an amount of latent heat not much greater than its original proportion of sensible heat, or 212°. In this case, we should have steam as heavy as water and as hot as flame.

If, on the contrary, this process were reversed, and the steam produced at 212° under the pressure of an atmo sphere permitted to expand in vacuo to double its bulk, a portion of the sensible heat would become absorbed into the spheres of caloric around the atoms of water, increasing the latent heat by 32°, and diminishing the sensible heat to 180°. The bulk being again doubled, and the steam expanded to four times its original bulk, the temperature would sink to 150°, and three more repetitions of the *ex­pansion* would give a vapour of 71° temperature, and 1141° of latent heat.

This expansion and contraction of the steam, accompanied by diminished temperature, is exactly what would exist if our atmosphere, instead of oxygen and nitrogen, were wholly composed of vapour of water. Suppose the temperature of the ocean to be 1000 , an atmosphere of vapour would be raised of 2000 times the weight of the present atmosphere : the under part of this atmosphere, compressed by the superincumbent weight, would be of great density, but in ascending, the diminished pressure would be attended with diminished temperature, until at last a cloud of white ice would be seen floating on the surface. Must not the sun, from his intense heat, be a body of this nature, having an atmosphere of enormous depth, on the summit of which the beautifully crystalline and sparkling crust is continually preserved by its diminish­ed temperature in a state of renewed whiteness ?

62. The specific gravity, density, and volume occupied by steam at different temperatures, have been correctly determined by experiment ; and it has been ascertained that the expansion of vapour follows the law of the expansion of other gases by heat ; viz., the law of Dalton and Gay Lussac, that all gases expand from 1. to 1.375 in bulk, by 180° of temperature, or 1/480 for each degree of Fahrenheit; and, secondly, that steam obeys the law of Boyle and Mariotte, contracting in volume proportionally to pressure. It is first of all necessary to know what bulk a given quantity of water converted into steam will occupy at a given pressure, and the application of these laws will determine the specific gravity, density, and volume at all other pressures and temperatures.

63. The experiments of Gay Lussac upon this subject are simple, elegant, and satisfactory. His apparatus is as follows :—A chauffer, F, contains burning fuel, by which heat is communicated to B C, a bath of mercury. A spherule A, of thin glass, hermetically closed, contains a given weight of water. G is a glass tube of considerable diameter, filled with pure dry mercury, and inserted in the bath, after which the spherule, A, containing the water, is allowed to ascend to the top of the mercury, and is then broken by concussion, so that a given quantity of water is thus placed in the Torricellian vacuum at the top of the mercury. By the fuel in F heat is then communicated upwards, by the fluids, to the whole apparatus, and to the water in the summit of the tube G; and the mercury descends until the whole of the water is converted into steam, after which it ceases to descend in the same rapid proportion to the increase of tempera ture. This change shows that the whole of the water is evaporated, and the heat must again be allowed gradually to diminish, until the depression of the mercury corresponds to the temperature indicated in our table of Elastic

Force. The capacity of the tube, G, is shown by divisions on its surface previously fixed, and the height of the mercurial column by a graduated rule and vernier *r* r, supported on the edge of the bath. The thermometers, A *h,* indicate the temperature of the fluids.

By means of this apparatus, Gay Lussac has determined the specific gravity of steam, to be .625, air being 1000.; that is to say, steam from boiling water is lighter than common air in the proportion of 5. to 8.

64. Dr Dalton’s recent experiments make the weight of a cubic foot of air at 60° = 535.68 grains ; therefore a cubic foot of common steam weighs 334.8 grains at 60°, under a pressure of 30 inches of mercury; but as this pressure would convert it into water, the true weight will be found, by the law of Mariotte, thus :

30 in. : .065 : : 334.8 : 7254

the true weight, in grains, of a cubic foot of steam at, 60°, and under the former pressure due to its own elasticity in vacuo ; but if we wish to know the weight of a cubic foot of steam at 212°, we must use the Iaw of Gay Lussac and Dalton, thus :

(212°-60°) or 152°/480 + 1 : 1 : : 334.8 : 254.3

254.3 grains is, therefore, the weight of a cubic foot of steam, as it passes off from water boiling in the air at 212°.

But the weight of one cubic inch of water at 60° is 253 grains ; therefore, the weight of a cubic inch of water at 60° is almost exactly equal to one cubic foot, or 1728 cubic inches, of steam.

Hence we find, that the particles of water, when they form steam, are so much repelled by their spheres of ca 1oric, as to be kept at twelve times their original distance from each other ; that, in this gaseous state, water is 1728 times rarer than when liquid ; and that one gallon of wa ter, with the requisite supply of caloric, will make 1728 gallons of steam.

65. The source from which caloric is obtained for the conversion of water into steam, is either the heat of the sun, the central heat of the earth, or of artificial fires. It is upon the intensity and quantity of this heat that the elastic force, temperature, density, and volume of the steam obtained for any particular purpose must depend ; and it is therefore an important point to determine how it is to be obtained.

The most important and common sources of heat for the production of steam, are the combustion of coal, char coal, wood, resin, and oil. Many experiments have been made upon the quantities of caloric given out during their combustion ; but the results vary much with the methods of applying the heat. The six following are some of the results of Dr Dalton’s experiments ; the rest are selected from the best authorities :

One lb. of Hydrogen, burnt with 7 lbs. oxygen, produces

8 lbs. of water, and raises 250 lbs. of water 180°. Charcoal, 2.8 3.8 carbon, acid, 31 lbs.

Oil, wax, tallow, 3.5 4.5 water and carb, ac., 81

Oil of turpentine, 46.4

Carburettedhydrogen,4. 5. water and carb. ac. 66 Olefiant gas, 35 4.5 water and carb. ac.67

Naphtha, 3.20 73

Rape oil, 90

Caking coal, 54

Olive oil, 76

Charcoal, 57

Coke, 51

Peat, 22

Newcastle coal, 55.5

Culm, 11

The numbers in the last column represent the number of pounds of water at 32°, which will be heated to 212°, when the fuel is applied in the most economical manner ; and hence the quantity of fuel to heat any other quantity