**which t**he principle of both are combined. Suppoſe a hydrometer with a stem, whoſe bulk is 1/10th of that of the ball, and that it sinks in aether to the top of the ſtem ; it is evident that in a fluid which is 1/10th heavier, the whole ſtem will emerge ; for the bulk of the displaced fluid is now 1/10th of the whole leſs, and the weight is the ſame as before, and therefore the ſpecific gravity is 1/10th greater.

Thus we have obtained a hydrometer which will indi­cate, by means of diviſions marked on the ſtem, all ſpecific gravides from 0,73 to 0,803 ; for 0,803 is 1/10th greater than 0,7 3. Theſe diviſions muſt be made in harmonic progreſſion, as before directed for an entire ſcale, placing 0,73 at the top of the ſtem and 0,803 at the bottom.

When it floats at the loweſt diviſion, a weight may be put on the top of the ſtem, which will again ſink it to the top. This weight muſt evidently be 0,073, or 1/10th of the weight of the fluid diſplaced by the unloaded inſtrument. The hydrometer, thus loaded, indicates the ſame ſpecific gravity, by the top of the ſtem, that the unloaded inſtrument indicates by the loweſt divi­ſion. Therefore, when loaded, it will indicate another ſeries of ſpecific gravities, from 0,803 to 0,8833 ( = 0,803 + 0,0803), and will float in a liquor of the ſpecific gravity 0,8833 with thewhole ſtem above the ſurface.

In like manner, if we take off this weight, and put on **I** — 0,080,3, it will ſink the hydrometer to the top of the ſtem ; and with this new weight it will indicate another ſeries of ſpecific gravities from 0,8833 **to** 0,97163 (=0,8833 + 0,08833). And, in the ſame manner, a third weight = 08833 will again ſink it to the top of the ſtem, and fit it for another ſeries of ſpecific gravities up to 1,068793. And thus, with three weights, we have procured a hydrometer fitted for all liquors ſrom sether to a wort for a malt liquor of two barrels *per* quarter. Another weight, in the ſame progreſſion, will extend the inſtrument to the ſtrongeſt wort that is brewed.

This is a very commodious form of the inſtrument, and is now in very general uſe for examining ſpirituous liquors, worts, ales, brines, and many ſuch articles of commerce. But the diviſions of the ſcale are general­ly adapted to the queſtions which naturally occur in the busineſe. Thus, in the commerce of ſtrong liquors, it is uſual to eſtimate the article by the quantity of ſpi­rit of a certain ſtrength which the liquor contains.— This we have been accuſtomed to call proof spirit, and it is ſuch that a wine gallon weighs 7 pounds 12 ounces; and it is by this ſtrength that the exciſe duties are levied. Therefore the diviſions on the ſcale, and the weights which connect the ſucceſſive repetitions of the ſcale, are made to expreſs at once the number of gallons or parts of a gallon of proof ſpirits contained in a gallon of the liquor. Such inſtruments save all trouble of calcula­tion to the exciſeman or dealer ; but they limit the uſe of a very delicate and expenſive inſtrument to a very narrow employment. It would be much better to adhere to the expreſſion either of ſpecific gravity or of bulk ; and then a very ſmall table, which could be compriſed in the ſmalleſt caſe for the inſtrument, might rendeer to applicable to every kind of fluid.

The reader cannot but have obſerved that the succeſſive weights, by which the ſhort ſcale of the inſtrument is **extended to a great** range of ſpecific gravities, do not increaſe by equal quantities. Each difference is the weight oſ the liquor dilplaced by the graduated ſtem of the inſtrument when it is ſunk to the top of the ſcale. It is a determined aliquot part of the whole weight of the inſtrument ſo loaded, (in our example it is always 1/13th oſ it). It increaſes therefore in the ſame proportion with the preceding weight of the loaded inſtrument. In ſhort, both the ſucceſſive additions, and the whole weights of the loaded inſtrument, are quan­tities in geometrical progreſſion ; and, in like manner, the diviſions on the ſcale, if they correſpond to equal differences of ſpecific gravity, muſt alſo be unequal.— This is not sufficiently attended to by the makers ; and they commit an error here, which is very conſiderable when the whole range of the inſtrument is great. For the value of one diviſion of the ſcale, when the largeſt weight is on, is as much greater than its value, when the inſtrument is not loaded at all, as the full loaded inſtrument is heavier than the inſtrument unload, ed. No manner whatever of dividing the ſcale will correſpond to equal differences of ſpecific gravity through the whole range with different weights ; but if the diviſions are made to indicate equal *proportions* of gra­vity when the inſtrument is uſed without a weight, they will indicate equal *proportions* throughout. This is evi­dent from what we have been juſt now saying ; for the proportion of the ſpecific gravities correſponding to any two immediately ſucceeding weights is always the ſame.

The beſt way, therefore, of conſtructing the inſtru­ment, ſo that the ſame diviſions of the ſcale may be ac­curate in all its ſucceſſive repetitions with the different weights, is to make theſe diviſions in geometrical progreſſion. The correſponding ſpecific gravities will alſo be in geometric proportion. Theſe being all inſerted in a table, we obtain them with no more trouble than by inſpecting the ſcale which uſually accompanies the hydrometer. This table is of the moſt eaſy conſtruction ; for the ratio of the ſucceſſive bulks and ſpecific gravities being all equal, the differences of the logarithms are equal.

This will be illuſtrated by applying it to the example already given of a hydrometer extending from 0,73 to 1,068793 with three weights. This gives four re­petitions of the ſcale on the ſtem. Suppoſe this ſcale

divided into 10 parts, we have 40 ſpecific gravities.

Let theſe be indicated by the numbers 0, 1, 2, 3, &c. to 40. The mark 0 is affixed to the top of the ſtem, and the diviſions downwards are marked 1, 2, 3, &c. the loweſt being 10. Theſe diviſions are eaſily determined. The ſtem, which we may ſuppoſe 5 inches long, was ſuppoſed to be 1/10th of the capacity of the ball. It may there­fore be conſidered as the extremity of a rod of 11 times its length, or 55 inches ; and we muſt find nine mean proportionals between 50 and 55 inches. Subtract each of theſe from 55 inches, and the remainders are the diſtances of the points of divilion from 0, the top of the ſcale. The ſmalleſt weight is marked 10, the next 20, and the third 30. If the inſtrument loaded with the weight 20 sinks in ſome liquor to the mark 7, it indicates the ſpecific gravity 27, that is, the 27th of 40 mean proportionals between 0,73 and 1,068793, or 0,944242. To obtain all theſe intermediate ſpecific gravities, we have only to ſubtract 9.8633229, the lo-