(5) It is agreed that we shall call the number of pounds or kilograms of inertia in any body its "mass." In other words, we agree in the physical sciences to use "quantity of matter," "quantity of inertia," and "mass" as exact synonyms, understanding that, in the broad sense of the term, we know nothing about the quantity of matter, and that inertia, in its wide sense, denotes merely a quality of matter; namely, a certain "laziness" in stopping and starting.

ABSOLUTE TEMPERATURE.

By K. E. GUTHE,

The University of Michigan.

[The following was written by Dr. Guthe in answer to a question in the department of Science Questions.]

"What is absolute temperature?"

The term "absolute temperature" as used in most text-books is open to criticism. The name implies that temperature measured in the absolute scale should be independent of any particular thermometric substance. There is only one scale which fulfills this requirement, namely the thermodynamic scale of temperature, based upon the efficiency of a reversible steam engine. This efficiency does not depend upon the nature of the working substance, but only upon the temperatures between which the substance works. The "absolute zero" is the temperature to which the working substance must be cooled in a Carnot cycle so that the efficiency of the engine becomes unity, or, so that all heating entering the engine is converted into work.

Absolute temperature is therefore temperature measured by the thermodynamic scale.

This scale agrees for all practical purposes with the indications of the gas scale if we choose a proper zero point.

The temperature which is usually called the absolute zero, but which I prefer to call the "zero point of the gas scale" is that temperature at which hydrogen gas would exert no pressure, supposing that it remain a gas even at the lowest temperatures.

This temperature is easily found from the equation

$$P_t = P_0 (1 + \alpha t)$$

if we place $P_t = 0$.

Frequently the zero point of the gas scale is defined by making use of change of volume of a gas with temperature. But this is contrary to international agreement according to which

the standard thermometer is a constant volume hydrogen thermometer and temperature differences are measured by differences in pressure.

It is difficult to propose a new name for temperatures measured from the zero point of the gas scale. I have been searching for one, but without success. "Hydrogen temperature" is a rather clumsy name and does not express exactly what we want. Here is a chance for a philological genius; until he arises we shall probably continue calling these temperatures absolute temperatures.

The numerical values of a temperature expressed in the absolute and in the hydrogen scale are very nearly the same, differing by less than $0^{\circ}.001$ C. between -50° and $+150^{\circ}$ C. and amount only to $0^{\circ}.044$ C. at $+1,000^{\circ}$ C. However, if we wish to formulate an "exact" definition we must distinguish between them. It is a pity that nature has not supplied us with a perfect gas, for, if this were used as thermometric substance the two temperatures would become identical and no conscientious scruples would arise when we *speak* of absolute temperatures, but *really mean* temperatures measured from the zero point of the gas scale.

A DEVICE FOR SHOWING THE EFFECT UPON E. M. F. AND INTERNAL RESISTANCE OF ARRANGING TWO SIMILAR CELLS IN SERIES AND PARALLEL.

BY LEWIS C. WILLIAMS,

Erasmus Hall High School, Brooklyn, New York City.

To realize nearly ideal conditions a cell is needed whose E. M. F. shall be very constant and whose internal resistance shall be large enough to enable one to neglect the small external resistance offered by the ammeter and its leads but shall be low compared with that of the voltmeter. With the resistance of ammeter and leads amounting to 0.2 Ohm and that of the voltmeter about 1,000 Ohms the best value for the internal resistance of the cell has been found to be from 12 to 15 Ohms. No cell in common use fulfills these conditions.

By the aid of the cut the device is seen to consist of a base-board 7"x9", in the center of which is fixed a brass tube terminating at its upper end in the upper surface of the middle board. This middle board is cut into from both sides providing openings to receive two U tubes 8" long and $\frac{7}{8}$ " in diameter.