PRACTICAL WORK AT THE CAVENDISH LABORATORY: HEAT

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Cambridge. University. Cavendish Laboratory

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EDITED BY

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INTRODUCTION.

THE work of the advanced class at the Cavendish Laboratory in the department of Heat during the Michaelmas Term, 1884 consisted mainly in the repetition of some of the classical experiments in the subject, using, of course, such models of the original apparatus as the laboratory could provide. It seemed not unlikely that a somewhat detailed account of this work, although not original and therefore not suitable for presentation to a learned society, might yet furnish to students in other Laboratories information of some value respecting the practical difficulties arising, and the effect of neglecting those precautions which it was beyond the power of the Laboratory or of the observer to provide for.

In the hope that this might prove to be the case, I requested the various members of the class to make themselves responsible each for the description of one or more of the experiments comprised in the syllabus. Results had been in most cases obtained during the term by several students, working independently with the same apparatus; such results are always entered in books kept in the Laboratory for the purpose, and it was understood that they were to be incorporated in the account, the different observers being indicated by initials.

It will be seen on reference to the syllabus that the experiments are not all described. With the exception however of No. 6 their arrangement here presented no points of difference from the ordinary descriptions in the books. The apparatus for No. 6 was not completed until so late in the term that there was no time to take observations with it.

The students very kindly undertook the responsibility and wrote the descriptions which are printed below. I have done but little by way of editing; I have however added a few notes where they seemed necessary.

W. N. SHAW.

CAVENDISH LABORATORY,
January, 1885.

SYLLABUS OF ADVANCED DEMONSTRATIONS IN HEAT, 1884.

1. MANUFACTURE AND CALIBRATION OF A MERCURY THERMOMETER.
   Maxwell, Heat, Chap. ii.
   MS. Kohlrausch, Phys. Meas. p. 58.
2. COMPARISON OF MERCURY AND AIR THERMOMETERS.
   Elementary Course, No. 38.
   Balfour Stewart, Heat, Chap. iv.
   Regnault, "Sur la mesure des Températures," Mémoires de l'Académie, T. XXI.
3. THE WEIGHT THERMOMETER. DETERMINATION OF THE COEFFICIENT OF EXPANSION OF GLASS.
   MS. Regnault (l. c.).
4. COEFFICIENT OF LINEAR EXPANSION OF A ROD.
   Elementary Course[1], No. 37.
5. COEFFICIENT OF CUBICAL EXPANSION OF A METAL BY THE ARŒOMETRIC METHOD.
   MS. Matthiessen, Phil. Trans. 1866.
6. COEFFICIENT OF ABSOLUTE EXPANSION OF MERCURY.
   B. Stewart, § 51.
   Regnault, Mémoires de l'Académie, T. XXI.
7. DETERMINATION OF THE TEMPERATURE OF MAXIMUM DENSITY OF WATER BY JOULE'S METHOD.
   Maxwell, Chap. xvii.
8. MANUFACTURE OF AN AIR-THERMOMETER FOR USE AT COMPARATIVELY HIGH TEMPERATURES.
   MS.
9. MEASUREMENT OF HIGH TEMPERATURES BY THE RESISTANCE OF A PLATINUM WIRE.
   MS. Report of British Association, 1874, p. 242.
10. LAPLACE AND LAVOISIER'S CALORIMETER. MEASUREMENT OF THE HEAT GENERATED IN AN INCANDESCENT ELECTRIC LAMP.
    MS. Maxwell, Chap. iii.
11. BUNSEN'S ICE CALORIMETER. DETERMINATION OF THE SPECIFIC GRAVITY OF ICE.
    MS. Phil. Mag. 1871.
12. FAVRE AND SILBERMANN'S CALORIMETER.
    Deschanel, p. 442.

[1] Glazebrook and Shaw, *Practical Physics*, § 36.

