what the water contained over at least the area traversed—whereas we now know that the Zoëas were confined to, at most, the latter half of the traverse and may have been even more restricted. Under these circumstances, an observation made solely in the water traversed during the first seven minutes would have given a very different result from that actually obtained; or, to put it another way, had two expeditions taken samples that evening at what might well be considered as the same station, but a few hundred yards apart, they might have arrived at very different conclusions as to the constitution of the plankton in that part of the ocean.

It is interesting to note that enormous numbers of *Oikopleura* "houses" covered with diatoms were present in some of the gatherings; and the abundance of the diatom *Thalassiosira Nordenskioldii* was phenomenal. We have some reason to think that there has been an exceptional flow of cold water from the north into the Irish Sea this spring and that may account for the presence of this northern diatom which has not been found in our region before.

As an example of two surface nets hauled together which gave much the same quantity of plankton, but where the gatherings differed widely in their nature, I may give the details of April 13. [Slide shown and details explained.]

The bearing of such observations as these upon some recent speculations as to the fish-population of the sea, and even as to the amounts of food-matters present in the waters of large areas, is obvious. Nothing in the economics of the sea could be more important than such speculations in regard to what I have proposed should be called the "hylokinesis" of the ocean, if we could be certain that our conclusions are correct, or even that they are reasonably close approximations.

It is possible to obtain a great deal of interesting information in regard to the hylokinesis of the sea without attempting a numerical accuracy which is not yet attainable. The details of measurement of catches and of computation of organisms become useless and the exact figures are non-significant, if the hauls from which they are derived are not really comparable with one another and the samples obtained are not adequately representative of nature. If the stations are so far apart and the dates are so distant that the samples represent little more than themselves, if the observations are liable to be affected by any accidental factor which does not apply to the entire area, then the results may be so erroneous as to be useless—or worse than useless, since they may lead to deceptive conclusions.

My view in brief is: (1) That we must investigate our methods before we attempt to investigate nature on a large scale, (2) that we must find out much about our gatherings of organisms before we can consider them as adequate samples; and (3) that we must make an intensive study of small areas before we draw conclusions in regard to relatively large regions such as the North Sea or the Atlantic Ocean.

W. A. HERDMAN

A SIMPLE ELECTRIC THERMOREGULATOR

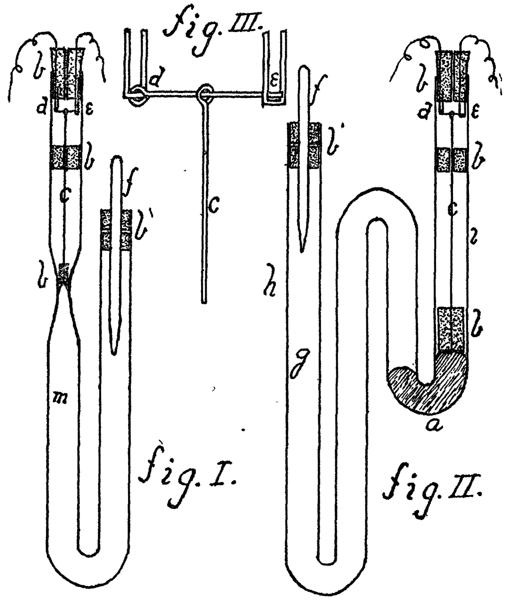
THE advantage of electricity over gas for heating paraffin baths, incubators, culture chambers, etc., in laboratories is well known. Electric thermoregulators for use in connection with such apparatus have appeared from time to time; but, as far as I know them, they are all more or less complicated or expensive.

The electric heating coil and regulator devised by Professor E. L. Mark[1] and used with success in the laboratories of the museum of comparative zoology at Harvard University ever since, costs between $25 and $30 for each bath. The expense of this device excludes its use in many laboratories, especially those in which quite a number are desired for individual use.

It was for the purpose of heating a small paraffin bath with a sixteen-candle power incandescent lamp that I first devised an electric thermoregulator. Later modifications of this piece of apparatus resulted in two forms, a mercury regulator and a glycerin or air regu-

[1] Mark, E. L., "A Paraffine Bath Heated by Electricity," *Amer. Nat.*, 37 (434): 115–119, 3 figs., February, 1903.

lator, both of which are represented in the accompanying figures. Their construction will be clearly understood by referring to the figures.



FIGS. 1 and 2. Side view of a median vertical section of mercury and glycerin electric thermoregulators respectively. One half natural size. General outline, wall of glass tube; *a*, mercury or water; *b*, cork; *c* and *d–e*, copper or platinum wire about 0.5 mm. in diameter; *f*, solid glass rod; *m*, mercury; *g*, glycerin, air, toluole, or chloroform.

FIG. 3. An enlarged view of the lever *d–e*, with its connections.

