is a stomachic tonic or stimulant. The most important application made of it is in the treatment of *bronchorrhœa, fetid bronchitis, gangrene of the lung*, etc. Eliminated by the lungs largely, it stimulates the tissues through which it passes, and thus a local action is added to the systemic effect. *Chronic bronchitis, capillary bronchitis, whooping-cough, humid asthma*, etc., are maladies in which it may be expected to afford a large measure of relief. In *hæmaturia* not due to acute congestion, and in *passive hæmorrhages* in general, it has been used with success.

It has long been known that oil of cloves, and indeed the essential oils generally, have the power to relieve a painful state of a sensory nerve. Inserted into the cavity of an aching tooth, they suspend the pain. A solution of oil of cloves in rhigolene is a nostrum for the cure of superficial *neuralgiæ*. ℞ Ol. caryophylli, ol. gaultheriæ, ol. thymii, āā ʒ j; tinct. benzoini, tinct. cinnamomi, āā ℥ iv. M. Sig.: *Apply on lint, and cover with oiled silk.*

The oil of cloves is the most effective deodorizer for sponge-tents hitherto employed.

The essential oils dissolved in alcohol (essence or tincture) are much used to correct *flatulence*.

Cajeput-oil has been used successfully in *cholera, cholera-morbus*, and *nervous vomiting*. ℞ Ol. cajuputi, ʒ j; spts. chloroformi, tinct. cinnamomi, āā ℥ j. M. Sig.: *A teaspoonful every half-hour in glycerin or sirup and water.* As a parasiticide, cajeput-oil is an effective local application in parasitic skin-diseases—*scabies, tinea, pityriasis*, etc.—and in the form of enema, in a suitable vehicle, against *ascarides vermiculares*.

AGENTS USED TO MODIFY THE FUNCTIONS OF THE NERVOUS SYSTEM.

In this division, remedies are employed with a view to their influence over the functions of the nervous system. They do not, immediately or necessarily, affect the function of nutrition; they do not enter into the formation of tissues; and, having modified the functions of the nervous system, they are excreted from the organism in the form in which they entered it. It is probable that the selective action on this system is due to the fact that the nervous tissue is the most highly specialized in function, and therefore most susceptible to such impressions.

The different parts of the nervous system are so closely united in function that a disturbance at any point is differentiated to other and often widely-separated points, and the complexus of effects is made up of many minor disturbances. For this reason it is quite impossible, in the present state of our knowledge, to make a classification which will sharply define the limits of activity of any particular remedy. Nevertheless, physiological experiment and clinical experience have furnished us sufficiently accurate information with regard to the most important actions of the remedies of this division, to justify an arrangement based on their most conspicuous qualities.

AGENTS WHOSE MOST IMPORTANT QUALITY CONSISTS IN EXCITING FUNCTIONAL ACTIVITY.

A.—OF THE SPINAL CORD AND SYMPATHETIC.

Electricity.—*Electricité*, Fr.; *Electricität*, Ger.

Forms of Electrical Force employed in Medical Practice.—Magnetism, static or frictional electricity (franklinism), galvanism, faradism (electro-magnetic, magneto-electric).

Static or Frictional Electricity.

This is obtained by friction from glass, as in the cylinder or plate, and by induction from the Holtz electrical machine. The last-named instrument is best adapted for medical use. The prime conductor of the electrical machine furnishes positive or vitreous electricity, and the rubber, negative or resinous. Various modes of electrization by static electricity are resorted to:

1. By sparks. In this mode the part to be acted on is made to receive sparks from the machine in action.

2. The electric bath. The patient is placed on an insulated stool, and is charged with positive or negative electricity from the prime conductor, or rubber, according as he is in connection with either. Sparks may be drawn from the affected part by presenting the knuckles or a metallic conductor. A sharp, tingling sensation, followed by redness and wheals, is produced by sparks, whether received from the machine or drawn from the body.

