wire A is in contact with mercury A' in the adjustable cup, which is connected by a wire under the base to the post e. The current then goes from one pole of the battery L to f, A, A', e and then through the primary of the induction coil back to the other pole. When the current is passing through the wire the magnet will repel the wire, and if the cup A' is at the proper height the contact with the mercury will be broken and since the wire when uncharged is not affected by the magnet its tension will make the contact once again and the same process will be repeated. The tension of the wire and consequently the rapidity of vibration, may be altered by the screw devices at each end.

This new form of apparatus is not only simpler in construction than the original, but is also much more readily adjusted and kept in adjustment. In the earlier form with two mercury cups it is necessary that the wire vibrate in such a way that loops are formed at the two cups, so that the original adjustment is more difficult to make and a variation in the number of vibrations per second is less easy to arrange. If three or more pieces of conductivity apparatus, each with its cell, are connected to the same vibrator, a smaller voltage may be used for the electromagnet, for the voltage in the wire is much greater and consequently the strength of the magnetic field may be much reduced and still give the same result.

[CONTRIBUTIONS FROM THE HAVEMEYER LABORATORIES OF COLUMBIA UNIVERSITY, NO. 13.]

THE SPECIFIC GRAVITY AND ELECTRICAL RESISTANCE OF METALLIC TELLURIUM.

BY VICTOR LENHER AND J. LIVINGSTON R. MORGAN.

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IN this Journal[1] one of us described the preparation of metallic tellurium by means of the reduction of an alkaline solution of the oxide of tellurium with sugar. A description was given in that paper of the means used to test the tellurium for impurities. The tellurium obtained by reducing with sugar was found to be volatile in hydrogen gas leaving no residue. Its oxide was found to be completely volatile in hydrochloric acid gas.

1 Lenher: This Journal, 21, 348.

As a further means of establishing the purity of the metal, a few physical tests were made. The specific gravity was carefully determined and a great deal of time was spent in attempting to determine its electrical resistance.

Determination of the Specific Gravity.—For this purpose, material was selected, which had been twice distilled in hydrogen.

The metal was finely powdered, as a number of preliminary experiments showed that owing to the great crystalline tendency that the metal exhibits, it is almost impossible to obtain a specimen of any size which does not contain gas. Consequently, it was found that reasonably constant results could be obtained only when the metal was carefully broken up.

The experiments were carried out in an ordinary 15 cc. pycnometer, pure water being used as the medium. The temperature was 20°. In order to expel the adhering air bubbles, the water with the metal was heated and the vessel allowed to stand over night to cool.

	Weight tellurium taken.	Sp. gr.
Experiment 1....	11.9727	6.194
" 2	11.9146	6.200
" 3	16.0946	6.204
Mean		6.1993

This figure is a trifle less than that obtained by Spring[1] but is almost identical with that obtained by Klein and Morel[2]. The latter chemists obtained the figures 6.204 and 6.215, while Spring obtained a figure slightly higher, 6.22.

The latest figure previous to our work is by Priwoznik[3] who obtained 6.2459 at 18.2°.

Determination of the Electrical Resistance.—For the determination of the electrical resistance of a metal, it is advisable to obtain great length and small diameter of the substance. With tellurium this is almost impossible. The metal is extremely crystalline, more strongly so than any metal which has come into our hands. As a result of this tendency, the metal, when of small diameter and possessing any appreciable length, is so weak that a rod grasped by the end will snap off, it not being able to sustain its own weight.

1 *Bull. Acad. Roy. Belg.* [3], **2**, 88-110 (1881).
2 *Ann. Chem.* (Liebig), [6], 5, 61.
3 *Chem. Centrbl.*, **2**, 962 (1892).

It is not practical to cast the metal in cold moulds. Various attempts were tried in this direction but proved unsuccessful. The best method for obtaining a suitable section was found to be to melt the metal in a thin glass tube of comparatively narrow bore. To this end an open glass tube was placed in an inclined combustion furnace and inside of it was introduced a smaller tube closed at one end and containing the metal to be fused. The fusion took place at a low red heat, while in the liquid condition, the tube was gently tapped until all of the gas escaped.

Slow cooling tends to produce larger crystals and the metal is correspondingly more brittle. Rapid cooling, on the other hand, gives smaller crystals, but the difference in resistance is not apparent. The most satisfactory results were obtained by jacketing the tube of molten tellurium with a larger tube also containing fused metal. Although in this instance the metal cooled under the pressure of the shell in the jacket, the only apparent difference was that longer sticks could be obtained.

From the many fusions that have been made in this laboratory, it appears that tellurium on cooling, first contracts until it solidifies, then slightly expands. As an example of this may be noted that each stick contained a depression in its upper part, which extended about one-fifth of the entire length[1] and that the tubes always cracked just after the metal solidified. The tubes invariably cracked at this time, no matter how carefully they had been annealed, nor how slowly they were cooled.

In order to obtain the best possible contact, a piece of rubber tubing was drawn over each end of the stick to be measured and the tubes filled with mercury. The latter was connected with a small dry battery, a wheatstone bridge and galvanometer being in the circuit.

No. 1.—Length, 100 mm., diameter, 7.42 mm. Resistance at $20^\circ = 1.38$ legal ohms. Specific resistance = 596.6.

No. 2.—Length 162 mm., diameter, 8.89 mm. Resistance at $20^\circ = 1.23$ legal ohms. Specific resistance = 463.6.

No. 3.—Length, 137 mm., diameter, 8.255 mm. Resistance at $20^\circ = 1.46$ legal ohms. Specific resistance = 569.9.

No. 4.—Length, 103 mm., diameter, 3.43 mm. Resistance at $20^\circ = 3.68$ legal ohms. Specific resistance = 330.1.

[1] This portion was always removed before measurements were made.

No. 5.—Length, 82 mm., diameter, 3.43 mm. Resistance at 20° = 2.48 legal ohms. Specific resistance = 279.4.

This specimen was a piece of No. 4 after a portion had been broken off.

No. 6.—Length, 84.5 mm., diameter, 3.05 mm. Resistance at 20° = 5.88 legal ohms. Specific resistance = 508.3.

No. 7.—Length, 86.1 mm., diameter, 4.83 mm. Resistance at 20° = 5.37 legal ohms. Specific resistance = 1152.

On close examination this bar was found to be cracked.

No. 8.—Length, 57.5 mm., diameter, 2.92. Resistance at 20° = 4.68 legal ohms. Specific resistance = 544.5.

As all of the bars showed a strong cleavage on the ends, the measurements could only be approximate, and when they are calculated to the standard conditions, one meter in length, with a cross section of one mm., the errors of measurement are correspondingly multiplied.

By using an ordinary copper clamp contact, almost any resistance can be obtained according to the amount of pressure exerted by the clamp; no difference in resistance could be detected when working in the light or dark.

By comparison of the results obtained, it will be observed that the mean would be about 500; however, from the great tendency to crystallization that the metal shows, it would seem more probable that the lowest result more nearly approaches the true figure. As gas carbon has a specific resistance equal to 50, the resistance of tellurium is seen to be enormous. The result obtained by Matthieson,[1] 0.000777 for the conductivity compared with silver as 100, would give a specific resistance of more than 2000, showing that the structure of his metal must have been different from ours or that different contact was made.

THE VOLUMETRIC DETERMINATION OF MAGNESIA.

BY JAMES OTIS HANDY.

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EVERY chemist, who has to make many determinations of magnesia in water, cement or other material, appreciates the difficulties surrounding the gravimetric process. These difficulties chiefly arise from the fact that the change from magne-

[1] *Pogg. Ann.*, 103, 428.