In constructing the lever the ring at *d* must be made large enough, so that the end *e*, where the circuit is broken, will fall with its own weight. This ring should consist of several coils so as to make the ring end of the lever heavier than the opposite end and give space enough for good electrical contact. Five coils, two on either side of the middle, is sufficient. I have also found it advisable to make a single turn loop in the lever near the middle, to connect with the ring on the wire *c*. This insures bearing always on the same point and prevents possible change in the adjustment of the regulator by the sliding of the ring on the lever.

Copper wire has proved very satisfactory in the construction of the lever and its connections. I have, however, had occasion to use it only about one week. It may be that continuous usage for a long period will cause sufficient oxidation at the point *e* where the circuit is broken, to prevent electrical contact. If this proves to be true, platinum will have to be substituted for copper.

If the cork *b′* is cut in half crosswise and a little vaselin put between the two parts as represented in the figures, the glass rod will slip through the cork very easily and there will be no difficulty with leakage.

The glycerin regulator will be more compact and easier to manipulate if the second bend in the glass tube is made in a plane at right angles to that in which the first bend lies, and the third in a plane at right angles to the second, so that the two portions *i* and *h* will lie near each other and a cross-section of the four straight portions will form a rectangle.

If glycerin and mercury are used in the regulator, represented in Fig. 2, it can be easily filled by first nearly filling the entire tube with glycerin, then pouring the desired quantity of mercury into the lever end, and then drawing the glycerin above the mercury off and washing it out thoroughly with water and alcohol. The space above the mercury must be clean and dry or the cork will be likely to stick.

Both regulators are adjusted in the same way. They are immersed in the water in the bath, then the glass rod *f* is partially or entirely withdrawn. This completes the circuit and the temperature begins to rise. As soon as it has reached the desired point, the glass rod is pushed in very slowly until the circuit is broken. The temperature now falls until the circuit is again complete. The adjustment is thus seen to be very simple. It must, however, be remembered that owing to currents in the water due to unequal heating, the temperature of the water in the region of the thermometer compared with that in the region about the regulator is likely to change and so it is to be expected that the regulator will not maintain the temperature recorded when the circuit is first broken. It will, however, soon reach a state of equilibrium and remain nearly constant.

The change in temperature required to make and break the circuit varies with the form and size of the regulator used and its contents. In the mercury regulator constructed as represented in Fig. 1 it is less than one half degree. In the regulator made as represented in Fig. 2, containing glycerin and mercury, it is less than one tenth degree. If air is substituted for glycerin, the regulator is still more sensitive, but the temperature maintained varies nearly two degrees with extremes in barometric pressure. Barometric changes, however, affect the liquid regulators but very little. If water and air are substituted for mercury and air, the temperature variation is slightly increased.

The advantage of glycerin toluole and chloroform over mercury lies in the fact that they have a much higher index of expansion than mercury and, at least glycerin and chloroform, are much cheaper.

Both forms can be made more sensitive, (1) by increasing the length of the chamber containing the mercury, glycerin or other substances, (2) by increasing the diameter of the tube near the electric end so as to admit the use of a longer lever, (3) by increasing the ratio between the diameter of the tube and that of its constriction. (A constriction can be made use of in the glycerin regulator as well as in the one containing only mercury.) It will thus be seen that there is theoretically no limit to the possible sensitiveness of these regulators.

A glass tube having an inside diameter of 7 mm., reduced to 2 mm. at the constriction, was found to be suitable for the construction of these regulators. In making the constriction the tube should be heated and rotated until the walls fall in before it is drawn out, so that they will become thick and the tube will be strengthened at this otherwise weak point. No special care need be exercised in bending the tube; various other forms than those represented will answer the purpose just as well.

Either form of the regulators described can, of course, be used in connection with "heating coils," such as described by Professor Mark or others, or in connection with incandescent electric bulbs. The latter are usually furnished without charge by electric power and lighting companies. They serve the purpose fairly well, although some inconvenience must be expected, owing to the liability with which they burn out, unless several are used in heating each bath.

In case bulbs are used and apparatus is constructed with this in view, I think metal tubes large enough to admit a bulb should be soldered in the side near the bottom. If the cylindrical form of bulb is used these need not be large. The tubes should be dead black inside and closed after the lamps are in. In this way practically all the light energy is transformed into heat energy.

Heating with electricity is somewhat more expensive than heating with gas. I was, however, surprised to find that a sixteen-candle power incandescent lamp, with the circuit broken nearly three fourths of the time, will maintain a temperature between fifty and sixty degrees in a well-insulated bath which holds about one liter.

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SEISMOGRAPHS IN UTAH

It may be of interest to many to know that seismographic apparatus has recently been installed at the University of Utah. The university campus covers part of a shore terrace built by the Pleistocene water-body known as Lake Bonneville on the easterly outskirts of the region now occupied by Salt Lake City, and lying practically at the base of the Wasatch range. The Wasatch Mountains are of immature age, and consequently are now rising. Raw scarps at the foot of a spur just northeast from the city, and similar scarps at the base of the main range a short distance to the southeast, tell of comparatively recent up-slips of these sections of the mountain mass. At the Wasatch base directly east from the city, along the line of the bench-land junction with the mountain mass, there is little