Specific Heat and Latent Heat.

Although the specific and latent heats of nearly every form of matter have been made the subjects of the most careful investigation by physicists, we fear that few practical men fully appreciate these two factors. They are apt to look upon such tables as they do upon tables that show the distances of the heavenly bodies. They know full well that these figures are the results of tedious labor and untiring patience, but they feel that they have no practical bearing upon their own work.

The melting point of metals and alloys, the specific gravity of solids and liquids, are factors of such importance to mechanics and inventors, to buyers and sellers, to manufacturers and consumers, to founders and designers, that tables of fusibility and density find their place in all handbooks and calendars, but rarely are the two other "constants of nature" placed therein. The heat of combustion receives recognition in the case of fuels, and men begin to talk more or less intelligently of "calorific intensity." Yet fusibility depends on the latent heat of fusion as well as on the temperature at which it melts. It is already pretty well known that the fuel consumed in boiling a liquid depends on the latent heat of the vapor; but that the *quantity* of heat required to heat a bar of iron red hot is any different from that necessary to heat a bar of copper to the same temperature, has probably escaped the serious attention of many an intelligent mechanic, and to those who have observed it the reason has not been quite evident.

The definition of specific heat given in our text-books is not one calculated to enlighten the common mind, or the treatment of the subject such as to interest the average reader. Knowing as we do that our readers are possessed of more than average intelligence, we have little fear of being able to make the subject of "specific heat" as clear as that of latent heat, or of the "heat of combustion." In any case our first care must be to explain, if we can, the difference between heat and temperature. Heat was formerly spoken of as "imponderable matter," because it could not be weighed. The world moves on, and we know that heat is not matter at all, but it can be measured like any other force, only the measure required is neither the imperial gallon nor the common yard stick. It is because we had to invent a new measure, which has not yet become familiar to all, that makes the measurement of heat seem difficult, if not utterly incomprehensible. Even a child notices that one thing feels hot and another cold, that what is cold to-day may be hot to-morrow, that boiling water feels quite different from ice. that a summer day is unlike a winter day, and that substances which have been near a fire feel warmer than those which have not. At first it was sufficient to call one day hot, another very hot, and a third warm, and a fourth quite warm, and so on. But some days the sun would pour down such a flood of heat that suffering humanity felt that the term "very hot" was not equal to the occasion, so they strung on a series of adjectives, such as "excessively hot," "awfully hot," etc., not forgetting the d——d hot. As these terms did not convey the same idea to different people, some measure was sought. It was known that liquids and gases expand when heated, and it was decided to use the expansion of mercury to measure the increase or decrease of heat. The thermometer does this; it goes up as it gets hotter, and down as it gets cooler. It gives no idea of *how much* heat there is in a substance, but only tells which of two bodies is the warmer. In ice water the mercury sinks to a certain point, in boiling water it rises to a given point. In our common thermometers these points are marked 32 and 212 respectively, the space between being divided into 180 equal parts. These parts are called arbitrary, but they are no more arbitrary than a pint or pound; neither have any existence in nature, as day and year have. If we cool a thermometer in snow and salt it goes down to its zero, marked 0, but by cooling it still more it goes still lower, showing that 0 does not indicate a point where there is *no heat* at all. Alcohol thermometers have been cooled to 100° below zero, and we have no reason to think that that is the limit of possibility. A substance that has a temperature of 100° is not twice as hot as one at 50°. A thermometer measures temperature, it does not measure heat; it is relative, not absolute.

One pound of boiling water will melt a given weight of ice, two pounds will melt twice as much ice; hence there must be twice as much *heat* in two pounds of water as there was in one pound, although the temperature is the same. There is more heat in a pound of water at 100° than in a pound at 50°, but how much more we do not know. There is more heat in a pound of water at 33° than in the same quantity of water at 32°. Although we have but little idea of how much that really is, we can take it for our unit and measure others by it. We could take a pound of water at 32° and put it over a gas flame, and see how much gas it would take to heat it to 33°, and this quantity of gas would give us a unit of heat. We should find it would take ten times as much gas to raise it from 32° to 42°, as to 33°, and we could call this 10 units of heat. But gas differs, burners differ, and there is a loss of heat, so it might take more *gas* at one time than another, but it does not take more heat, so it is conducive to accuracy to speak of units of heat, in preference to feet of gas, but perhaps our explanation will be clearer if we adhere to the gas method.

A cubic foot of gas may be burned so as to heat ten pounds of water 100°. The same quantity of gas will heat ten pounds of nickel ten times as many degrees. In other words, it only takes one-tenth as much gas to heat a pound of nickel from 35° to 45° as it would to heat a pound of water from 35° to 45°. Tin and antimony require but half as much heat (or we consume but half as much gas in heating them), say from 35° to 45°, as for nickel, while lead and platinum take less than one-third.