3. By the Leyden-jar. In this method, the electricity is condensed in the Leyden-jar, and the charge is transmitted through the part to be acted on.

Owing chiefly to the physicians of Guy's Hospital, London, and Dr. Charcot and his pupils, Dr. Arthius and Dr. Vigouroux, of Paris, the use of static electricity as a therapeutical agent has been revived and rendered entirely practicable. Dr. Morton, of New York, and the author, simultaneously arrived at a method of using the Holtz electrical machine as a means of stimulating muscular contractions, and as a substitute for the faradic current in cases requiring such treatment. Before describing these manipulations it is necessary to say something regarding the structure of the Holtz machine. Various modifications of the original pattern have been introduced; but the most successful is that of Toepler. There are, however, several excellent machines adapted from the Holtz model to suit the views of mechanical theorists or practical electricians, which may be employed with entire confidence. The author has used with satisfaction a machine the revolving plate of which has a diameter of fourteen inches and the fixed plate of sixteen inches. The power may be furnished by an electric motor, by a water motor or more conveniently by an assistant. In the annexed figure, the arrangement of the Toepler-Holtz is shown. This is

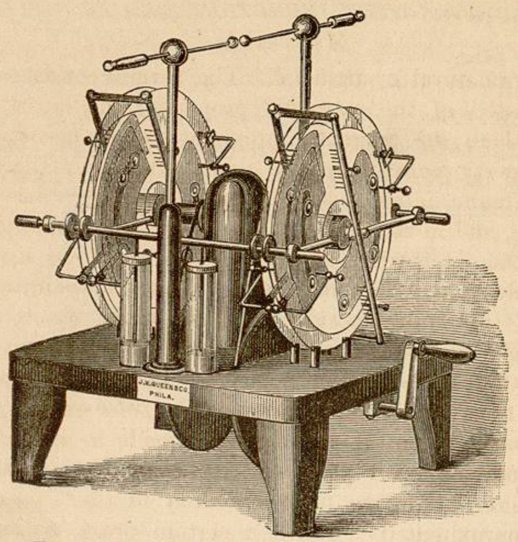

Fig. 1.—The Toepler-Holtz Electrical Machine.

the model which the author uses, and is found to be sufficiently powerful for medical purposes. During the winter, when the consultation-room is kept at or about 70° Fahr. by artificial heat, this instrument works with entire satisfaction. In the late spring and summer, for the most part, the atmospherical conditions are such that some means are necessary to preserve the instrument from moisture. This is accomplished by inclosing the machine in a suitable glass case and keeping within it some chloride of calcium to absorb the moisture. An arrangement of this kind is preferred by Dr. Morton, of New York, who uses the original Holtz machine.

The Holtz machine may also be employed to procure the muscular effects, hitherto obtained only from faradic appliances. The current passing between the discharging-rods can be tapped by means of a flexible wire attached to the outer coating of one condenser, and another flexible wire connected with the brass knob or bar which is in communication with the interior of the other condenser. The strength of the current and the rapidity of the interruptions are regulated by the distance between the knobs of the discharging-rods. At every passage of

a spark a muscular action takes place. If the knobs are placed very near each other, so rapidly do the sparks pass, that the effect produced is very like that obtained from a mild faradic current. Thus, by an arrangement of the machine which can be done on the instant, the actions, heretofore only obtainable from the faradic machines, are readily procured from the statical electrical instrument. Besides the effectiveness of this method, it has the advantage that it is almost painless. In no other way can strong muscular contractions be induced with so little pain, at least.

Magnetism.