13. MEASUREMENT OF HEAT BY THE METHOD OF MIXTURE. DETERMINATION OF THE LATENT HEAT OF STEAM.
Elementary Course[1], No. 34.
Regnault, Mémoires de l'Académie, T. XXI.

14. MEASUREMENT OF HEAT BY THE METHOD OF COOLING.
Elementary Course[2], No. 35.
B. Stewart, § 232.
Regnault, Ann. de Ch. et Phys. 3 Ser. IX. p. 322.
Dulong, Ann. de Ch. et Phys. X. p. 399.

15. CLÉMENT AND DÉSORMES' EXPERIMENT ON THE RATIO OF THE SPECIFIC HEATS OF GASES.
Masson, Ann. de Ch. et de Phys. 3 Ser. LIII. p. 268.
Dupré, Théor. mécan. de la Chaleur (1869), p. 87.
Maxwell, Chap. xi.
MS.

16. DETERMINATION OF THE SPECIFIC GRAVITY OF A VAPOUR. HOFMANN'S METHOD.
Kohlrausch, p. 50; (edit. 1883), p. 55.

17. DETERMINATION OF THE SPECIFIC GRAVITY OF A VAPOUR. DUMAS' METHOD.
Kohlrausch, p. 45; (edit. 1883), p. 50.

18. DETERMINATION OF THE SPECIFIC GRAVITY OF A VAPOUR. VICTOR MEYER'S METHOD.
Kohlrausch (edit. 1883), p. 56.

19. MEASUREMENT OF THE SATURATION TENSION OF WATER-VAPOUR IN VACUO.
Regnault, Mémoires de l'Académie, XXI. p. 481.

20. MEASUREMENT OF THE SATURATION TENSION OF WATER-VAPOUR IN AIR.
Elementary Course[3], No. 28.
Cam. Phil. Trans. 1883.

21. DEW-POINT MEASUREMENT. VERIFICATION OF REGNAULT'S FORMULA FOR THE WET-AND-DRY-BULB THERMOMETERS.
Regnault, Ann. de Chimie. 3 Ser. T. XIV.
Elementary Course[4], Nos. 29, 30.

22. COMPARISON OF THE CONDUCTIVITIES OF IRON AND COPPER.
MS.

23. EXPERIMENTS ON RADIATION.
B. Stewart, Book II., Chap. i.

[1] *Practical Physics*, § 39.
[2] *Ib.* § 40.
[3] *Ib.* § 42.
[4] *Ib.* §§ 43, 44.

No. 2. JOLLY'S AIR THERMOMETER[1].

In this thermometer the air is kept at a constant volume, the pressure required to keep it at that volume measuring the temperature.

The instrument consists of a glass bulb connected by means of a capillary tube with a vertical glass tube sliding up and down a fixed scale, and connected by means of india-rubber tubing with a second vertical tube sliding in front of a second scale, the divisions of which correspond with those of the first. Let us call the tube bearing the bulb the left-hand, and the other the right-hand tube. Since the india-rubber and glass-tubings are filled with mercury, we increase or decrease the pressure in the bulb, by raising or lowering the right-hand tube, and can therefore keep the air at a constant volume whatever its temperature.

The fiducial mark indicating the constant volume is the point of a small beak of dark coloured glass sealed to the interior of the tube and curving downwards.

The pressure due to the difference of level in the two tubes together with the atmospheric pressure is evidently the pressure of the gas in the bulb, and this by Charles' law is proportional to the temperature measured from $-273°$ C.

The chief differences between Jolly's Thermometer and other instruments working on the same principle consist in increased facilities for reading. Small metal slides are placed on the tubes, which being pushed up until they exactly coincide with the top of the mercury, are more easily seen than the mercury column itself. Another improvement consists in the scales being marked on silvered glass. The reflection of the slide in the glass when exactly covered by the slide itself insures the horizontality of the line of sight and therefore the reading of the

[1] The instrument was supplied by Stollnreuther and Sohn. Munich.