and although the same heat that produced the ebullition be still continually applied, and although we know that this heat must be continually entering into the water, still it is not detected, or in any way exhibited by the thermo meter. On this account, the heat given to water during ebullition is said to become *latent,* or lie hid from the thermometer ; and, indeed, the thermometer merely indicates the intensity of heat, the calorimeter alone can measure its quantity. The quantity of heat given out to water after it has begun to boil, is more than fivefold that which is sufficient to bring it from the freezing up to the boiling point ; for, if we continue the fire with the same intensity that was used in bringing it to boil, it will require more than fivefold that duration and quantity of fuel to boil all the water away, or convert it all into steam of 212° of heat. Thus the sensible heat, added from 32°, will be 180°, and that latent in the steam is more than fivefiold ; or, in other words, the *insensible caloric* in steam is five fold its *sensible* heat ; or the same quantity of matter in the condition of steam at 212°, and of water at 212o, will hold different quantities of caloric, in the proportion of about 6 to 1. This is called the greater *capacity of steam for caloric* than of water for that substance ; and it is in part accounted for, by the greater distances of the particles of the matter of steam and water from each other in the former than the latter condition ; for when the distances of the particles are increased 12 times, the spheres of caloric around each atom may be much larger, without increased elasticity of the calorific fluid. Dr Black was the discoverer of the admirable doctrine of *latent heat.*

13. Dr Dalton has thus illustrated the doctrine of latent heat, and of the increased capacity of a liquid for holding caloric, when it passes into the condition of vapour. The liquid and its vapour may be considered as two reservoirs of caloric, capable of holding different quantities of that fluid. Let figure 1. represent to us such an arrangement ; the internal cylinder of smaller capa city, the external one of enlarged capacity surrounding and ex tending far above it, and a small open tube of glass, communicating freely at the bottom with the inside of the cylinders. Let us now conceive water to be poured into the internal cylinder, the water will manifestly flow into the slender tube till it stand on the same level in the tube as in the cylinder. If any additional quantity be now poured into the internal cylinder, the rise of water in the slender glass tube will serve as an index of the quantity of added fluid ; and when it is filled to the top, the fluid will stand at the height marked 212°, and will still be a correct index of the addition of fluid. But if more water be now added to it, it will not make its appearance in the slender tube, but will simply overflow from the internal cylinder over into that of enlarged capacity, so that, while a large quantity is passing into the vessel and gradually filling it up to 212°, no additional rise takes place until the whole of the outer cylinder become filled to that point, after which any further addition will again become sensible, by a corresponding rise in the tube. This pro­cess is in precise analogy to the succession of circumstances in heating a liquid, and converting it into steam. The internal cylinder represents the liquid, the external one the vapour of greater capacity, and the slender glass tube at the side the thermometer placed in communication with

them. When heat flows into the liquid, it passes equally into the thermometer ; and each increment of the one produces an equal increment in the other, until the liquid reaches the limit of its capacity, when it suddenly begins to enlarge its bulk and take the form of steam ; but the quantity of heat required to fill up this enlarged capacity is so great as to require about 5½ times as much to fill it as was contained in the whole liquid before, so that all this time the thermometer is standing still, and it is not until the whole of the steam is thus supplied with 212° of caloric, that the thermometer will begin to show any further elevation ; after which, any increment of heat thrown into the steam will make its appearance on the thermometer, and proceed as formerly, by simultaneous increments.

14. It appears, therefore, that the cause why water boiling under the open air does not reach a higher temperature than 212°, is, that the steam which is raised by any additional heat, carries that additional quantity of heat along with it into the air. But here a question occurs at once to the enquirer into these phenomena, viz. Why does water require to be heated up to 212° before it will throw off its increments of heat and vapour into the air ? Why does not steam rise equally strongly from water at 200° or 180° ? The categorical reply is, that the elastic force of the heat is not sufficient to enable the steam to force its way against the pressure of the air until it reaches this point. In order to understand the means by which we arrive at this conclusion, it is necessary to know that, when the pressure of air on the surface of the water is artificially diminished, the steam does actually rise, and the water bubbles and boils with great violence, at temperatures far below 212°. It is only when the surface of the water is exposed to the full *pressure Of the air* in a common vessel that it is prevented from rising in vapour, at temperatures Iower than the usual boiling point. If the surface **of** the hot water be protected from the pressure of the air, by being placed under a glass shade, and the air removed from the inside of it by an air-pump, the water may be made to boil at all temperatures below 212°. The following table contains the results of a series of experiments made, with great care, by Dr Dalton, towards the end of last century, in order to ascertain how much of the whole pressure of the air it was necessary to remove, in order to make water boil at a given temperature. In order to understand the

way in which this

table was form

ed, the reader

must conceive a

vessel of water

first of all boiling

at 212° in the

open air, as the

vessel A in figure

2, the thermo

meter I being

placed in it.

After allowing

the water to cool

to 200°, let the

vessel of water

and the im

merged thermo

meter be now

placed on the

plate stand P of an air-pump, and covered over with a strong glass receiver R ; and let a portion of the enclosed air he now withdrawn by the pump from the inside of the receiver by the pipe F ; and suppose that there are in all 30 cubical inches, or other volumes, of air in the receiver at first, then the water being at 200°, when about 7