Magnets are natural or artificial. The former consist of a native iron-ore possessed of the magnetic property; the latter are pieces of steel in which the magnetic property has been induced. This magnetic property consists in the power to attract pieces of iron and steel, in maintaining a certain fixed position when suspended to move freely, and in attracting or repelling the extremities of other similar magnets. A magnet suspended, free to move, always points in a certain direction, north and south. That end pointing north is the "marked" extremity, because it has a mark, notch, or groove, or the letter *N*, to indicate it. Because of this property, the magnet is said to have "poles," or polarity. The poles behave toward each other in a certain definite way: *Unlike poles attract; like poles repel*, is the law. When a bar-magnet is made to approach a magnetic needle moving on a pivot or suspended, there ensues attraction or repulsion, according to the polarity of the extremities approximated. When a certain proximity is attained, yet some distance short of actual contact, the magnetic influence is exerted, and attraction or repulsion, according to the pole, takes place. If a bar of soft iron, not magnetized, is suspended, on the approach of a permanent magnet, the former is seen to move toward the latter when they are approximated. The magnetic force is thus exerted through an intervening space: *inversely as the square of the distance*, is the law, which expresses this action in mathematical form. To this property is applied the term *magnetic induction.* When the soft iron is acted on by a sufficiently powerful magnet, it ceases to be in a neutral or unexcited state, the magnetic property is *induced* in it, and for the time being it assumes the polar condition; but not possessing the *coercitive* property—i. e., the property to retain the magnetism induced in it—soon returns to its former neutral condition. Steel, having the coercitive property, is the material out of which permanent magnets are made. The magnetic prop-

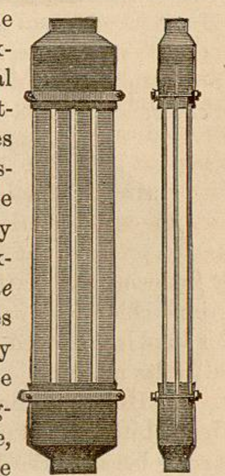

Fig. 2.—Compound Magnet.

erty is induced in such pieces of steel by the contact of other permanent magnets. When once induced, the magnetic property may be readily destroyed by a powerful blow, by repeated scratching, and by heating.

When a magnet is broken into several fragments, each piece has the same polarity. The forms of magnets are the bar and horseshoe, chiefly—the latter being more convenient, and also better retaining its power, because an armature can be kept in position. A compound horseshoe magnet is usually preferred for medical use, because of the proximity of the poles, but the straight form (Fig. 2) is also used.

Galvanism.

All chemical action is accompanied by electrical phenomena. The electricity furnished by the galvanic combinations in use is derived

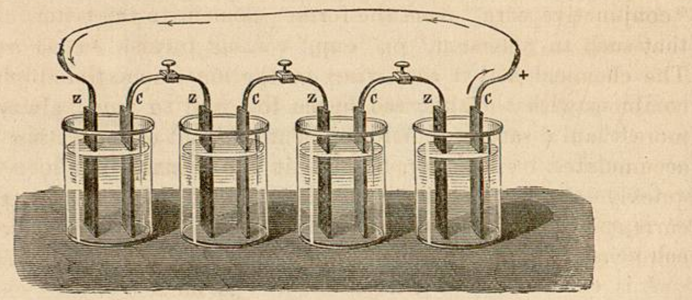

Fig. 3.—Galvanic Battery.

from a chemical action which takes place in the elements. These are of various forms. Reduced to its simplest condition, a galvanic combination consists of two substances, one of which can be acted on chemically, while the other has merely the conducting property; and also of a material—a fluid, usually—which can excite the chemical action. There is, then, a generating plate or element, usually of zinc, a conducting plate or element of copper or carbon, usually, and a fluid or semi-solid which acts on the zinc, setting up the chemical action. When such elements with the exciting fluid are placed in a glass or earthen vessel, the whole combination is called a *galvanic cell* or *couplet*, and when several of these are united they form a *battery* (Fig. 3).

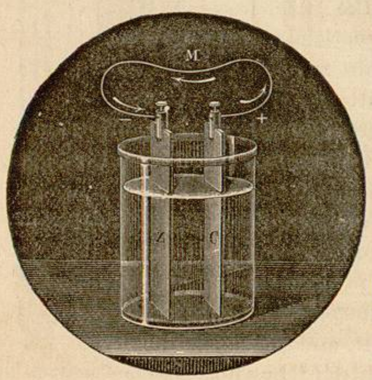

Fig. 4.—A Cell.

