TABLE II.—SOLUBILITIES OF NH_4Br IN H_2O TO 100° AT ROUNDED TEMPERATURES.

Temp. ° C.	G. NH_4Br per 100 g. H_2O.	Molar fraction. NH_4Br.	Temp. ° C.	G. NH_4Br per 100 g. H_2O.	Molar fraction. NH_4Br.
0	60.6	0.1004	40	91.1	0.1437
5	64.3	0.1058	45	95.2	0.1491
10	68.0	0.1112	50	99.2	0.1546
15	71.7	0.1165	60	107.8	0.1656
20	75.5	0.1220	70	116.8	0.1768
25	79.3	0.1274	80	126.0	0.1881
30	83.2	0.1328	90	135.6	0.1996
35	87.1	0.1383	100	145.6	0.2111

In one instance (Experiment marked * Table I) a point on the metastable portion of the lower solubility curve was obtained. This was accomplished by placing the cold tube in the bath maintained at the temperature predicted by prolongation of the lower curve and the known composition of the contents of the bulb. In this manner it was possible to completely dissolve the crystals at a temperature nearly 1° below that at which the same sample, when in the form stable at that temperature, was found to dissolve. In order to determine the saturation temperature for the stable form, the temperature of the bath was raised a degree or so above the transition point and the solid was allowed to stand several minutes in contact with the solution (without shaking). On lowering the temperature slightly and determining the saturation temperature in the usual manner the point on the equilibrium curve was obtained.

The solubilities from 0 to 100° do not agree with those given by Eder. To show the amount of the discrepancy, his values are plotted with our own results in Fig. 2. He gives no description of his method of determining the solubility.

Summary.

Heating and cooling curves showed the transition point of ammonium bromide to lie between 130° and 143°. The solubilities in water from 0 to 170° were determined by the closed tube method. A well defined break in the solubility curve occurs at 137.3°, the transition temperature. The solubility measurements from 0 to 100° do not agree with the only ones heretofore available in the literature.

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[CONTRIBUTION FROM THE CHEMICAL LABORATORY OF THE UNIVERSITY OF CALIFORNIA.]

THE PRACTICAL INSTALLATION OF THE DOUBLE COMBINATION POTENTIOMETER.

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The advantages of multiple thermoelements for use in calorimetry, and the design and installation of suitable potentiometers for these and other precise potential measurements have been discussed at length by White.[1] In attempting to install a double combination potentiometer[2] of highest sensitivity, certain improvements and precautions not discussed by White have been worked out.

Our instrument was originally designed for use with lead storage cells as the primary source of electromotive force. The lead cell is not satisfactory. In the first place the e. m. f. is unnecessarily high, thus increasing leakage difficulties. In the second place the cell has a high temperature coefficient and even at constant temperature the e. m. f. is not particularly constant. Thus the instrument requires frequent comparison with the standard cell. On the other hand, the large size Hulett[3] standard battery is free from these defects, our batteries seldom varying under working conditions by more than 0.0001 volt. However, because the e. m. f. of the Hulett battery is but slightly greater than that of the standard cell, certain changes in the design of the instrument were necessary. These changes affect only the low-resistance side of the instrument. In the original instrument the battery current flowed through both the dial resistances of 99 ohms and an auxiliary resistance of 1018 ohms. This last coil was used not only as an auxiliary resistance, but also for checking the battery current against the standard cell (1.0181 volts at 25°). The Hulett cell does not give a sufficient e. m. f. to force a current of 0.001 amp. through these two resistances. We therefore substituted for the 1018 ohms coil in the battery circuit a coil (W) of 919.1 ohms, making the total resistance of the battery circuit inside the potentiometer 1018.1 ohms. We then re-arranged the connections so that the battery current is checked against the standard cell through this total resistance, and the old coil is used as a substitute resistance when the potentiometer is cut out.

The precise details of the connections as modified will be made clear by reference to Fig. 1 which combines Figs. 7, 10 and 11 of White[4] into a simple schematic diagram. The block letters refer to the same parts as in Fig. 11, and the roman to the letters given to the binding posts by the makers of our instrument. What the significance of this last lettering is we have been unable to ascertain. The heavy lines indicate those parts included in the potentiometer box. In practice switches E_1, E_2 and E_3 are combined into a single 3-pole double-throw switch. Similarly, switch M is a 4-pole double-throw and SC and SH are 2-pole double-throw switches. Switches SC and SH correspond to the unlettered switches of White, Fig. 12.

