lary orifice. Then, if it is wished to free the tube entirely of air, the bulb is heated fully to the highest temperature it is ever intended to measure, and whilst in that state, the mercury then filling the whole tube, the capillary point is to be melted in the flame of a lamp.

To render a very slender thread of mercury more distinct­ly visible, Dr Wilson of Glasgow introduced tubes with flat­tened bores. This form, which is now in very general use, has often been objected to, as tending to render the bore unequal ; but from attentively witnessing the process of drawing tubes, we are rallier at a loss to see any ground for the objection. The uniformity of a bore may be easily tested by trying whether the same minute quantity of mer­cury occupies the same length in every part of the tube when shifted through it. There is however one fortunate circumstance regarding tubes, which seems to be entirely overlooked, namely, that the bore, whether cylindrical or flattened, is seen considerably magnified by the refraction of the glass.

The bulbs of thermometers are generally spherical. Sometimes, however, to suit particular purposes, or to ac­quire more speedily the temperature of contiguous bodies, other figures are given them, such as that of a pear, an egg, a lens, or a cylinder. When a bulb is exposed to any pressure materially different from the mean of the atmo­sphere, its size, especially if large and thin in the glass, is so much affected as sensibly to alter the height of the mer­cury in the stem ; but this is so different in different ther­mometers, that the requisite correction can only be ascer­tained for any one by actual trial.

The fixed points which are now universally adopted for thermometers are the boiling and freezing points of water. The boiling water point, it is well known, varies some de­grees according to the pressure of the atmosphere. In an exhausted receiver water boils at 98° or 100° Fahrenheit, whereas in Papin’s digester it may require 400°. Nay, unless the bottom of the digester be hotter than the top, the pressure of the steam will completely prevent any boil­ing till the vessel burst. Hence it appears that water boils at a lower point, according to its height in the atmosphere, or to the smaller pressure of the air upon it.

The history, as well as the mode of applying the varia­tions in the boiling point of water to the mensuration of heights, has been given by Sir John Leslie under the article Barometrical Measurements, vol. iv. p. 401, which probably was written for the Supplement to the former edition of this work, before Dr Wollaston hail described his thermometrical barometer in the Philosophical Transac­tions for 1817. But at the Dublin meeting of the British Association, Colonel Sykes, after objecting to this refined apparatus, as expensive, and so fragile as to be extremely liable to accidents in travelling on mountains, described a variety of very satisfactory measurements which he had made with common thermometers.

As artists may be obliged to adjust thermometers under very different pressures of the atmosphere, M. Deluc, in his *Recherches sur les Mod. de l'Atmosphere,* from a series of experiments, has given an equation for this difference, in Paris measure, which has been verified by Sir George Shuckburgh ; who, as well as Dr Horsley and Dr Maskelyne, has adapted the equation and rules to English measures, and reduced the allowances into tables. Dr Horsley’s rule de­duced from Deluc's is this :

99000/899log.*z*-92·804=*h*,

where *h* denotes the height of a thermometer plunged in boiling water above the point of melting ice, in degrees of Fahrenheit, and *z* the height of the barometer in 10ths of an inch. From this rule he has computed the correction in the second column of the following table :

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Barometer. | Deluc’s Correction. | Differ­ence. | Shuckburgh’s Correction. | Differ­ence. |
| 26∙0  26∙5 | — 6∙83  — 5∙93 | ·90 | — 7∙09  — 6∙18 | ∙91 |
| 27∙0 | — 5∙04 | ·89 | — 5∙27 | ∙91 |
| 27∙5 | —4∙16 | ·88 | —4∙37 | ∙90 |
| 28∙0 | —3∙31 | ·87 | —3∙48 | ∙89 |
| 28∙5 | —2∙45 | ·86 | — 2∙59 | ∙89 |
| 29·0 | — 1∙62 | ·83 | — 1∙72 | ∙87 |
| 29∙5 | — 0∙80 | ·82 | — 0∙85 | ∙87 |
| 30∙0 | 0∙00 | ·80 | 0∙00 | ∙85 |
| 30∙5 | + 0∙79 | ·79 | +0·85 | ∙85 |
| 3l∙0 | + 1∙57 | ·78 | + 1∙69 | ∙84 |

In the first column is the height of the barometer, in inches. The second shows the correction to be applied, according to the sign, to 212° of Fahrenheit, to find the true boiling point, which for all intermediate states of the barometer may be had with sufficient accuracy by taking proportional parts. The fourth column contains a correction for the same purpose, according to the experiments of Sir George Shuckburgh. See Philosophical Transactions, vol. lxiv. art. 20 and 30.

The temperature of steam in a nearly closed vessel is more steady, and slightly lower than that of boiling water; and the latter is from 2° to 4° higher in a glass vessel than in one of metal. It is of material importance that the water be pure, because foreign substances are apt to affect both the freezing and boiling points.

The Royal Society, fully apprised of the importance of adjusting the fixed points of thermometers, appointed a committee to consider the best method for this purpose. See Philosophical Transactions, vol. lxvii. part ii. art. 37.

Although the boiling point be placed rather higher on some thermometers than on others, this produces very little error in observations on the weather, at least in this climate ; for an error of 11/2° in the boiling point will make an error only of half a degree in the position of 92°, and of not more than a quarter in that of 62°. It is only in nice expe­riments, or with hot liquors, that this can be of importance. In adjusting the freezing as well as the boiling point, the tube ought to be kept of the same temperature as the ball. Many a thermometer, whilst undergoing this operation, has little more than the bulb immersed in the bath which is to give the requisite temperature, the stem being just allowed to take its chance of holding some unknown tem­perature intermediate between those of the bath and of the air. The indications of such an instrument, though pretty well adapted for ordinary chemical purposes, must be some­what uncertain. But it is evidently impossible to apply a correction for this, either to an instrument so vaguely gra­duated, or indeed to the very best of thermometers when used with the stem at an unknown temperature ; so that tables formed upon the idea that the stem has always the same temperature as the air of the apartment, cannot be expected to afford the proper correction, especially consi­dering how rapidly hot air and vapour may rise around the stem, from a hot liquor. A mode of lessening this error will afterwards be noticed.

In the ordinary manufacture of thermometers, it is reck­oned sufficient to place the new instrument horizontally in a bath along with a standard thermometer, and to mark on it the corresponding degree, or part of a degree ; next, either to change the temperature of the same bath, or to put the instruments together into a bath of a different tem­perature, marking the degree as before. The space be­tween the two points so marked is then divided equally into the corresponding number of degrees (regard of course being had to any fraction), and the like division, if neces-