Space forbids our entering upon the practical application of these facts. A hint will suggest others. It is well known that all metals must be heated to the same temperature before they give out light. In other words, a bar of iron when red-hot has the same temperature as a bar of red-hot nickel or silver, about 1,000° Fahr. Supposing a mechanic enters his workshop on a cold morning when the temperature is at 40°. All his tools have that temperature. Suppose he picks up a bar of nickel and attempts to heat it red-hot. It must receive a certain very definite *quantity* of heat to effect this change of temperature. A bar of silver of the same shape and weight (it would differ a little in size) would require 53 per cent as much heat, and hence consume 53 per cent as much fuel, an item of some little importance when gas is used as fuel. Iron requires about 5 per cent more fuel than nickel, while copper takes 12 per cent less. A soldering copper, weighing 2 lbs., can be heated to the melting point of tin with the consumption of about 35 per cent less fuel than a block of iron of the same weight, if all the heat is utilized. Is not this a subject that is of more than theoretical interest? Can the practical man afford to neglect to take specific heat into his calculations?

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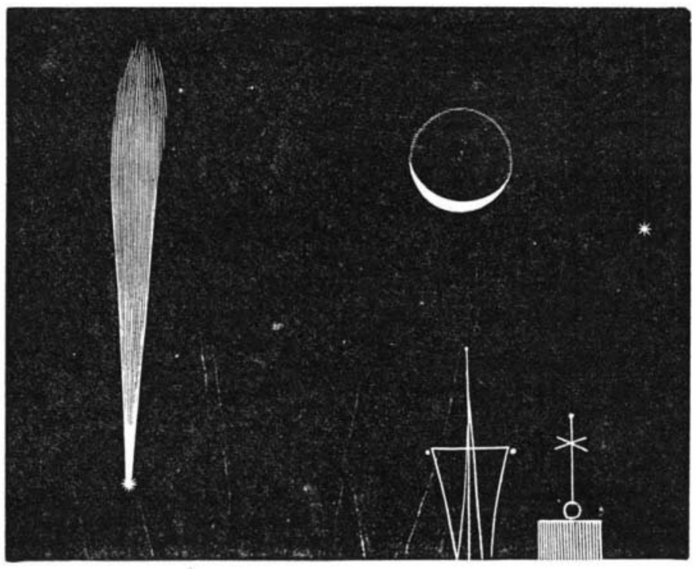
THE WELLS COMET, AS SEEN IN SYDNEY.

Concerning this visitor, Mr. Russell, the government astronomer, at Sydney, Australia, says: "The comet has lost much of the brilliancy it had when I first saw it on the 15th of June, but the tail has extended enormously. On the 19th it could be traced distinctly for 20 degrees upward, and with a slight curve to south; at its widest part it was fully 2 degrees. This evening (June 20) the comet is altogether much fainter, partly because of the moonlight, and partly because it is receding from the earth and the sun. I endeavored to get a determination of the spectrum, but could only make out a faint continuous spectrum and three bright bands, probably the usual comet spectrum, which is almost exactly the same as that of coal gas. Owing to the moonlight and faintness of the comet through haze, I could not get complete measures of the spectrum. It is satisfactory, so far, that the comet is simply composed of gas; how attenuated it must be will be obvious from the fact that on June 18 the nucleus passed close to two small stars, so that the tail passed between us and them, and I could not detect any difference in the light of the star when seen through the comet's tail or without any intervening cometary matter. The comet will probably be visible with a telescope until September; but, although it is a very fine comet, it has not attained the magnificence that the early observers anticipated. Like the great comet of 1880–1843, its perihelion is made very close to the sun, and a much finer display was expected than has been made, and it must now decrease is brilliance, although the tail may get longer. The comet was discovered on March 18, by Mr. Wells, Albany, New York.



THE WELLS COMET, AS SEEN AT SYDNEY AUSTRALIA.

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The Loss of Heat in Combustion.

In a note on the heat of combustion of hydrocarbons, published in the *Journal* of the Russian Chemical and Physical Society, Professor Mendeleeff shows that in previous determinations of the combustion heat of hydrocarbon compounds the correction due to the physical and chemical changes which accompany chemical reactions has been neglected. Thus, in burning fuel to carbonic acid, and passing this through incandescent carbon, there is obtained the reaction $CO_2 + C = CO + CO$, which shows that out of two volumes of carbonic acid we get four volumes of carbonic oxide; but this action is attended by an absorption of heat. The same result is obtained when water is passed through heated carbon, and $CO + H_2$ is produced. Therefore the professor says that in using calorimetric data of chemical reactions—*i.e.*, the records of the actual quantity of heat set free in the process of combustion, as measured by any form of calorimeter, these data should be cleared of the influence of the physical and mechanical processes which accompany the reaction. This is equivalent to stating that a certain proportion of the calorific intensity of combustion is not available for measurement in a calorimeter, or otherwise for actual duty, because it is absorbed in internal work. The correction is similar to that made when bodies are weighed in air, in the course of careful determinations of specific gravity. Another correction which should be made is that due to the change of volume, which, as in the case of $CO_2 + C = 2 CO$, is a consideration quite apart from the production of the change of composition. The effect of these corrections, so far as they can be made in the present imperfect knowledge of the heat of combustion, has been to reduce and otherwise modify the data applicable to twenty different hydrocarbons.

