Log∙∕= (1°g∙ <—1°g∙ «) ■ ~~1~~~~1~~~~°~~~~o~~~~g.^ ■·~~

When, therefore, *p* and *r* are determined for a given vaIue of *m,* the relative is obtained. If we take the value *m* = 2, and if we take from the experiments of the French Academy and Franklin Institute, values of *t* and *f* above and below 30 inches, or unity, which is the value of *m,* and let these values be *t'*, *t”, t', t'';* then from *(ξ) we* have

\_ι . \_I

f' J log·/' ***Ç t"*** J log·/" \_Q

and

lθg∙ (7) lθg√' l°ff∙ (γ∙) ⅛∙∕, = 0 ***i***

We have only, therefore, to assume *r* so as to satisfy these conditions. Now,

t \_ <Fahr∙ + c 7 212 + c

that is to say, if we reckon temperature from some given point *c* above or below the usual zero, viz. at the freezing point of mercury, like Dr Dalton’s scale of temperature, and use the elastic force at 212° as our unit of pressure, we have then only to take *f'* and *f"* from the tables of experiment, and give such a value to *c* as will satisfy the conditions. But as Dr Dalton places that zero at 175° we get

< \_ iF4hr +175o r “ 387

We have still to find *p* the index of progression, cor responding to the values of *f and f"* in the experiments.

If we take the value of ***m*** = 2, then since by ***ζ***

(. y log, m

—)w∙'=f

From the French experiments we *get p—*1.103, whence by substitution, *r* being=387o, jb=1.102, m=2, we have

<+175° ⅛

387° = (1.103) R.

From Dr Dalton’s experiments we get *r =* 387°, *p* = 1.1320, *m* = 2.602,

log f∙

whence ι<,g 2.602

f+1750 = (1.1320) .S.

387\*

From the combination of Dr Dalton’s experiments below 30 inches, with the mean between those of the French Academy and the Franklin Institute, we get

r= 330o, *p* =1.11401, *m* =2.0,

whence

log F. log. 2

<+121o = (1.11401) T.

333°

It is from equation S and equation T that we have constructed the large table (Art. 56) in which the results of these formulæ are compared with experiment ; the formula for high-pressure steam being compared with the mean of the French and American experiments ; but, as they do not extend below 212°, that part is compared with Dr Dalton’s table. The coincidence of these formulæ with experiment turns out to be much closer than could possibly have been expected where the discrepancies of experiments from each other are so great. The experiments of Dr Ure deviate from those of Dr Dalton, below

the pressure of the atmosphere, as much as .33, and the greatest deviation of the formulæ is .08. At pressures above the atmosphere the maximum deviation in the first ten atmospheres between the French and American experiments amounts to 6.4°, while the maximum deviation of the formulæ is only 1.1°.—

It is, however, remarkable, that in all the experiments hitherto made, the law of elasticity below the atmospheric pressure appears to deviate considerably from that above the atmosphere—perhaps it may arise from the circum stance that the experiments below atmospheric pressure have been made with different apparatus, having errors of a different kind from those made at high pressures above the atmosphere.

From these equations we easily deduce the following formulæ in a shape convenient for calculation.

o.i ( Log. F = 7.71307 (log. — 2.587711) A

S∏ ) Log. i = 0.12965.log. F + 2.587711 ( oa

I!« ) i s

«Ss b ( when i=f,'4hl'∙f175.o J

Finally

o . ∙ I Log. F=6.42 (log. *t*—2.5224442) 1

J Log. f=0.1557634. log. F+52244422. f .r,

4feS ( when Z=iF\*hr·J121.o )

These formulæ converted into rules are as follows :

To find the pressure corresponding to any given temperature of steam above 212°—

*Rule.* To the temperature add 121°, find the logarithm of that sum, subtract from this logarithm the number 2.5224442, and multiply the remaining number by 6.42, the product is the logarithm of the pressure in atmos­pheres of 30 inches of mercury.

To find the temperature of steam, having any given pressure greater than that of the atmosphere—

*Rxde.* Find the logarithm of the pressure in atmospheres, multiply it by 0.1557634, add to the product 2.5224442 ; the sum is the logarithm of the temperature, from which, if 121° be subtracted, the remainder will be the temperature on the common scale.

*Example.* To find the temperature at which high pres sure steam will exert a force greater than the atmosphere by 195 lbs. on the inch—

195. lbs. = 390. inches of mercury,

390. inches of mercury =13. atmospheres,

.∙. 14 atmospheres s= total elastic force of the steam. Logarithm of 14 1.1461280

.1557634

11461280

5730640

573064

80227

6876

342

44

.17852473 Add 2.5224442

502.306 is the number of which 2.7009689 is the log. 121. being subtracted

381.306° is the temperature on Fahrenheit’s scale at which the elastic force of steam has a pressure of 14 atmospheres; an elastic force of 13.×15. lb. excess of pressure above the atmosphere on each square inch, = 195. lbs.

To find the pressure corresponding to any given temperature of steam below 212°—

*Rule.* To the temperature add 175°, find the logarithm of that sum, subtract from this logarithm the number