A CONSTANT TEMPERATURE BATH FOR MAINTAINING TEMPERATURES LOWER THAN THAT OF THE ROOM.*

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There are many forms of thermo-regulators on the market by which the supply of gas or electricity may be automatically controlled in such a way as to maintain constant temperatures in water-baths, hot-air ovens, incubators, etc. All of these, however, are adapted for maintaining temperatures *above* that of the ordinary laboratory or room.

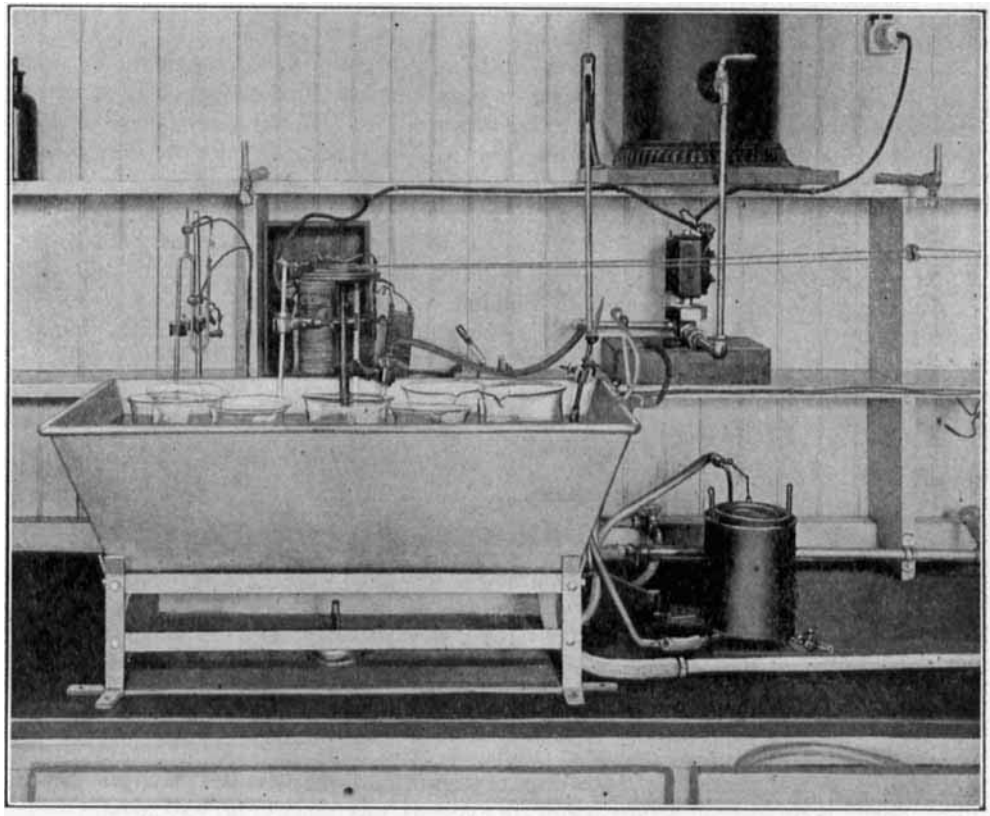

FIG. 1.—Arrangement of apparatus employed for maintaining temperatures lower than that of the room.

Continuing my experiments with the use of gold fish [1] as a means of standardizing the drugs belonging to the Digitalis group, I found the best temperature at which to carry out these tests to be from 21° to 22° C. As the temperature of our laboratory in the summer months is always above 22° C., and often as high as 27 to 31° C., I found it necessary, in order to continue my experiments, to devise

* Read before Scientific Section, A. Ph. A., Atlantic City meeting, 1916.

[1] "Preliminary Note on a New Pharmacodynamic Assay Method, *Carassius auratus* (Gold Fish) as Test Animals for the Digitalis Series." J. A. Ph. A., April, 1915.

some method or apparatus by which it would be possible to keep a water-bath at a temperature of 20 to 22° C. (below the normal room temperature at this season). For this purpose I devised the apparatus described below, which has been in our laboratory for some time and has proven entirely satisfactory.

Briefly summed up, this apparatus consists of a metal tank (see Fig. 2) used as a water-bath which is provided with a perforated shelf on which beakers or other containers holding the material to be kept at a definite temperature may be placed. Near the center of the tank and dipping into the water there is a stirring apparatus driven by a small water motor. At one end of the tank there is a toluol-mercury regulator (see Fig. 3) which dips into the water, and at the opposite end there is an alcohol-mercury gas regulator also arranged to dip into the water.