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[1] THIS JOURNAL, 36, 1856, 1868, 2011, 2292, 2313 (1914).

[2] Leeds and Northrup Instrument No. 26761.

[3] *Phys. Rev.*, 27, 33 (1908).

[4] THIS JOURNAL, 36, 1868 (1914).

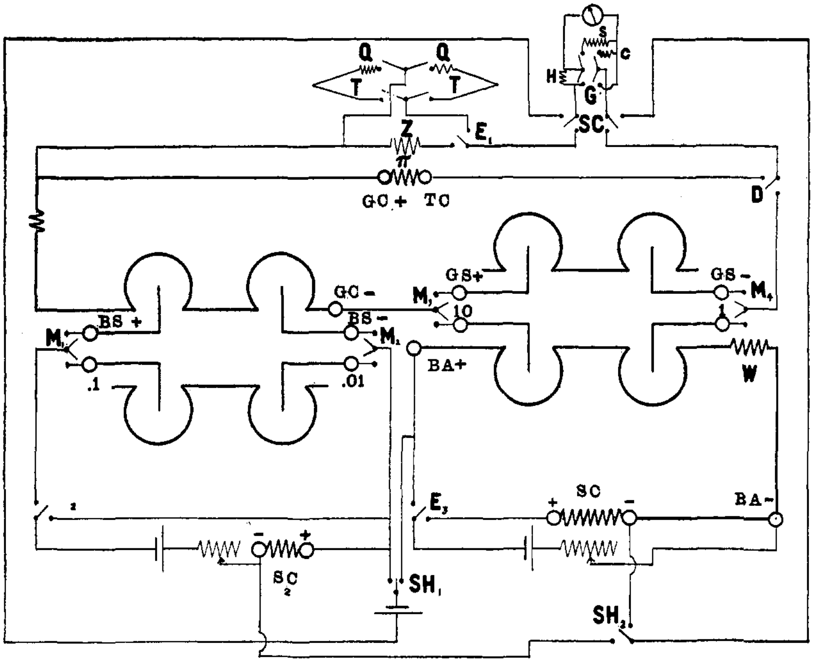

Fig. 1.

The Elimination of Parasitic Thermoelectric Effects.—In our installation parasitic thermoelectric effects have been reduced to less than 0.01 microvolt; in fact none are detectable within the limits of sensibility of the galvanometer. This result has been obtained by carefully eliminating all metals except copper in the external circuits, and by entirely enclosing the instrument, wiring and galvanometer.

The special switches which White recommends have been improved by specifying copper instead of brass clips for fastening the wire to the switch contacts, thus providing a continuous copper circuit. It is, of course, unnecessary, and in fact undesirable from a mechanical standpoint, that the screws, bolts, etc., be of copper.

While the "clothes-pin" contact of White is entirely satisfactory, we have found the form of binding post shown in Fig. 2 to be more rugged and convenient for a permanent installation. It consists of a threaded copper rod, A, a threaded copper bushing, B, a brass binding nut, C, and a brass nut, D, soldered to the copper rod. The permanent connection is made by soldering to the copper rod. This binding post is much cheaper than an all copper post, is thermoelectrically as satisfactory, and mechanically much better.

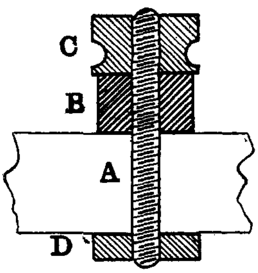

Fig. 2.

The remaining thermal parasitics are mainly in the brass binding posts of the galvanometer and potentiometer box. These brass binding posts should be replaced by posts of the type described in the preceding paragraph. In our instrument we have not made these replacements but have eliminated these effects by complete thermal enclosure.