Galvanic cells may have a single or two fluids: the single fluid is not constant; in the two-fluid, there are arrangements, partly mechanical, chiefly chemical, for securing constancy in the current. In Fig. 4

we have two metals—zinc, *z*, and copper, *c*—united by the wire, *M*, placed in a glass vessel containing dilute sulphuric acid. The chemical action in such a cell consists in the formation of the sulphate of zinc, the water being decomposed, and hydrogen appearing at the surface of the copper. Such an arrangement may be defined to be a means of making a difference in potential between two points. Electricity flows from the higher to the lower potential. The point where the chemical action is taking place—the surface of the zinc—is the higher potential, and hence "the current" passes from this through the liquid to the lower potential, the copper, which is the conducting plate. Now, as the current always flows from the higher to the lower potential, it follows that, outside of the element, the copper becomes positive and the zinc negative, for the current passes through the "conjunctive wire" from the former element to the latter. It follows that such an "element," or "cup," can not furnish a *constant* current. The chemical action soon rises to the maximum, the sulphuric acid combines with the zinc, and hence the exciting fluid is soon nothing more than a saturated solution of zinc sulphate, while the hydrogen accumulates on the copper plate. The chemical action, therefore, quickly subsides, and the hydrogen-bubbles hinder the passage of the current by the conducting plate. Elements of this kind are usually employed to run faradic machines, but they are not suited for gal-

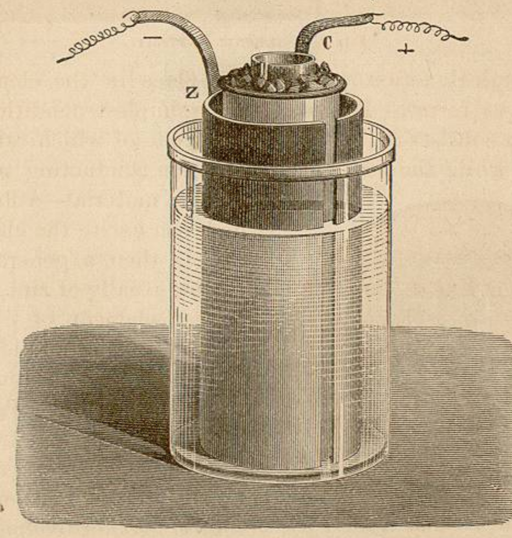

Fig. 5.—Daniell's Element.

vanic batteries, since the tension of the current varies so much in a short time, and the action soon ceases.

The two-fluid cells, in which the chemical action is less violent, and mechanical devices prevent the polarization of the hydrogen, are alone suited to medical uses. Only those ascertained by experience to be adapted to medical purposes can be referred to. One of the earliest two-fluid cell batteries constructed was that of Daniell (Fig. 5). The arrangement of the parts in this cell will illustrate the principles concerned in such galvanic combinations. The zinc and copper elements and the two liquids are separated by a porous cup of unglazed earthenware. The zinc, *z*, is outside, and is a cylinder having a cleft; about it is diluted sulphuric acid (1 part to 16 of water). The copper, *c*, is contained in the porous cup, and is surrounded by a saturated solution of copper sulphate, which is kept at the point of saturation by a quantity of the crystals packed around the copper element. The polarization of the hydrogen is prevented by chemical means, for in the decomposition of copper sulphate the hydrogen combines with oxygen to form water, while metallic copper is deposited on the copper element. The Daniell, as modified by the celebrated Dr. Remak, of Berlin, has been more widely used for medical purposes than any other cell, and still maintains its superiority. In this arrangement made by Siemens and Halske, of Berlin, and known under their name, besides the porous cup, a quantity of *papier-maché*, or paper-pulp, is packed

