be wanting : for a liquor which **answers to N⁰** 4 will sink No 2 by heating it a few degrees, and therefore N⁰ 3 may be ſpared. This is a great advantage in or­dinary buſineſs. A nice hydrometer is not only an expenſive inſtrument, but exceedingly delicate, being ſo very thin. If broken or even bruiſed, it is uſeleſs, and can hardly be repaired except by the very maker.

As the only queſtion here is, to determine how many gallons of exciſe proof ſpirits is contained in a quantity of liquor, the artiſt has conſtructed this ſeries of bubbles in the ſimpleſt manner poſſible, by previouſly making 40 or 50 mixtures of ſpirits and water, and then adjuſting the bubbles to theſe mixtures. In ſome ſets the number on each bubble is the number of gallons of proof ſpirits contained in 100 gallons of the liquor. In other ſets the number on each bubble expreſſes the gal­lons of water which will make a liquor of this ſtrength, if added to 14 gallons of alcohol. Thus, if a liquor anſwers to N⁰ 4, then 4 gallons of water added to 14 gallons of alcohol will make a liquor of this ſtrength. The firſt is the beſt method ; for we ſhould be miſtaken in ſuppoſing that 18 gallons, which anſwer to N⁰ 4, con­tains exactly 14 gallons of alcohol : it contains more than 14, for a reaſon to be given by and by.

By examining the ſpecific gravity of bodies, the phi­loſopher has made ſome very curious diſcoveries. The moſt remarkable of theſe is the change which the denſi­ty of bodies suffers by mixture. It is a moſt reaſonable expectation, that when a cubic foot of one ſubſtance is mixed *any how* with a cubic foot of another, the bulk of the mixture will be two cubic feet ; and that 8 gal­lons of water joined to 18 gallons of oil will fill a veſſel of 36 gallons. Accordingly this was never doubted ; and even Archimedes, the moſt ſcrupulous of mathema­ticians, proceeded on this ſupposition in the ſolution of his famous problem, the diſcovery of the proportion of ſilver and gold in a mixture of both. He does not even mention it as a poſtulate that *may* be granted him, ſo much did he conceive it to be an axiom. Yet a little reflection ſeems sufficient to make it doubtful and to require examination. A box filled with muſket-balls will receive a conſiderable quantity of ſmall ſhot, and af­ter this a conſiderable quantity of fine sand, and after this a conſiderable quantity of water. Something like this might happen in the admixture of bodies of porous texture. But ſuch ſubſtances as metals, glaſs, and fluids, where no diſcontinuity of parts can be perceived, or was suſpected, ſeem free ſrom every chance oſ this kind oſ in­troſuſception. Lord Bacon, however, without being a naturaliſt or mathematician *ex professo,* interred from the mobility of fluids that they consiſted of diſcrete parti­cles, which muſt have pores interpoſed, whatever be their figure. And if we aſcribe the different denſities, or other ſenſible qualities, to difference in ſize or figure of thoſe particles, it muſt frequently happen that the ſmaller particles will be lodged in the interſtices between the larger, and thus contribute to the weight of the ſenſible maſs without increaſing its bulk. He therefore ſuspects that mixtures will be in general leſs bulky than the ſum of their ingredients.

Accordingly, the examination of this queſtion was one of the firſt employments of the Royal Socſety of London, and long before its inſtitution had occupied the attention of the gentlemen who afterwards compos**ed it. The regiſter of the Society’s early meetings**

contains many experiments on this ſubject, with mixtures of gold and ſilver, of other metals, and of various fluids, examined by the hydroſtatical balance of Mr Boyle. Dr Hooke made a prodigious number, chief­ly on articles of commerce, which were unfortunately loſt in the fire of London.

It was ſoon found, however, that Lord Bacon’s con­jecture had been well founded, and that bodies changed their density very ſenſibly in many caſes. In general, it was found that bodies which had a ſtrong chemical affinity increaſed in denſity, and that their admixture was accompanied with heat.

By this dilcovery it is manifeſt that Archimedes had not ſolved the problem of detecting the quantity of silver mixed with the gold in King Hiero’s crown, and that the phyſical ſolution of it requires experiments made on all the kinds of matter that are mixed together. We do not find that this has been done to this day, al­though we may affirm that there are few queſtions of more importance. It is a very curious fact in chemiſtry, and it would be moſt deſirable to be able to re­duce it to ſome general laws ; For inſtance, to aſcertain what is the proportion of two ingredients which pro­duces the greateſt change of denſity. This is impor­tant in the ſcience of phyſics, becauſe it gives us considerable information as to the mode of action of thoſe natural powers or forces by which the particles of tan­gible matter are united. If this introſuſception, con­centration, compenetration, or by whatever name it be called, were a mere reception of the particles of one ſubſtance into the interſtices of thoſe of another, it is evident that the greateſt concentration would be obſerved when a ſmall quantity of the recipiend is mix­ed with, or diſſeminated through, a great quantity of the other. It is thus that a ſmall quantity of fine fand will be received into the interſtices of a quantity of ſmall ſhot, and will increaſe the weight of the bagful, without increaſing its bulk. The caſe is nowiſe diffe­rent when a piece of freeſtone has grown heavier by imbibing or abſorbing a quantity of water. If more than a certain quantity of fand has been added to the ſmall ſhot, it is no longer concealed. In like manner, various quantities of water may combine with a maſs of clay, and increaſe its ſize and weight alike. All this is very conceivable, occaſioning no difficulty,

But this is not **the** caſe in any of the mixtures we are now conſidering. In all theſe, the firſt additions of either of the two ſubſtances produce but an inconſiderable change of general denſity ; and it is in general moſt remarkable, whether it be condensation or rare­faction, when the two ingredients are nearly of equabulks. We can illuſtrate even this difference, by reflecting on the imbibition of water by vegetable ſolids, ſuch as timber. Some kinds of wood, have their weight much more increaſed than their bulks ; other kinds of wood are more enlarged in bulk than in weight. The like happens in grains. This is curious, and ſhows in the moſt unqueſtionable manner that the particles of bodies are not in contact, but are kept together by forces which act at a diſtance. For this diſtance between the centres of the particles is moſt evidently ſuſceptible of variation ; and this variation is occaſioned. by the in­troduction of another ſubſtance, which, by acting on the particles by attraction or repulſion, diminiſhes or **increaſes their mutual actions, and makes** new diſtances