bulk of the compound muſt be to 100 gallons as *g* to G. And ſince we want to make it ſtill up to 100 gallons, we muſt increaſe it in the proportion of G to *g.* And becauſe this augmentation muſt be of the same ſtrength with this contracted liquor, both ingredients muſt be increaſed in the proportion of G to *g,* and we muſt have G *:g = y* : z, and *z = g* × y/G. Now, instead of y, write a ms/w+ms, and inſtead of I/G write w+ms/w+s, which are reſpectively equal to them. This gives us z = *g a × w+ms/w+s × ms/w+s, = g a × ms/w+s.* All this will be illuſtrated by an example.

Suppoſe that we have obſerved the ſpecific gravity of a ſpirituous liquor of the temperature 60⁰ to be 0,94128. Looking into Sir Charles Blagden’s table, we find the gravities 0,94018 and 0,94296, and the s correſponding to them is 80 and 75, the water in each mixture being 100. By interpolation we obtain the *s* correſponding to 0,94128, *viz.* 78. At this temperature m = 1/0.825, = 1,21212, and ms= 94,54545, = 19,997, orvery nearly 50.

We have ſeen even perſons not unacquainted with ſubjects of this kind puzzled by this fort of paradox, z is ſaid to be the percentage of ſpirit in the com­pound. The compound has the ſame proportion of in­gredients when made up to 100 gallons as before, when *y* was ſaid to be its percentage, and yet *y* and *z* are not the ſame. The fact is, that although z is the number of gallons of alcohol really contained in 100 gallons of the compound, and this alcohol is in the ſame propor­tion as before to the water, this proportion is not that of 50 to 50 : for if the ingredients were ſeparated again, there would be 50 gallons of alcohol and 52,876 of water.

The proportion of the ingredients in their ſeparate state is had by the 3d Equation *y = a ms/w+ms*, which

is equivalent to G *a ms/w+s.* For the preſent example *y* will be found 48,599, and *a —y,* or the water per cent. 51,401, making 100 gallons of unmixed ingre­dients. We ſee then that there has been added 1,398 gallons of alcohol ; and since both ingredients are aug­mented in the proportion of G to *g,* there have alſo been added 1,478 of water, and the whole addition for making up the 100 gallons of compound is 2,876 gallons ; and if the ingredients of the compound were ſeparate, they would amount to 102,876 gallons. This might have been found at the first, by the proportion, G:y— G = 100: *(The addition.)*

The next queſtion which uſually occurs in busineſs is to find what density will reſult from any proposed mix­ture *per* gallon. This queſtion is ſolved by means of the equation wy/m(a-y) = s*.* In this examination it will be

moſt convenient to make w = *a.* If the value of *s* found in this manner falls on a value in the tables, we have the ſpecific gravity by inspection, If not, we must interpolate.

*N. B.* The value of m, which is employed in theſe re­ductions, varies with the temperature. It is always ob­tained by dividing the ſpecific gravity of alcohol of that temperature by the ſpecific gravity of water of the ſame temperature. The quotient is the real ſpecific gravity of alcohol for that temperature. Both of theſe are to be had in the first and laſt copartments of Sir Charles Blagden’s table.

Theſe operations for particular caſes give the anſwers to particular occasional questions. By applying them to all the numbers in the table, tables may be constructed for ſolving every queſtion by inspection.

There is another queſtion which occurs moſt fre­quently in the exciſe tranſactions, and alſo in all compositions of ſpirituous liquors, viz. What ſtrength will reſult from a mixture of two compounds of known ſtrength, or mixing any compound with water ? To ſolve queſtions of this kind by the table ſo often quo­ted, we muſt add into one film the water *per* gallon of the different liquors. In like manner, take the ſum of the ſpirits, and ſay, as the ſum of the waters is to that of the alcohols, ſo is *a* to *s ;* and operate with *a* and s as before.

Analogous to this is the queſtion of the duties. Theſe are levied on proof ſpirit ; that is, a certain du­ty is charged on a gallon of proof ſpirit ; and the gau­ger’s busineſs is to diſcover how many gallons of proof ſpirit there is in any compound. The ſpecification of proof ſpirit in our exciſe laws is exceedingly obſcure and complex. A gallon weighing 7 pounds 13 ounces (at 55⁰) is accounted 1 to 6 under proof. The gal­lon of water contains 58476 grains, and this ſpirit is 54688. Its denſity therefore is 0,93523 at 55⁰, or (as may be inferred from the table) 0,9335 at 60⁰. This denſity correſponds to a mixture of 100 grains of wa­ter with 93,457 of alcohol. If this be ſuppoſed to re­ſult from the mixture of 6 gallons of alcohol with 1 of water (as is ſuppoſed by the designation of 1 to 6 un­der proof), the gallon of proof ſpirits consists of 100 parts of ſpirits by weight, mixed with 75 parts of water. Such a ſpirit will have the denſity 0,9162 nearly.

This being premiſed, in order to find the gallons of proof ſpirits in any mixture, find the quantity of alco­hol by weight, and then ſay, as 100 to 175, ſo is the alcohol in the compound to the proof ſpirit that may be made of it, and for which the duties muſt be paid.

We have considered this ſubject at ſome length, be­cauſe it is of great importance in the ſpirit-trade to have theſe circumſtances aſcertained with precision ; and be­cauſe the ſpecific gravity is the only ſure criterion that can be had of the ſtrength. Firing of gunpowder, or producing a certain bubble by ſhaking, are very vague teſts ; whereas, by the ſpecific gravity, we can very ſecurely aſcertain the ſtrength within one part in 500, as will preſently appear.

Sir Charles Blagden, or Mr Gilpin, have publiſhed @@\* a moſt copious ſet of tables, calculated from theſe valuable experiments. In theſe, computations are made for every unit of the hundred, and for every degree of the thermometer. But theſe tables are ſtill not in the moſt commodious form for bufineſs. Mr John Wilſon, an ingenious gentleman reſiding at Dundee, has just pub- @@@[m]\* Philosophy Trans. 179.