XXXI. *On the Means of producing a double Distillation by the same heat.* *By* Smithson Tennant, *Esq. F. R. S.*

Read June 30, 1814.

It was first made known by the experiments of Dr. Black, and has since been confirmed by those of Mr. Watt and other philosophers, that the quantity of heat required for raising the temperature of water from fifty degrees to that of the boiling point, is only about a sixth of that which is afterwards required for converting the boiling water into steam. As the steam itself is not hotter than the boiling water, the heat which it had absorbed was said by Dr. Black to be latent; being merely employed in supporting the aerial state which the water had assumed. Whenever this steam is condensed, the heat which was latent again reappears, and in such considerable quantity, that it has been found convenient for various purposes to employ the condensation of steam for heating other bodies.

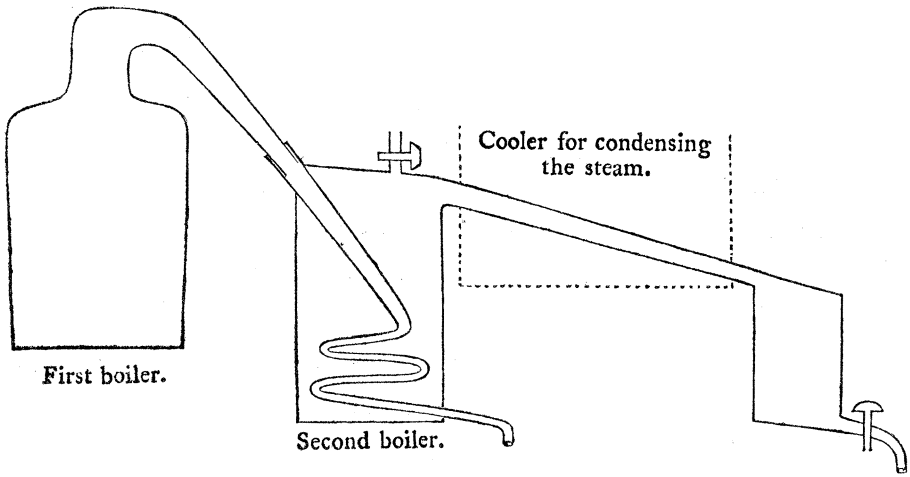
But though water may by this means be brought to the boiling point, it can not be raised above it, and therefore cannot be converted into vapour, so as to pass over by distillation. As soon as the steam has imparted to the water its own temperature, there is no longer any transfer of heat, and the steam passes through the water uncondensed.

If, on the contrary, the steam did continue to condense, then the water would itself be converted into steam, and might by

that means be distilled over without any additional fire; and though this does not take place under the usual circumstances, yet it may be effected in the following manner.

The temperature required for converting any fluid into vapour is dependent on the pressure of the air upon its surface, and may therefore be lowered if that pressure is diminished. If then the weight of the air was removed from water, it would rise into vapour below the common boiling point, and might therefore be distilled over by steam of the usual heat.

In order to produce this effect, a vessel having a receiver connected with it should be made air tight, and the steam made to pass through the vessel along a worm or spiral tube of metal, in the manner represented in the annexed outline.



The vacuum is now easily produced by applying heat to the vessel till the steam issues from the opening in it, and in the receiver, when they are to be immediately closed, and the heat removed.

The water distilled over is collected in the receiver, which is kept cool for that purpose.

An apparatus of this kind I had constructed chiefly for the purpose of explaining the theory of latent heat, or of the capacity of bodies for heat in different states; but it is possible that it may also be of some further practical utility, whenever it is of consequence to economise the consumption of fuel. When water is deficient on board of ship, it has been in some degree supplied by distillation from the ship's boiler, and if the steam from the boiler had been made to pass through the apparatus just described, the quantity would be nearly doubled.

By an experiment which I had made some time ago, about three fourths of the quantity obtained by the first distillation were added by the second. But I believe a larger proportion may be procured when the second distilling vessel is duly coated with flannel, or some light substance, to retain the heat.

Though salt water does not boil at so low a degree of heat as fresh water, yet upon trial with sea water the difference was found to be quite insignificant, compared with that of the steam formed under the usual pressure, and *in vacuo;* and did not sensibly affect the result of the process. The only doubt as to the propriety of taking such a vessel to sea, would arise from the degree of danger which there is of experiencing a want of fresh water. This probably, I apprehend, is not great; but on the other hand, there is the important object of saving the lives of the people in the ship, whenever such deficiency is experienced.