Insulation.—For an instrument that is to be used in a chemical laboratory it is essential that there be as few exposed electrical parts as possible, and that the insulation between different exposed parts be of such a nature that it can easily be renewed. Properly treated paraffin forms a most satisfactory insulation. In our instrument all the wires are led through glass tubes which are embedded in paraffin. The paraffin used for purposes of insulation should be of the best quantity obtainable, should be boiled before using, and should be cast in thin layers, each of which is allowed to harden before a successive one is applied. Paraffin thus treated has an effective resistance of more than 10^{11} ohms per cm./cm^2. The complete enclosure of all of the wires in one solid block of paraffin makes local electrical shielding almost unnecessary. The whole instrument, galvanometer, and connected apparatus must, of course, be shielded by White's method. In many cases where the insulation is not perfect we have found local shielding a positive disadvantage.[1] The switches should be particularly well insulated. We have replaced the fiber parts by bakelite and have submerged the bases entirely in paraffin, thus allowing a renewal of the surface insulation from time to time.

For convenience our instrument is mounted as a unit upon a wooden table 36″ × 36″. The Hulett batteries are carried on a shelf below the table. All the wiring is brought underneath the table through glass, paraffin-filled tubes, and the connections cast as a unit in a shielded paraffin block. Following the suggestion of White, the various switches, rheostats, and resistances are mounted in a tin-lined wooden box and operated by draw rods. It is of great advantage to enclose the sliding contacts on the top of the potentiometer box and to operate the dials by means of shielded extension handles. Connections to the standard cell, batteries, galvanometer and thermoelements are made by means of copper binding posts outside the enclosing case.

We have found the unprotected galvanometer the source of very serious thermoelectric forces. At the suggestion of Prof. Lewis it was enclosed in a heavy sheet copper box with a small plane glass window. The box is connected with the shielding system. The telescope is mounted on the top of the case enclosing the switches 50 cm. from the galvanometer mirror and the strongly illuminated scale is several meters away and at such a height that troublesome double reflections are avoided. The galvanometer switches are operated by foot pedals.

[1] Leakage currents may best be tested for by short-circuiting the thermocouple.

The Galvanometer.—For use with multiple thermoelements of 20 to 50 couples a galvanometer of the following specifications[1] is recommended: resistance 30 ohms, external critical damping resistance 400 ohms, period 7 sec., sensitivity 4 mm. per microvolt with the damping resistance in series. The potentiometer is usually used with several thermocouples which have different resistances. Instead of changing Z (Fig. 1) to correspond to the resistance of each thermocouple, it is fixed at 400 (C. D. R. of galvanometer)—105.5 (resistance of remainder of external galvanometer circuit) and an auxiliary resistance, Q, placed in series with each thermocouple. This resistance Q is wound of copper wire so as to be free of thermoelectric forces, and has such a value that its resistance added to that of the thermocouple equals Z.

For the above galvanometer the resistance S should have the value 400 ohms, and H 3572 ohms[2] in order that the galvanometer can be set to give $^1/_{10}$ sensitivity.

Our instrument as finally set up has no detectable thermoelectric parasitics, and only an extremely constant leakage e. m. f. of slightly less than 0.1 microvolt.

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THE TEMPERATURE EFFECT IN DIALYSIS AND A SIMPLE RAPID DIALYZER.[3]

BY MARKS NEIDLE.

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The speed of dialysis depends upon the following factors: First, the nature of the membrane; second, the area of the membrane which is in contact with liquid on both sides; third, the difference in concentration of diffusible substances in internal and external liquids close to the membrane; fourth, the temperatures of the internal and external liquids.

By utilizing, especially the third and fourth principles, it is possible to prepare large quantities of inorganic hydrosols, containing only minute amounts of electrolytes, in a comparatively short time. The method consists in suspending a parchment paper membrane of about one liter capacity in a two liter beaker containing about a liter of the solution to be dialyzed. Distilled water is run at a fairly constant rate into the membrane, which is maintained a little more than half full by means of an automatic syphon. The colloidal solution which is in the beaker is heated to any desired temperature (70–90°).

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[1] For use with low-resistance couples the critical damping resistance can be reduced to 150 ohms with an increase of sensitivity.

[2] For a galvanometer 150 ohms C. D. R., S = 150 ohms, and H = 1625 ohms.

[3] Presented at the spring meeting of the American Chemical Society, 1916.