallic salts of like nature, such as the salts of zinc and copper, will, in poisonous quantities, cause severe pain in the stomach. They are also curative of gastralgia in small doses. The saline purgatives, calomel, ipecac, rhubarb, colocynth, podophyllin, aloes, and castor oil, will, in sufficient quantity, cause diarrhœa and dysentery, yet, in medicinal doses, they will cure these diseases.

Arsenic, in excessive doses, causes various inflammatory diseases of the skin, but is nevertheless curative in diseases of the same nature, such as chronic eczema and chronic psoriasis. Bromide of potash, chloral, hydrocyanic acid, and chloroform are among the most nauseous of remedies, yet in small doses they are almost specific in their power of allaying nausea and vomiting.

Sulphate of zinc, tartar emetic, and ipecac are other examples of the curative power of emetic remedies to relieve the irritable condition of the stomach of which nausea is the symptom.

Turpentine, balsam of copaiba, oil of cubebs, savine, capiscum, cantharides, buchu, and other remedies possessing similar properties will, in poisonous doses, cause inflammation of the pelvic viscera, yet these inflammations form their stage of their therapeutic action.

Counter irritation is remedial only by its power of calling forth the vitality of the part to which its influence is exerted. The various organs are so intimately connected by the nervous system, that an effect cannot be produced on one part without modifying the others in greater or less degree. This explains the fact that extensive burns may be followed by inflammation of internal organs; and the spread of inflammation from one eye to the other is due to the same nervous influence. The connection between parts supplied from the same nervous center is especially close, and any irritation applied to one is quickly reflected to the other. In this way inflammation of an organ may be relieved by a remedy applied to an adjacent part. The reflex impression on the morbid tissues is, of course, an injurious one, but it develops their vitality and is in this way curative. The close nervous connection of tissues explains the power of anodyne remedies to relieve internal pain when applied to the skin, as in the case of rheumatism, where soothing liniments externally applied will allay the pain seated in the joints.

Purgatives, diuretics, diaphoretics, and emetics may be classed together as eliminative medicines, whose effect is nearly the same, differing only as to parts on which they act. They all produce relaxation of the blood vessels, and this state of the vessels characterizes the affections in which they prove remedial. This is very obviously the case in diseases characterized by dropsy. In most of such troubles the vessels are in a relaxed condition, and the purgative remedies usually given produce the same state, but this slight relaxation is followed by a reaction in which the vessels are stimulated, the effused serum absorbed and the dropsy disappears with its cause—the atonic condition of the vessels. The cause of dropsy is supposed to be the increased pressure of the blood, but this view is shown to be erroneous, by the fact that there is not in general an unusual blood pressure in the diseases of which dropsy is a symptom. The vessels are relaxed, and allow the blood to pass through them in the same way that water leaks from a barrel whose staves are shrunken. These medicines are used in inflammations and fevers, in both of which there is a weakened, dilated condition of the vessels. The pathology of both these affections is, I believe, the same.

They always accompany each other, and there is good reason to suppose that fever is never anything more than the sympathetic disturbance of an inflammation. This is certainly true of the fever which accompanies those inflammations caused by wounds; and not only does fever never occur without its accompanying inflammation, but the state of the blood vessels is nearly the same in both. The only difference between the two is that the one is a local disease, set up at the seat of injury, while the other is a similar condition, less intense, but more general, in which all the vessels share in the injurious effect produced on a few of them. The nervous centers and sympathetic plexuses which supply the vessels being intimately associated, any disturbance of one part of the vascular system is quickly conveyed to the whole of it, on the same principle that burns of the skin cause inflammation of the internal organs. The increased activity of the processes of nutrition which take place in fevers is owing to the fact that the dilated vessels permit an unusual supply of blood to the organs whose functions are temporarily stimulated. It is supposed that eliminative agents relieve febrile conditions by diminishing the amount of the watery constituents of the blood, thus removing the tension of the vessels. If this were true, we must assume that there is more blood in the body in fevers than in a state of health—a fact which has never been proved and is without probability. Furthermore, the vascular condition may be relieved by remedies which do not diminish the quantity of serum, but which produce an atonic, relaxed condition of the vessels. Emetics belong to this class of medicines. They, as well as all the other eliminatives, by their injurious action on the vascular system, excite in it a reaction which not only overcomes the poisonous influence of the drugs, but also relieves the diseased condition to which the febrile symptoms are due.