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The Grape Worm.

What a host of enemies beset the grape vine! Root, stem, bud, leaf, tendril, blossom, fruit, and even the seeds, are each subject to the attacks of one or several insects. These, as a general thing, attack the vine before the fruit is ripe, and if, after all, the fruit matures, the wasps and the birds are ready to claim their share. Notwithstanding all this, we manage to have grapes, and in plenty, so bountiful is the vine, and so abundantly does it repay a little care in protecting it from its enemies. It is within a comparatively few years that the Western vineyardists found they had an insect which served their grapes much in the same manner that the codling moth does the apples; the caterpillar or "worm," living within the green fruit, and destroying it. It has on this account been called the "grape codling," but is more generally known as the grape berry moth. Thinking it to be a new species, Professor Packard named it *Penthina vitivorana;* but later observations show that it is most probably identical with a European insect, in which case *Lobesia botrana* will be the accepted scientific name.

When the grapes are examined early in July, a small spot will be found where the worm entered. If a grape thus marked is opened, there will be found within a small white caterpillar, with a cinnamon-colored head, which feeds upon the pulp of the berry, and usually eats out the contents of the seeds. If one grape is not enough, it fastens the remains of that to a sound one, by means of silken threads, and makes its way into the second berry. The result is that the berries thus attacked shrivel and die.

The worm is very active, and when the fruit is disturbed it will wriggle out of it, and let itself down by its silken thread. At maturity it is olive-green or dark brown, with a honey-yellow head, and it then leaves the ruined grape to seek a place on the leaves of the vine, where it forms its cocoon. Having selected a spot, it spins a covering of silk over it, and then cuts out an oval flap, which is attached on one side, as if hinged; this flap is rolled over, its free edge fastened to the leaf, thus forming a shelter, within which it in two days turns to a chrysalis. The cocoon is sometimes made by cutting two pieces and joining them together in the middle.

In about ten days the moth appears; it is of a slaty-brown color, with pale buff markings. There are two, if not three broods, the pupæ of the last brood passing the winter in the cocoons.

The insect has been especially destructive in Ohio, where one year it destroyed, so says the *American Agriculturist*, about half the grapes in the vineyards on the lake-shore; it is also abundant in Illinois and Missouri, attacking in preference the grapes with the most tender skins. As the last broods pass their winter in their cocoons on the leaves, it is evident that raking up and burning the fallen leaves will do much to diminish this pest. The habit of the worm of leaving the berry when alarmed, and suspending itself by a thread, may be turned to good account in capturing this insect where the number is not large.

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Comparative Weight and Yield of Eggs.

A correspondent of the *Country Gentleman* gives the standard yield and weight of eggs for the different varieties of domestic fowl as follows:

Light Brahmas and partridge Cochins, eggs 7 to the pound; they lay, according to treatment and keeping, from 80 to 100 per annum, oftentimes more if kept well. Dark Brahmas, 8 to the pound, and about 70 per annum. Black, white, and buff Cochins, 8 to the pound; 100 is a large yield per annum. Plymouth Rocks, 8 to the pound, lay 100 per annum. Houdans, 8 to the pound, lay 150 per annum; non-sitters. La Fleche, 7 to the pound, lay 130 per annum; non-sitters. Black Spanish, 7 to the pound, lay 150 per annum. Dominiques, 9 to the pound, lay 130 per annum. Games, 9 to the pound, lay 130 per annum. Crevecœurs, 7 to the pound, lay 150 per annum. Leghorns, 9 to the pound, lay from 150 to 200 per annum. Hamburgs, 9 to the pound, lay 170 per annum. Polish, 9 to the pound, lay 150 per annum. Bantams, 16 to the pound, lay 60 per annum. Turkeys, eggs 5 to the pound, lay from 30 to 60 per annum. Ducks, eggs vary greatly with different species, but from 5 to 6 to the pound, and from 14 to 28 per annum, according to age and keeping. Geese, 4 to the pound, lay 20 per annum. Guineas, 11 to the pound, lay 60 per annum.