

on each rod, the single ring (Fig. 1) being left in contact with the disc, and a very small amount of paraffin wax is melted round the rings. When the vessel is supported with the rods downwards, as in Fig. 2, the solid wax holds the indexes in position. The arrangement is then placed between the condenser and the focussing lens of the lantern, and boiling water is poured into the brass vessel. When that part of a metal rod, in the neighbourhood of the double ring of the index, reaches the

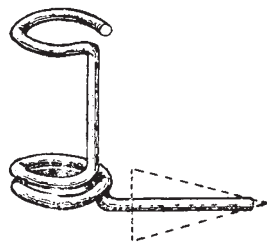


FIG. 1.—Enlarged view of index.

melting temperature of the wax, the index commences to slip downwards, carrying the wax with it, and when the temperatures of the rods have acquired steady values, the indexes will have descended to points on the various rods where the wax just solidifies, and which, therefore, possess equal temperatures. Hence, the conductivities of the various rods are proportional to the squares of the distances from the bottom of the brass vessel to the respective positions indicated by the several arrow-heads.

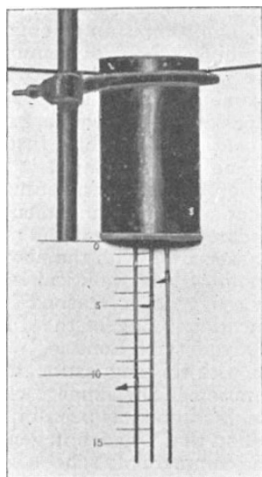


FIG. 2.—Lecture apparatus for demonstrating the relative thermal conductivities of metals. (The left-hand rod is of copper, the middle one of brass, and the right-hand one of soft steel.)

A scale of equal parts, or, better still, a scale of squares, may be drawn on the screen, when the relative conductivities may be directly read off.

In Fig. 2, rods of copper, brass and soft steel are shown with the indexes in the positions acquired at the end of an experiment. It will be seen that the relative conductivities work out to within three or four per cent. of the accepted values for the mean conductivities between 0° and 100° C.

Royal College of Science, July 8. EDWIN EDSER.

### The Electrical Resistance of the Blood.

It is no easy task to measure the electrical resistance of the blood of a living individual. The principal difficulty depends upon the fact that only very small quantities of blood can generally be obtained at a time. During the last five years many attempts have been made by me to obtain trustworthy and consistent results; various methods and forms of apparatus have been employed and subsequently rejected.

The best results were obtained by placing five cubic milli-

metres of freshly-drawn blood between two cup-shaped electrodes three millimetres in diameter, coated with spongy platinum, and fixed at 0.75 mm. apart.

The average resistance of normal blood at 60° F. measured by Kohlrausch's method in this apparatus is 550 ohms. A striking change may be observed in pernicious anæmia, the resistance in this disease being sometimes diminished to about one-half that of normal blood. The deduction is that the blood in pernicious anæmia contains an abnormal amount of salts, due to the destructive metabolism going on.

DAWSON TURNER.

### School Laboratory Plans.

I HAVE long believed that by far the best arrangements of the benches in a laboratory for elementary chemical teaching is the last one suggested by Mr. Richardson, viz. "single benches, cross-ways, like the desks of an ordinary class room."

It must be remembered that qualitative analysis now occupies a secondary place in an elementary course, and a great number of reagents is not required for preparations and simple quantitative experiments. The superstructure of shelving may therefore be replaced by a single rack for the common reagents. This allows perfect supervision from the raised demonstration table in front of the benches, and the work of the class can at any moment be interrupted for explanation or revision of the work done, or for an experiment made by the master himself. It is surely a mistake to divide an elementary course of chemistry into two parts—*theoretical and practical*; the proposed arrangement allows of the practical work forming a part of the general course.

In this county this arrangement has been successfully carried out. The grammar schools are, however, unwilling to risk the refusal of the Science and Art Department to recognise such a laboratory for earning grants, the old-fashioned benches with uncleanly teak tops and rarely used drawers and cupboards being usually insisted on.

T. S. DYMOND.

County Technical Laboratories, Chelmsford.

### The Origin of the Doctrine of Compensation of Errors in the Infinitesimal Calculus.

I SHOULD be much obliged if you could help me by inserting a query on this point.

Lazare Carnot, at the end of his "Reflexions sur la Méthode Physique du Calcul Infinitésimal," stated that "it is singular that in this indispensable condition of elimination the real character of Infinitesimal Quantities . . . should not hitherto have been discovered."

However, Lagrange (see "Œuvres," t. vii. p. 595) had explicitly stated this doctrine many years before. Very possibly Carnot did not see this note, but Lagrange again stated it in the preface of his "Théorie des Fonctions Analytiques," which Carnot had certainly seen, as he quoted some passages from it in the later editions, at least, of his "Reflexions."

If Carnot has any right to an independent discovery, he could hardly have quoted Lagrange in the first edition of his work. The first edition of both Carnot's and Lagrange's works was dated 1797.

I have been unable to find a first edition of "Carnot" here, so write to ask if any one can tell me whether there is any mention or quotation of Lagrange in it.

PHILIP E. B. JOURDAIN.

63 Chesterton Road, Cambridge, June 30.

### Robert Browning and Meteorology.

ROBERT BROWNING'S well-known description of Aurora Borealis, in "Easter Day" (c. xv. xvii), is so graphic that it must have been written from personal observation. Probably few persons can fully appreciate its accuracy; but on September 24, in that wonderful Aurora year 1870, just such a display took place, which I had the fortunate opportunity of watching nearly all night from the Welsh hills, when all the phenomena Browning describes, and many others, were abundantly visible. But I can find no account of any such display having been seen in these latitudes earlier in the century, and "Easter Day" dates from 1850.

The lunar rainbow in "Christmas Eve" (c. iv. and vi.), which "rose at the base with its seven proper colours chorded,"