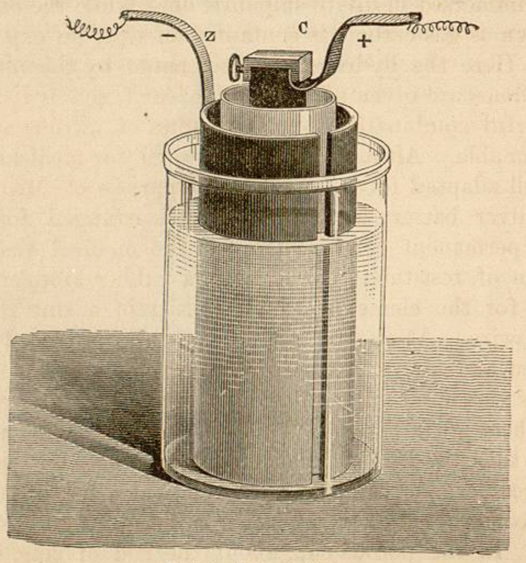

FIG. 6.—BUNSEN CELL.

in between the elements, and, while the copper is surrounded by copper sulphate in solution, only water is used with the zinc. In the decomposition, copper is deposited on the copper element and sulphuric acid diffuses through into the zinc compartment. This cup is remarkable for the uniform tension of the current, for constancy, and for economy. A "gravity battery," composed of zinc and copper elements,

zinc sulphate solution about the zinc, and copper sulphate solution about the copper, and separated merely by the specific gravity of the respective solutions, is now much employed in telegraphy, and to a considerable extent in medical practice. Zinc and carbon are now utilized in two-fluid as in one-fluid cells. The Bunsen combination is a most efficient one (Figs. 6 and 7). The outer zinc plate has a

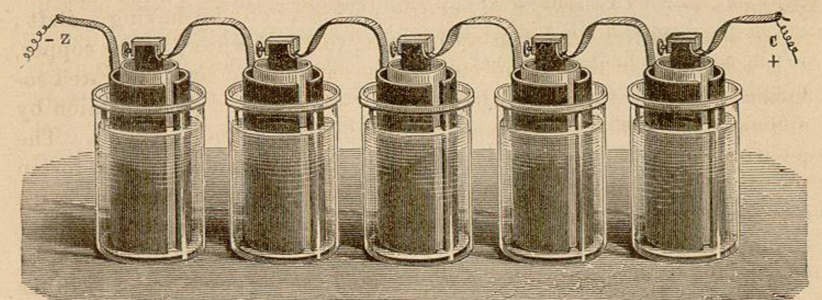

FIG. 7.—BUNSEN BATTERY.

cleft, and is immersed in dilute sulphuric acid, while the carbon, of the variety known as gas-carbon, is contained in a porous cup with strong nitric acid. Here the hydrogen is intercepted by the nitric acid, nitrous-acid fumes are given off, and sulphate of zinc is formed. It is a very powerful combination, but the fumes of nitrous acid make it very objectionable. Although it is not suited for medical use in general, it is well adapted for galvano-caustic purposes. Mr. De la Rue's chloride-of-silver battery is admirably well arranged for forming a portable or permanent combination for the medical electrician. It may be made of test-tubes, closed with a rubber stopper containing two orifices for the elements, which consist of a zinc rod and flattened silver wire. At the bottom of the tube is placed some chloride of silver, and above this a solution of common salt. The silver element dips down into the chloride of silver, and above this is insulated by sheet gutta-percha. This cell has an electro-motive force a little more than the Daniell, and it is remarkably constant, portable, and unchangeable. A very efficient and at the same time economical cell can be constructed of a tin can, iron filings, a porous cup, and a rod of zinc. In the porous cup, about the rod of zinc, is put some common potash, and the iron fillings which form the positive element are packed around the porous cup.

Besides the above, mention should be made of the two-fluid bichromate of potash cell. A solution of the bichromate in dilute sulphuric acid is now chiefly used as the exciting fluid in single-fluid cells; but, in the two-fluid arrangement, the carbon element is placed in a porous cell containing a saturated solution of bichromate of potash in water