

in the barometric reading would make an appreciable difference in the weight of a cubic inch of air, weighing at best only one-third of a grain. For this purpose suppose the barometer to fall from 30 in. to 29 in., that is the air becomes $\frac{1}{30}$ lighter, or its buoyancy is diminished by $\frac{1}{30}$, that is, this cubic inch of air becomes lighter by $\frac{1}{90}$ of a grain, and consequently the apparent weight of a cubic inch of water is heavier by that much. Knowing also how small a difference in weight can be detected by a well made balance we can readily understand that a difference of even a small fraction of an inch in the barometric reading will make an appreciable difference in the weight of a cubic inch of water. The next condition to be observed is that the thermometer is to stand at 62° F. We know that most substances increase in volume when heated and contract again when the heat has been withdrawn, and, for certain temperatures, water forms no exception to this rule. If, then, the weighing were done with the thermometer below 62° , the water would be more dense, more of it would be required to fill a cubic inch of space and consequently the cubic inch of water would weigh heavier than it would at 62° and conversely for temperatures higher than 62° .

Lastly, why should brass weights be used?

If the weight of the substance which is being weighed in one scale-pan of the balance is affected by the temperature and pressure of the atmosphere, so also must the weights in the other scale-pan. Now, any given weight of brass which is about 8 times as heavy as water, will occupy nearly 3 times as much space as the same weight of platinum which is more than 21 times as heavy. Suppose then, an ounce of brass and the same weight of platinum to be accurately balanced in a vacuum, would they balance if surrounded by air? Certainly not, for

the brass weight of which we are speaking occupying 3 times as much space as the platinum one will be affected 3 times as much by the buoyancy of the air, that is, will have its weight diminished to 3 times as great an extent as the oz. of platinum, and consequently the brass weight will no longer be able to balance the other, so that although the cubic inch of water of which we are speaking would weigh the same in a vacuum whether the weights used were brass, platinum or any other substance, yet this would not be true when the weighing is done in air, for we have seen that a substance that would balance a certain absolute weight of brass in air would not be heavy enough to balance the same absolute weight of gold, platinum or any substance heavier than brass. It follows therefore, that variations in the atmospheric pressure will affect the apparent weight of light substances to a greater extent than heavier ones, and hence the necessity for selecting some specified substance with which to do the weighing.

We are thus forced to the conclusion that the prescribed conditions were all necessary in determining with requisite accuracy the unit of weight from the unit of length, nor are we surprised that this method was not adopted to produce a new standard so long as any other means of doing so was available.

The unit of capacity is the space occupied by 10 lbs. Avoirdupois of distilled water weighed in air, the temperature being 62° F. and the barometer at 30 in. This unit is called the *Imperial* gallon. It is easy to find the number of cubic inches in a gallon, for if 252.458 grs. of water occupy one cub. inch it follows that 10 lbs. or 70,000 grs. must occupy 277.274 cubic inches. This space might, therefore, have been fixed upon as the unit of capacity, and the necessity for any reference to the density or temperature avoided, that is,