ratio) *of* the heavy fluid, the light fluid, and the mix­ture (their bulk being that of the hydrometer). We have β = B + b. The addition which would have been made to the bulk β, if the lighteſt fluid were changed entirely for the heavieſt, would be D — *d ;* and the change which is really made is ϐ*—d.* Therefore β : b = D—*d : ϐ—d.* For ſimilar reaſons we ſhould have β : B = D - d: D — ϐ *;* or, in words, “ *the difference be­tween the ſpecific gravities of the two fluids, is to the differ­ence between the ſpecific gravities of the mixture and of the lightest fluid, as the bulk of the whole to the bulk of the heaviest contained in the mixture ;"* and “ *the difference of the ſpecific gravities of the two fluids, is to the difference of the ſpecific gravities of the mixture and of the heaviest fluids, as the bulk of the whole to that of the lightest contained in the mixture.”* This is the form in which the ordinary buſineſs of life requires the anſwer to be expreſſed, becauſe we generally reckon the quantity or liquors by bulk, in gallons, pints, quarts. But it would have been equally eaſy to have obtained the anſwer in pounds and ounces ; or it may be had from their bulks, ſince we know their ſpecific gravities.

The hydrometer more commonly uſed is the ancient one of Hypatia, conſiſting of a ball, A (fig. 2.), made ſteady by an addition B, below it like the former, but having a long ſtem CF above. It is ſo loaded that it sinks to the top F of the ſtem in the lighteſt of all the fluids which we propoſe to meaſure with it, and to ſink only to C in the heavieſt. In a fluid of intermediate ſpecific gravity it will ſink to ſome point between C and F.

In this form of the hydrometer the weight is al­ways the ſame, and the immediate information given by the inſtrument is that of different bulks with equal weight. Becauſe the inſtrument sinks till the bulk of the diſplaced fluid equals it in weight, and the addi­tions to the diſplaced fluid are all made by the ſtem, it is evident that equal bulks of the ſtem indicate equal additions of volume. Thus the ſtem becomes a ſcale **of** bulks to the ſame weight.

The only form in which the ſtem can be made with ſufficient accuracy is cylindrical or priſmatical. Such **a** ſtem may be made in the moſt accurate manner by wire-drawing, that is, paſſing it through a hole made in **a** hardened ſteel plate. If ſuch a ſtem be divided into equal parts, it becomes a ſcale of bulks in arithmetical progreſſion. This is the eaſieſt and moſt natural divi­ſion of the ſcale ; but it will not indicate denſities, ſpecific gravities, or weights of the ſame bulk in arith­metical progreſſion. The ſpecific gravity is as the weight divided by the bulk. Now a ſeries of diviſors (the bulks), in arithmetical progreſſion, applied to the ſame dividend (the bulk and weight of the hydrometer as it floats in water), will not give a ſeries of quotients (the ſpecific gravities) in arithmetical progreſſion : they will be in what is called *harmonic progreſsion,* their differences continually diminiſhing. This will appear even when physically conſidered. When the hydro­meter sinks a tenth of an inch near the top of the ſtem, it diſplaces one tenth of an inch of a light fluid, com­pared with that diſplaced by it when it is floating with all the ſtem above the ſurface. In order therefore that the divisions of the ſtem may indicate equal changes of ſpecific gravity, they muſt be in a ſeries of harmonic progreſſionals increasing. **The point at which the in**ſtrument floats in **pure** water **ſhould be** marked 1000, and thoſe above it 999, 998, 997, &c. ; and thoſe be­low the water mark muſt be numbered 1001, 1002, 1003, &c. Such a ſcale will be a very appoſite picture of the denſities of fluids, for the denſity or vicinity of the divisions will be preciſely ſimilar to the denſity of the fluids. Each interval is a bulk of fluid of the ſame weight. If the whole inſtrument were drawn out into wire of the ſize of the ſtem, the length from the water mark would be 1000.

Such are the rules by which the ſcale muſt be divi­ded. But there muſt be ſome points of it determined by experiment, and it will be proper to take them as remote from each other as poſſible. For this purpoſe let the inſtrument be accurately marked at the point where it ſtands, in two fluids, differing as much in ſpe­cific gravity as the inſtrument will admit. Let it alſo be marked where it ſtands in water. Then determine with the utmoſt preciſion the ſpecific gravities of theſe fluids, and put their values at the correſponding points of the ſcale. Then the intermediate points of the ſcale muſt be computed for the different intervening ſpecific gravities, or it muſt be divided from a pattern ſcale of harmonic progreſſionals in a way well known to the mathematical inſtrument-makers. If the ſpecific gra­vities have been accurately determined, the value 1000 will be ſound to fall preciſely in the water mark. If we attempt the diviſion entirely by experiment, by making a number of fluids of different ſpecific gravi­ties, and marking; the ſtem as it ſtands *in* them, we ſhall find the divisions turn out very anomalous. This is however the way uſually practiſed ; and there are few hydrometers, even from the beſt maker, that hold true to a single diviſion or two. Yet the method by compu­tation is not more troubleſome; and one ſcale of harmo­nic progreſſionals will ſerve to divide every ſtem that offers. We may make uſe of a ſcale of equal parts for the ſtem, with the aſſiſtance of two little tables. One of theſe contains the ſpecific gravities in harmonic progreſſion, correſponding to the arithmetical ſcale of bulks on the ſtem of the hydrometer ; the other con­tains the divisions and fractions of a diviſion of the ſcale of bulks, which correſpond to an arithmetical ſcale of ſpecific gravities. We believe this to be the beſt me­thod of all. The ſcale of equal parts on the ſtem is ſo eaſily made, and the little table is ſo eaſily inspected,that it has every advantage of accuracy and dispatch,and it gives, by the way, an amuſing view of the rela­tion of the bulks and denſities.

We have hitherto ſuppoſed a ſcale extending from the lighteſt to the heavieſt fluid. But unleſs it be of a very inconvenient length, the divisions muſt be very minute. Moreover, when the bulk of the ſtem bears a great proportion to that of the body, the inſtrument does not ſwim ſteady ; it is therefore proper to limit the range of the inſtrument in the ſame manner as thoſe of the firſt kind. A range from the denſity of aether to that of water may be very well executed in an in­ſtrument of very moderate ſize, and two others will do for all the heavier liquors ; or an equal range in any other denſities as may suit the uſual occupations of the experimenter.

To avoid the inconveniences of a hydrometer with a very long and ſlender ſtem, or the neceſſity of having **a series of them, a third sort has been contrived,** in