|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| A. | W. | Volume. | Sp. Gravobſerved. | Sp. Grav Condensation. calculated. | |
| 18 | 20 | 4,81182 | 0,9349 | 0,9087 | 262 |
| 17 | 20 | 40,6061 | 0,9375 | 0,9112 | 263 |
| 16 | 20 | 39,3939 | 0,9402 | 0,9139 | 263 |
| 15 | 20 | 38,1818 | 0,9430 | 0,9167 | 263 |
| 14 | 20 | 36,9697 | 0,9458 | 0,9197 | 261 |
| 13 | 20 | 35,7576 | 0,9488 | 0,9229 | 259 |
| 12 | 20 | 34,5455 | 0,9518 | 0,9263 | 255 |
| **I I** | 20 | 33,3333 | 0,9549 | 0,9300 | 249 |
| 10 | 20 | 32,1212 | 0,9580 | 0,9340 | 240 |
| 9 | 20 | 30,9091 | 0,9612 | 0,9382 | 230 |
| 8 | 20 | 29,6970 | 0,9644 | 0,9429 | 215 |
| 7 | 20 | 28,4849 | 0,9675 | 0,9479 | 196 |
| 6 | 20 | 27,2727 | 0,9707 | 0,9533 | 174 |
| 5 | 20 | 26,0606 | 0,9741 | 0,9593 | 148 |
| 4 | 20 | 24,8485 | 0,9777 | 0,9659 | 118 |
| 3 | 20 | 23,6364 | 0,9818 | 0,9731 | 87 |
| 2 | 20 | 22,4242 | 0,9865 | 0,9811 | 54 |
| 1 | 20 | 21,2121 | 0,9924 | 0,9900 | 24 |
| 0 | 20 | 20,0000 | 1,0000 | 1,0000 |  |

It is to be remarked, that the condenſation is great­**eſt** when 161/2 ounces of alcohol have been added to 20 of water, and the condenſation is 2633/91835, or nearly 1/30th of the computed denſity. Since the ſpecific gravity of alcohol is 0,825, it is evident that 161/2 ounces of alco­hol and 20 ounces of water have equal bulks. So that the condenſation is greateſt when the ſubſtances are mix­ed in equal volumes ; and 18 gallons of alcohol mixed with 18 gallons of water will produce not 36 gallons **of** ſpirits, but 35 only.

We may alſo obſerve, that this is the mixture to which our revenue-laws refer, declaring it to be *one to six* or *one in ſeven* under proof, and to weigh 7 pounds 13 ounce per gallon. This proportion was probably ſelected as the moſt eaſily compoſed, viz. by mixing equal meaſures of water and of the ſtrongeſt ſpirit which the known proceſſes of diſtillation could produce. Its ſpecific gravity is 0,939 very nearly.

We muſt conſider this elaborate examination oſ the mixture of water and alcohol as a ſtandard ſeries of ex­periments, to which appeal may always be made, whe­ther for the purpoſes of ſcience or of trade. The re­gularity of the progreſſion is ſo great, that in the column which we have examined, viz. that for temperature 60⁰, the greateſt anomaly does not amount to one part in six thouſand. The form of the ſeries is alſo very judiciouſly choſen for the purpoſes of ſcience. It would perhaps have been more directly ſtereometrical had the proportions of the ingredients been ſtated in bulks, which are more immediately connected with denſity. But the author has aſſigned a very cogent reaſon for his choice, viz. that the proportion of bulks varies by a change of temperature, becauſe the water and ſpirits fol­low different laws in their expanſion by heat.

This is a proper opportunity for taking notice of a miſtake which is very generally made in the conduirons drawn from experiments of this kind. Equal addi­tions of the ſpirit or water produce a ſeries of ſpecific gravities, which decreaſe or increaſe by differences con­tinually diminiſhing. Hence it is inferred that there is **a** contraction of bulk. **Even Dr Lewis, one of our**

moſt accompliſhed naturaliſts, advances this poſition, in a diſſertation on the pot-aſh of America ; and it considerably affects his method for eſtimating the ſtrength of the pot-aſh leys. Rut that it is a miſtake, appears plainly from this, that although we add for ever equal quantities of the ſpirits, we ſhall never produce a mix*ture* which has as ſmall a ſpecific gravity as alcohol. Therefore the ſeries of ſucceſſive gravities muſt appro­ximate to this without end, like the ordinates of a hy­perbolic curve referred to its aſſymptote.

That this may appear in the moſt general terms, let *w* repreſent the weight of the confiant quantity of wa­ter in the mixture, and let *a* be the weight of the ſmall addition oſ ſpirits. Alſo let *w* repreſent the bulk of this quantity of water, and *b* the bulk of the ſmall ad­dition of alcohol. The weight of the mixture is *w +a,* and its bulk is *w + b,* and its ſpecific gravity is w + a/ w +b

If we now add a ſecond equal quantity of ſpirits, the weight will be w + 2a, and if the ſpirit retains its den­ſity unchanged, the bulk will be w+2b, and the ſpecific

*w+2a*

gravity is w + 2b and after any number *m* of ſuch

equal additions of ſpirits, the ſpecific gravity will be w + ma

Divide the numerator of this fraction by its

denominator, and the quotient or ſpecific gravity will *m× a—b*

be 1 + w + mb. This conſiſts of the conſtant part 1,

*m (a — b)*

and the variable part. We need attend only

*w + mb.*

to this part. If its denominator were conſtant, it is plain that the ſucceſſive ſpecific gravities would have

equal differences, each being = becauſe *m*

w + mb,

increaſes by the continual addition of an unit, and *a — b* is a conſtant quantity. But the denominator *w + mb* continually increaſes, and therefore the value of the

*a—b*

**fraction** continually diminiſhes.

Therefore the gradual diminution of the increments or decrements of ſpecific gravity, by equal additions of one ingredient to a conſtant meaſure of the other, is not of itſelf an indication of a change of denſity of either of the ingredients ; nor proves that in very diluted mixtines a greater proportion of one ingredient is abſorbed or lodged in the interſtices of the other, as is generally imagined. This muſt be aſcertained by comparing each ſpecific gravity with the gravity expreſſed by 1 + w+ *m (a—b)*

*w + mb*

This ſeries of ſpecific gravities reſembles ſuch a nu­merical ſeries as the following, 1 ; ; 1,156;

1,163 ; 1, + 69 ; &c. the terms of which alſo conſiſt of the conſtant integer 1, and the decimal fractions 0,156;

*The fraction*

0,163 ; 0,169 ; &c. The fraction w + mb expreſſes

this decimal part. Call this *d.* or make *d =*

*w + mb*

*m a - w d*

**This will give us** *b =*  Now *a* **is the weight**

of the added ingredient, and *d* is the variable part of the ſpecific gravity obſerved ; and thus we learn whe­-