This table enables us to go as low as 1.43 atmospheres’ and is strikingly accordant with the two others as far as they extend in common.

À curve which would be traced by the following table, which may be considered to represent the mean of the foregoing, would differ little more than one-tenth of an atmosphere in any part of the range, from the observations, omitting one noticed in the first, and another noticed in the second table ; the pressures in general differing less than one-tenth of an atmosphere from the observed pressures.

*Table of the Elastic Force of Steam from One to Ten Atmospheres.*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Pres  sure. | Ob  served  Temp. | Pres­  sure. | Ob­  served  Temp. | Pres  sure. | Ob  served  Temp. | Pres  **sure** | Ob  served  Temp. | Pres  sure | Ob­  served  Temp |
| Atmo. | Fah.° | Atmo. | Fah.° | Atmo. | Fah.° | Atmo | Fah.° | Atmo. | Fall.° |
| 1 | 212 | 3 | 275 | 5 | 3041/2 | 7 | 326 | 9 | 345 |
| 11/2 | 235 | 3⅛ | 284 | 5½ | 310 | 7½ | 331 | 9½ | 349 |
| 2 | 250 | 4 | 2911/2 | 6 | 315½ | 8 | 336 | 10 | 352½ |
| 21/2 | 264 | 41/2 | 298½ | 61/2 | 321 | ∞ | 340½ |  |  |

To compare our results with those given by the committee of the French Academy, we have traced a curve, from the above table, and another from those of the thirty observations, selected by the committee of the Academy, from their experiments which are below ten atmospheres. The curve of our observations, passes at low pressures nearer to the line AB than that of the French experimenters, and after coinciding at the medium pressures of the table, crosses the latter, differing at 10 atmospheres 5 degrees, or at 352½ degrees .65 of an atmosphere.

The difference here noticed is too considerable to be admitted as within the limits of errors in the apparatus or in observation. Having an authority of so much weight against them, the committee have been driven to examine their results very closely. The care employed in the graduation of the gauge seems to exclude the idea of error from it ; the upper portion of the scale was divided to .05 of an inch, and could easily be read to half of that distance, making about .1 of an atmosphere at the highest pressure attained. A specific correction for capillarity was ascertained and employed. In one point of manipu­lation, namely, the method employed to dry the air, the committee differed from what was usual, and though they think there is reason to confide in that method, they have examined what effect would be produced if air were saturated with moisture. Recent experiments on the passage of gases, out and into vessels placed over mercury, and observations connected with them, warrant, moreover, a suspicion, that dry air standing in a glass vessel over mercury, the surface of which is covered by water, may become impregnated with vapour. The effect of such a source of error they have calculated in the highest and lowest results of table No. II. and find it to be as follows :—

For 2481/4° the tension of the vapour is 1.96 instead of 1.97, and 352 „ 9.78 „ 9.91.

Differing from the numbers given in table No. II. by .01 and . 13 of an atmosphere.

This supposition is thus shown to be inadequate to explain the discordance, and must, in fact, be deemed, to a certain extent, gratuitous.

The committee have next compared the results furnished by the safety-valves graduated independently of the gauge, and these, as has already been shown, gave calculated pressures four per cent and ten per cent higher

than the pressures indicated by the gauge. From these independent experimental data we have then an evidence that our results are, probably, not too high."

SECT. IΠ. ON THE MATHEMATICAL LAW WHICH CON

NECTS THE ELASTIC FORCE OP VAPOUR WITH ITS

TEMPERATURE.

\*35. An inference which may be drawn from all these experiments is, that Nature seems to affect a certain law in the dilatation of aeriform fluids by heat. They seem to be dilatable nearly in the proportion of their present dilatation. For, if we suppose the vapours to resemble air in having their elasticity in any given temperature proportional to their density, we must suppose that if steam of the elasticity 60, that is, under a pressure of 60 inches of mercury, were subjected to a pressure of 30 inches, it would expand into twice its present bulk. The augmentation of elasticity, therefore, is the measure of the bulk into which it would expand, in order to acquire its former elasticity. Taking the increase of elasticity, as a measure of the bulk into which it would expand under one constant pressure, we see that equal increments of temperature produce nearly equal multi plications of bulk. Thus, if a certain diminution of temperature, diminishes the bulk of steam ½, another equal diminution will very nearly diminish this new bulk ½. Thus, in our experiments (Art. 25), *the temperatures being in arithmetical progression, having equal differ­ences, we see that the corresponding elasticities are very nearly in the continued proportion of* 1 to 2, *thus :*

Temperatures 110° 140° 170° 200° 230°

Corresponding Elasticities }2∙25 5∙15 11.05 22∙62 44.7∙

Now, although extreme temperatures differ consider­ably from this law, still we see that there is a considerable approximation to it ; and it will frequently assist us, to recollect that within these limits an increase of 30° of temperature nearly doubles the elasticity and bulk of watery vapour.

This law obtains exactly in air and other gases, all of which are subject to the Boylean law, or law of Marriotte, as it is called, and have their elasticity proportional to their bulk inversely. If the bulk were always augmented in the same proportion by equal augmentations of temperature, the elasticities would be accurately represented by the ordinates of a logarithmic curve, of which the temperatures are the corresponding abscissæ ; and we might contrive such a scale for our thermometer, that the temperatures would be the common logarithms of the elasti­cities, or of the bulks having equal elasticity ; or, with our present scale, we may find such a multiplier *m,* for the number *t* degrees of our thermometer (above the temperature where the elasticity is equal to unity), that this multiple shall be the common logarithm of the elas­ticity F ; so that

Log. F = *m t*  A.

36. As Dr Dalton was one of the earliest to investigate the properties of steam by well-contrived experiment, he has likewise been the most successful in obtaining pro found and accurate views of those general relations which connect this with coordinate branches of physical know ledge. His experimental researches have been the model of imitation to all subsequent investigators. His apparatus was simple, his artifices were highly refined, and his processes elegant and precise; and, consequently, the results of his labour were immediately transferred to the works of highest philosophical character on the Contiuent and at home, and became part of the staple of accurate science. But his philosophical views were not so readily and widely received, and the fault lay, in part, with their author himself. He had overreached the ex