Digitalis is a cardiac poison, yet, in medicinal doses, it gives relief in diseases characterized by weak action of the heart. Strychnia causes symptoms very similar to those of tetanus when given in lethal doses, but when properly used is remedial in that affection. We will now consider a class of remedies which, when given in excessive doses, have a distinctly poisonous action on the nervous system. Opium, chloroform, ether, bromide of potash, chloral, etc., are capable of causing death or, as in the case of bromide of potash, symptoms of a serious character.

They act primarily on the nervous system, and affect other parts only secondarily. They are curative in the diseases of which the essential feature is nerve weakness. Pain and spasm, as well as other forms of perverted function of the nerves and their ganglia, indicate an abnormal condition, a condition of weakness or loss of tone, yet it is in this form of disease that the various sedative, narcotic, and anti-spasmodic remedies give temporary and sometimes permanent relief. The caustic substances which are used to detroy malignant growths and gangrenous or sloughing tissues, while destroying some of the healthy tissues near the diseased mass, arouse their vital force, and in this way produce all the healing effect they are capable of.

Remedies which are irritant to the bronchial mucous membrane, such as ammonia and turpentine, and which are able, in sufficient amount, to set up inflammation of the respiratory mucous membrane, are successfully used in the treatment of bronchitis and pneumonia.

Many more examples might be quoted of the fact that medicines possess no healing qualities in themselves, other than their capacity to inflict injury, and in sufficient quantity death, of the tissues with which they come in contact, in virtue of which they are able to excite the vital powers to action, when given in doses too small to produce permanent damage.

The instances I have mentioned are, however, enough, I think, to prove that the principle on which they exert their remedial effects is the one which governs the action of nearly all the therapeutic agents in use. I say nearly all, because there are a few remedies which act by assisting the function of the organ on which their curative power is supposed to act. These afford only temporary relief, and in the end simply aggravate the trouble for which they are given. Pepsin is an example of this class of medicines; by supplying a deficiency of this constituent of the gastric fluid, it gives relief for a time, but will not produce any permanently good results. It is the same with the use of alkalies to overcome acidity of the stomach; the relief given is only temporary, while small doses of the mineral acids produce a permanent cure. In the same way a deficiency in the acid of the digestive fluid is cured, not by giving hydrochloric acid, but by small doses of the alkalies. The skin is excited to a healthy condition, not by a tepid bath, which, by its warmth, assists the natural powers, but by a cold bath, whose primary injurious effect is followed by a reaction which stimulates vital action.

Who has not felt the enlivening influence of a frosty autumnal morning, or deplored the enervating effect of a sultry summer day? Yet heat is the supporter of life, while excessive cold induces a drowsiness which is merged in the sleep of death. The principle which governs the action of all remedies regulates the growth and development of the physical and mental qualities of men. Hard work, want, and adversity are destructive in their nature and are capable of producing the worst consequences, yet it is through struggling with them that the greatest men have had perfected in them those qualities which have gained for them the applause of the world. Man is "made perfect through suffering," rather than through ease and enjoyment.

Our knowledge of the physiological effects of drugs is very imperfect; it is therefore impossible to see the relation between the poisonous and medicinal properties of remedies in all cases, but I believe that wherever this relation can be clearly traced, it can be shown to be governed by the same principle which underlies the remedial powers of the therapeutic agents I have mentioned.

It may be said that drugs are not to be judged by their poisonous properties. But in ascertaining the nature of a remedy, it is best shown when given in such a manner and under such conditions as shall reveal the