reflected, none of it can be transmitted to him. The richer colours transmitted by thinner strata of vapour are thus noticed by M Leopold Nobili of Reggio. “ The tints exhibited by the clouds in every variety of aspect are al most all comprised in Sir Isaac Newton’s first ring (the white, yellow, orange, red ; or the blood, tawny, copper, ochre, and fire red, and vialaceous red, or No. 1—12 of Mr Nobili’s scale). Tints of this kind do not arise from refraction and diffraction, they are produced only *by means of thin plates.* Now the measurements of Sir Isaac New ton have shown what are the dimensions of the layers of air, of water, and of glass, which produce the colours of the several rings ; and, as we know that the vesicular vapours are formed of water, and that they do not reflect or transmit any other tint, we may conclude that their external film is in no case thicker than ten millionth parts of an inch. This result appears to me to be so decidedly certain as to be entitled to a place in science.” It was to the effect of thin plates on light that Newton referred the colours of all bodies ; and the accounting for the rich golden hues of the clouds, and the fiery red colour of light passing through dispersed steam, by the effect of the thin plates of water enclosing the vapoury spheroids of pure steam, must be regarded as one of the most satisfactory applications of his theory. (See article Optics.)

5. A very singular phenomenon takes place, if the flame of a candle or lamp be held below a jet of steam, as it issues from the mouth of a small pipe ; the steam instantly ceases to be visible. In this case, one of two changes may be conceived to take place, either or both of which account for the permanent invisibility of the vapour : the intense heat of the flame may disperse the particles to such a distance, that there does not remain in a given space a sufficient number to form a vesicle of vapour, and it therefore remains diffused in combination with the air, which always holds a large quantity of invisible vapour, especially at high temperatures ; or the vapour may be decomposed by the flame into the permanent and invisible gnses, of which it consists, which may again become combined, to a certain extent, with the burning substance, and support the flame.

6. \*When steam is produced, the water gradually wastes in the teakettle, and will soon be totally expended if we continue it on the fire. It is reasonable, therefore, to suppose that this steam is nothing but water, changed by heat into an aerial or elastic form. If so, we should expect that the privation of this heat would leave it in the form of water again. Accordingly, this is fully verified by experiment ; for, if the pipe fitted to the teakettle be surrounded with ice, or any cold substance, no steam will issue, but water will continually trickle from it in drops : and if the process be conducted with the proper precautions, the water which we thus obtain from the pipe will be found equal in quantity to that which disappears from the teakettle. Steam is therefore the matter of water, converted by heat into an elastic vapour.

7. Steam, water, and ice, are three conditions of the same substance, which it assumes under different circum stances of heat and of external pressure. In each condition it obeys different laws ; as a solid, ice obeys the laws of the mechanics of solid bodies : in Russia it is quarried Iike rock, and is used for building houses and paving ways ; it is cast into moulds for domestic purposes, like iron or lead ; it is painted like alabaster, and chiselled like marble : ns a liquid, water is the exemplar of the hydrostatical laws of all fluids : as a vapour, it obeys the laws of aerostatics ; and we now know that steam is, in all respects, similar in its constitution and phenomena to all other elastic fluids or gases. If we apply heat to a bar of extremely cold ice, it expands like other solids with heat, gradually elongating with its increased temperature, its particles receding

from one another by the repulsive action induced between the particles by the entrance of caloric between them, the cohesion of the particles becoming less and less, until at last, if the heat be continually thrown in, the cohesion of the particles is altogether overcome, they lose their aggregation, they become separable without effort, and, falling to pieces, the bar of ice loses its form and subsides into water. When thus melted, the water being placed in a vessel, and having heat applied to it, will, like other fluids, continue to expand from its point of greatest den sity, and will increase in bulk nearly one-twentieth by about 172°, but at last the entrance of so large a quantity of heat will produce a repulsive force between the particles so strong as to cause them suddenly to spring apart from one another, so as to recede to a distance twelve times as far asunder as in the state of water, and they have now assumed the aerial condition of gas or vapour, and constituting steam, occupy 1728 times their original space. The ice passing into the condition of water, is said to be *liquefied,* and the heat necessary to convert ice into water is called the *caloric of liquidity of ice,* or the *caloric of condition of water ;* when water is con verted into steam, the quantity of caloric necessary for this purpose is called the *caloric of vaporization of water,* or the *caloric Of elasticity of steam,* and the water is then said to *boil* or *evaporate.* This process may be reversed. If the steam have been collected in a close receptacle, it may be squeezed by external compression into its original bulk, or by cooling the outside so as to withdraw the caloric of elasticity from between the particles, they may be allowed to come together by the at traction of cohesion, and resuming their original proximity to each other, appear once more in their former condition of water, and in this case the *vapour* is said to be *condensed ;* and if the process of abstraction of caloric, with sufficient pressure, be continued, the liquid particles approaching each other, will gradually contract the bulk of the mass, and at a certain point will take again the original character of ice, and the *liquid* is then said to be *congealed* or *frozen.* The same particles of matter do “ thus in turn play many parts.”

Ice melts and becomes water by increment of heat. Water evaporates into steam by increment of heat. Steam is condensed into water by decrement of heat. Water congeals into ice by decrement of heat.

(8.) These phenomena are not confined to one sub

stance : many substances, apparently the most refractory, have been melted and again congealed, while other sub stances which had never been observed in any other form than that of transparent air or invisible gas, have been condensed by the expedients of modern artifice into liquids heavier than water, and have even been congealed into hard and strong solids. To so great an extent has this taken place, that we are now almost warranted in deducing, from a wide induction of facts, the following generalization ; that all bodies assume the solid, liquid, or gaseous condition, according to the accidents of temperature and pressure under which they happen to be placed ; and that it is merely from the circumstance of their being more ordinarily found, at the present temperature of the earth and under the weight of our present atmosphere, in one of these states rather than another, that some substances have been characterised and distinguished, and classed as permanent solids, liquids, or airs. We now speak of ice only as frozen water ; but had we lived under a temperature such as that which the inhabitants of the planet Jupiter, at their distance from the sun, may be conceived to endure, we should have spoken of swallowing *melted ice* as we now speak of molten lead, and a separate name for melted ice would have remained unknown ; or, if we conceive, in like manner, our air to be withdrawn, and the