XII. *On a Re-arrangement of the Molecules of a Body after Solidification.* *By* ROBERT WARINGTON, *Esq.*

Read January 4, 1842.

HAVING occasion lately to prepare some alloys of lead for the purpose of lecture illustration, I was much surprised at an alteration taking place in the arrangement of the particles of one of these alloys, as shown by the appearance of the surfaces of fracture after the metal had assumed the solid form. The alloy experimented on was that known as Newton's fusible metal, composed of 8 parts of bismuth, 5 of lead, and 3 of tin. On pouring this alloy in the melted state on a marble slab, and breaking it as soon as solid, and when it may be readily handled, the exposed surfaces were found to exhibit a bright, smooth, or conchoidal metallic appearance, of a tin-white lustre; and the act of disjunction at one part will, frequently, cause the whole to fly into a number of fragments analogous to the breaking a piece of unannealed glass.

The metal after this becomes so hot as to burn the fingers if taken up and when this evolution of heat has ceased the alloy will be found to have entirely altered its characters, having lost its extreme brittleness, requiring to be bent to and fro several times before it will break, and presenting on fracture a fine granular or crystalline surface of a dark colour and dull earthy aspect. Similar phænomena accompany the casting of the fusible alloy of H. Rose, composed of 2 parts of bismuth, 1 of lead, and 1 of tin.

The fact of the evolution of heat from the alloy of Newton, and its cause, are thus noticed by Berzelius in his *Traité de Chimie*. "If this alloy is plunged into cold water and quickly withdrawn and taken in the hand, it becomes sufficiently hot after a few moments to burn the fingers. The cause of this phænomenon is, that during the solidification and crystallization of the *internal parts* the latent heat of these is set free and communicates itself to the surface before the fixing and cooling." The alteration in the internal arrangement of the particles, as proved by the surfaces of fracture, is not however noticed, and the explanation is defective, as it supposes the interior not to have assumed the solid state until the evolution of the heat occurs. If such were the case it would be seen on breaking it in the first instance. The phænomena can only be accounted for by admitting a certain degree of mobility among the particles, and that a second molecular arrangement takes place after the metal has solidified; this may arise from their not having assumed in the first state that direction in which their cohesion was the strongest.

That a very marked and extraordinary alteration in the characters and properties of various substances arises entirely from this change in the position of their component particles, effected either by the communication or abstraction of heat after solidification, there can be no doubt. And these changes are applied to many very important purposes in the arts and manufactures; such as the hardening and tempering of steel, the rolling of commercial zinc, and rendering that metal permanently malleable, the annealing of glass, and a variety of other uses, particularly in crystallization, which might be adduced.

The following experiments were made to ascertain to what extent the emission of latent heat takes place. The melted alloy was poured in a perfectly fluid state on the bulb of a thermometer placed in a small platinum crucible, having a capacity equal to about 70 grain measures of water, and standing in a vessel of cold water or mercury. The thermometer surrounded by the solidified metal and crucible was removed from the cooling medium before it had reached its stationary point, and the greatest decrease of temperature noted. The heat then rose rapidly again, and the maximum effect was registered. The fusing point of the alloy was 202° Fahr.: the following results were obtained:—

Exper.		Fahr.		Fahr.	Diff. Fahr.
1.	thermometer fell to	97°	and then rose to	157°	60°
2.	... ...	94	... ...	149	55
3.	... ...	90	... ...	150	60
4.	... ...	87	... ...	147	60
5.	... ...	104	... ...	156	52
6.	... ...	97	... ...	148	51
7.	... ...	92	... ...	152	60
8.	... ...	104	... ...	155	51

So that in four out of the eight trials a difference of 60° Fahr. was rendered apparent.

In a platinum crucible of larger size the effects were not so marked, 34° Fahr. being the greatest difference obtained; this of course would arise from the greater bulk of the melted metal not exposing comparatively so large a surface to the cooling medium.