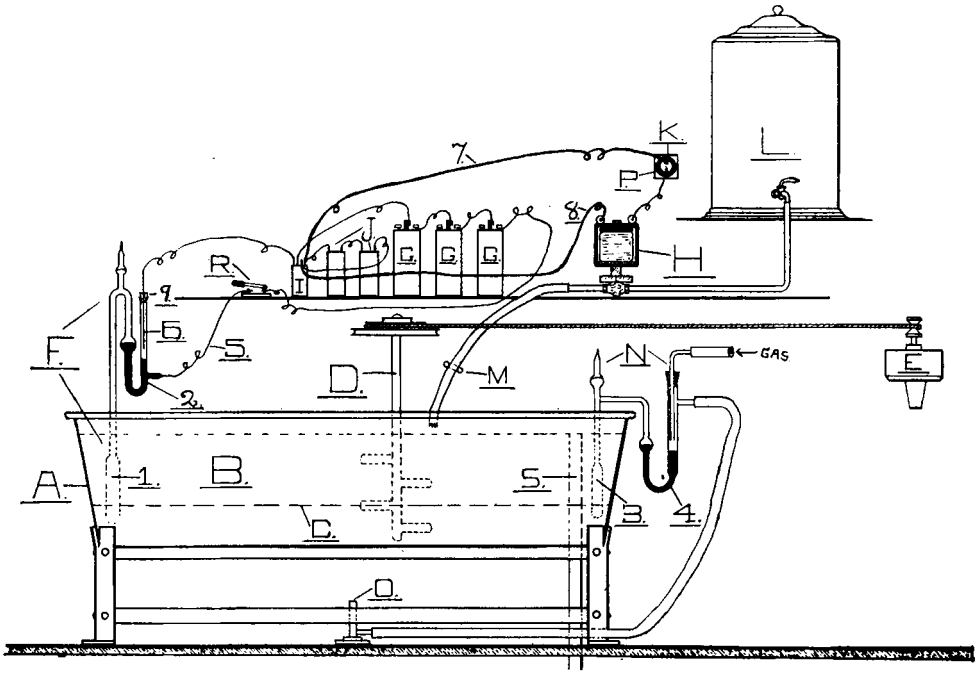

FIG. 2.

The toluol-mercury regulator is connected electrically to a water cooler, and, by means of a solenoid water valve in the electric circuit, the cold water supply from the cooler may be either released or withheld.

When an experiment is to be conducted the toluol-mercury regulator is adjusted to the temperature which we desire to maintain as described under Fig. 3 and as soon as the temperature of the water in the water-bath rises above this the toluol expands sufficiently to make an electrical contact which releases ice-water from the cooler by means of a solenoid valve and thus the temperature of the water in the tank is lowered.

As the contents of the water-bath become cooler the toluol in the regulator contracts and the electrical circuit is broken, thereby automatically shutting off the ice-water supply until the temperature once more rises above that which we desire to maintain.

DETAILED DESCRIPTION OF APPARATUS.

The following illustrations and explanation cover the arrangement of this apparatus in detail. Fig. 2 shows the entire apparatus as it is connected when ready to begin an experiment.

A represents a metal tank used as a water-bath; B indicates place for water; C, a perforated shelf to support the beakers containing gold fish (or any other material which is to be kept at a constant low temperature); D, stirring apparatus; E, small water motor for driving stirring apparatus (D); F, toluol-mercury

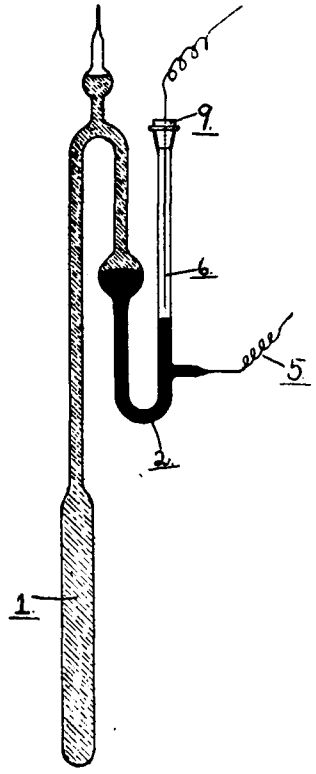

FIG. 3.

regulator (1, toluol, 2, mercury); G, dry batteries; H, electrically operated solenoid water valve of the plunger type. When the electric current is passed through the coil it forms a magnet which raises the plunger and opens the valve. When the current is shut off, the plunger falls by gravity and closes the valve. I, relay; J, condensers, which are used to prevent sparking when the relay makes and breaks the electric current and thus prevents the contacts from burning off. K, plug; L, water cooler; M, stopcock; N, alcohol-mercury gas regulator (3, alcohol, 4, mercury); O, small bunsen gas burner; P, socket; connected with either 110 or 220-volt electric current; 5 and 6, battery wires; 7 and 8, electric wires either 110 or 220 volts; R, switch to disconnect thermostat when not in use in order to save batteries; S, overflow pipe.

