THE HEAT OF FUSION OF TIN.

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After observing the results of examinations in heat for a number of years the writer has found that, despite every effort otherwise, students get an idea that water, or ice, is the only substance that possesses a heat of fusion; and the common answer to the question, "What is a heat of fusion," is, "The amount of heat required to melt a gram of ice." It seemed desirable then, to find an experiment which would make clear the fact that every pure, crystalline substance has a heat of fusion. The writer claims no particular originality in the method for the determination of the heat of fusion of tin described below, for it will be found, in various forms, in some of the standard laboratory manuals in physics, but the apparatus is so simple and the results are so gratifying that he feels justified in calling it to the attention of physics teachers at this time.

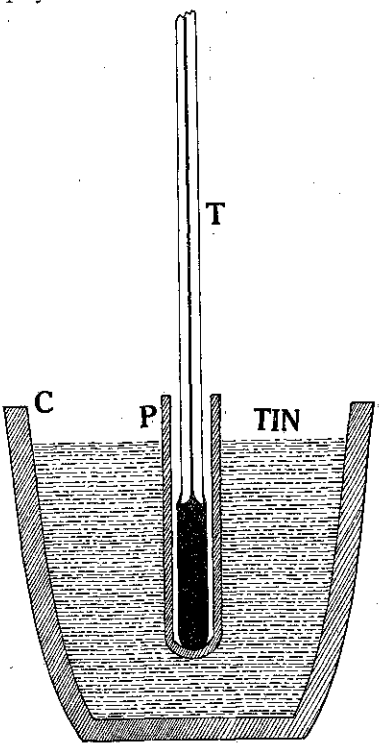

Fig. 1.

The method is essentially a cooling-curve method and consists in heating a quantity of tin to a temperature somewhat above the melting point and then making a time-temperature cooling curve, making readings of the temperature for some little time after the molten tin has solidified.

The necessary apparatus is shown in figure 1, which consists of a No. 000, Dixon Graphite Crucible, C; a 360° C. thermometer, T, which may be purchased from the supply houses for $0.55 each, and these are sufficiently accurate for student work; an iron shield, P, to protect the thermometer when the tin solidifies. This last may be made by boring out the center of a soft iron rod so as to make a thin iron shell closed at one end. The writer's students use a Mèeker Gas burner for melting the tin because this burner gives a very high temperature, but a good Bunsen burner should serve equally well for the melting temperature of tin is only 232° C.

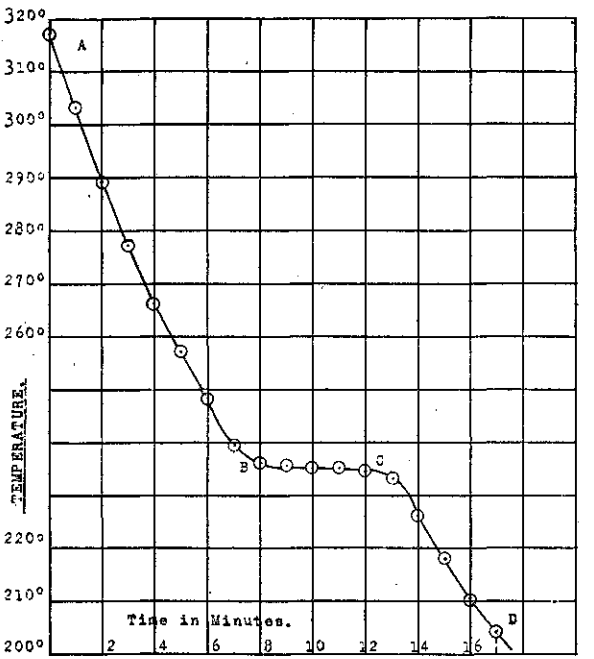

FIG. 2. SHOWING THE COOLING-CURVE FOR TIN.

Figure 2 shows a time-temperature curve taken at random from a student's laboratory report. The method of computing the heat of fusion consists of finding the average rate at which

the crucible and its contents lose heat, both before and after solidification; then the assumption is made that during the time of solidification, or B C, in Figure 2, the process of solidification produces sufficient heat to prevent the lowering of the temperature by radiation, conduction and convection. Knowing the time of solidification, the average heat loss per minute before and after solidification, and the mass of the tin, the heat of fusion may be calculated.

The following data was taken from a student's report.

Wt. of Tin=94 g.	Sp. Ht. of Molten Tin=0.064.
	Sp. Ht. of Solid Tin=0.060.
Wt. of Crucible=115 g.	Sp. Ht. of Crucible=0.200.
Wt. of Iron Shield=16.5 g.	Sp. Ht. of Iron=0.116.

Water Equivalent of the Crucible and Shield=24.91.

Average loss of heat before and after solidification=269.44 Calories per minute.

Time of solidification (from curve)=4.5 minutes.

Heat of Fusion of Tin=12.9 calories.

The presence of the iron protecting shield causes some temperature lag as shown by the rounded corners at the solidification temperature, but this may be prevented to a certain degree by introducing some mercury in the thermometer shield thereby insuring a little higher rate of heat flow to the thermometer.

The most obvious points of interest to the student are:

1. The measurement of temperatures above the boiling point of water.
2. The sharp, definite melting point of a pure, crystalline substance.
3. The heat of fusion of a metal.
4. The calculation of the heat lost as a body cools freely in the air.
5. The determination of a "heat quantity" without resorting to the "time-honored" method of mixtures.

The writer is well aware of the fact that the method described has errors which would prohibit its adoption in careful research work, yet it has proved to be an experiment of considerable interest and profit to his students—which is alone the justification for this discription.