Fig. 3 shows the construction of the toluol-mercury regulator. That portion of the glass tube which is lightly shaded represents (1) toluol. The black portion (2) represents mercury. It will be noted that the platinum end of battery wire (5) is constantly in contact with the mercury. This wire (5) is connected directly with the zinc pole of the dry batteries. The platinum point of battery wire (6) which is connected to one "battery pole" of the relay is so arranged that it may be raised or lowered through stopper (9). The other "battery pole" of the relay is connected with the carbon pole of the batteries, thus completing the circuit when the relay is closed. The relay must be of the type which makes a contact when the battery circuit is closed by the thermostat and breaks the contact when the battery circuit is broken.

In order to adjust the regulator so that it will throw the relay at a given temperature, say for example 22° C., it is only necessary to place bulb (1) in a large

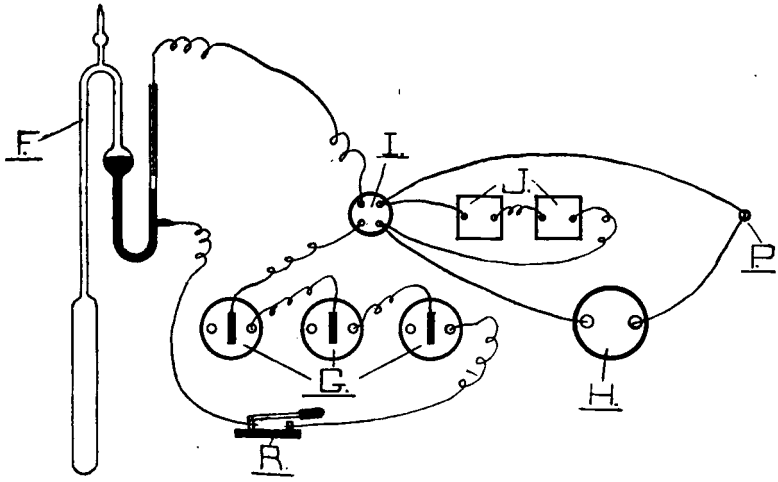

FIG. 4.

beaker of water, bringing the temperature of the water to exactly 22° C., and then adjust battery wire (6) so that it just touches the surface of the mercury. The regulator is then placed in the bath which is to be kept at 22° C., and if the temperature rises above 22° C. a contact is formed as described later on.

Fig. 4 shows method of connecting thermostat (F), relay (I), condensers (J), batteries (G), and solenoid valve (H) with the electric plug (P).

In order to maintain a constant temperature *lower* than that of the room, it is necessary, therefore, to first arrange the apparatus as described under Figure 2, then regulate the thermostat, as already outlined under Figure 3, so that it will make a contact at the desired temperature, say for example, 22° C. Fill cooler (L) with ice and water; start stirrer (D); put cake of ice in water (B) until temperature falls to about 20 or 21° C.; remove ice from (B) and insert plug (K) in socket (P). The apparatus will then automatically keep the water (B) at a uniform temperature of 21.5 to 22° C. as follows:

The comparatively warm air of the room produces a gradual increase in the temperature of the water (B) which causes the toluol in (F) to expand and the

mercury in F2 to rise. When the temperature of the water reaches exactly 22° C. the mercury touches the platinum point of wire (6) which completes the battery circuit and allows the current from the battery to run through the coil of the relay, thus forming an electromagnet which lifts the armature of the relay and in turn makes the contact which closes the electric circuit from socket (P) and allows the strong electric current to pass through the coil (H) which opens the water valve, as previously described, and allows ice-water from (L) to run into (B). The stirrer (D) distributes the ice water throughout the tank.

With the gradual lowering of the temperature of the water the toluol contracts and causes the mercury to fall away from the platinum wire (6), thus breaking the battery current which is passing through the relay. This break allows the armature of the relay to fall away from the contact and thus breaks the strong current from socket (P) which is passing through and holding open the solenoid valve. This allows the plunger to fall and shut off the flow of ice-water. The warm air of the room then gradually increases the temperature of the water until at 22° C. the mercury in the thermostat again makes a contact and the whole operation repeats itself.

The alcohol-mercury gas regulator (N) is familiar to all laboratory workers and it is therefore unnecessary to describe it here. This regulator is for use in cold weather when the temperature of the room is below that desired in the water-bath.

PHARMACODYNAMIC LABORATORY, H. K. MULFORD COMPANY.

IMMUNO-CHEMISTRY OF PLANTS.

A great fund of knowledge has been gathered in recent years concerning the processes involved in the immunity of animals to specific diseases, but comparatively little is known about analogous processes in plants. Mr. R. W. Thatcher has reported some investigations of the latter subject, comprising a comparative biochemical study of healthy and diseased plants, and a biochemical and microchemical study of the reactions produced in the host plant by a growing parasite. He states that sufficient progress has been made to justify the recognition of two types of resistance, or immunity, viz.: (1) an antagonism of the tissue substances of the infected plant to the action of the enzymes or other agents excreted by the growing hyphæ of the parasite, and (2) a hypersensitiveness of the host, whereby its tissues at the point of entrance of the parasite are killed and no longer supply nutrient material for the latter, thereby causing its death by starvation.—*Scientific American.*