end of the tube into a vessel of coloured alcohol, and then heating the ball to expel the greater part of the air, or by placing it under a receiver of the air-pump. When the thermometer is properly filled, the end D is closed by drawing it to a point, and slightly melting it at a lamp, and it is then said to be hermetically sealed. Formerly the in­cluded air was generally left of about one third its natural density, to prevent the alcohol in the tube from separating ; but some now try to expel the air entirely, and assign the same reason for so doing. When the temperature in­creases, the alcohol expands, and rises in the tube ; and when the heat decreases, it descends, as measured by means of an attached scale.

The alcohol thermometer, being unaffected by varia­tions in the pressure of the atmosphere, soon came into ge­neral use, and was at an early period introduced into Bri­tain by Mr Boyle. To this instrument, as then used, there are, however, many objections. The liquor employed not being always of the same strength, different tubes filled with it, and exposed to the same temperature, did not cor­respond. It was another defect, that the scale did not com­mence at any fixed point. The highest term was adjust­ed to the great sunshine heats of Florence, which are very variable and undetermined ; and frequently the workman formed the scale after his own fancy. While the thermo­meter was so defective, it could not be of general use.

To discover some fixed point by which a determinate scale might be obtained, to which all thermometers might be accurately adjusted and rendered comparable among themselves, was the next desideratum. Mr Boyle, who had at an early period studied the subject, proposed the freezing point of oil of aniseeds ; but this he soon aban­doned. Dr Halley next proposed that thermometers should be graduated in a deep pit, where the temperature in all seasons is pretty uniform ; and that the point at which the spirit of wine stood there, should be the commencement of the scale. But this was evidently so inconvenient that it also was speedily abandoned. The freezing point of water he regarded as a variable one.

It seems to have been reserved for the genius of Sir - Isaac Newton to determine this important point, on which the accuracy and value of the thermometer depends. He chose, as fixed, those points at which water freezes and boils ; the very points which experiments have since de­termined to be the most fixed and convenient. Sensible of the disadvantages of spirit of wine, he tried linseed oil, which is capable of about fifteen times greater expansion. It has not been observed to freeze even in great colds, and it bears a considerable heat before it boils. With these advantages, it was, in 1701, used by Newton, who esti­mated by it the temperatures of boiling water, melting wax, boiling spirit of wine, and melting tin. His method of ad­justing the scale was this. Supposing the bulb, when im­mersed in thawing snow, to contain 10,000 parts, he found the oil expand by the heat of the human body so as to take up 1/39th more space, or 10,256 such parts ; and by water boiling strongly 10,725, and by melting tin 11,516: so that, reckoning the freezing point as a common limit be­tween heat and cold, he there began his scale, marking it 0°, and the heat of the human body he made 12° ; and as­suming the degrees of heat proportional to the expansion, or 256 : 725 ; : 12 : 34, this last will express the heat of boiling water, and, by the same rule, 72 that of melting tin.

To the application of linseed oil as a measure of heat and cold, there are insuperable objections. It is so viscid, and adheres so strongly to the sides of the tube, that it moves too slowly. In a sudden cold, so much remains ad­hering to the sides of the tube, that the top of the oil is seen lower than the temperature requires it

All the thermometers hitherto proposed having been liable to many inconveniences, this led Reaumur to attempt

a new one, which was described in tire *Mémoires de l'Académie* for 1730. This thermometer was made with spirit of wine. He took a large ball and tube, graduating the latter such, that the space from one division to another might contain the 1000th part of the liquor as it stood at the freezing point, which he adjusted by an artificial con­gelation of water. Then putting the ball and part of the tube into boiling water, he observed whether it rose eighty divisions ; if it exceeded these, he added water, or if it fell short of eighty divisions, he added rectified spirit. The liquor thus prepared served for making a thermometer of any size which would agree with his standard.

But as the bulbs were three or four inches in diameter, the surrounding ice would be melted before its tempera­ture could be communicated to the whole bulb, and con­sequently the freezing point would be marked too high. Dr Martine accordingly found, that instead of 32° Fahren­heit, it corresponded with 34°, or a little above it. Doubts have often been started whether Reaumur had really ever put his thermometer in boiling water, considering that al­cohol boils at a much lower temperature. But unless the upper end of the tube be open, or comparatively cold, the alcohol so enclosed will, owing to the increased pressure, scarcely boil at all, and more especially if a portion of air be included along with it. No doubt there will be some risk of bursting the bulb, though not much with such weak alcohol as Reaumur’s. It is however quite obvious that the boiling point of any liquid with which a thermometer may be filled is not necessarily the upper limit of its scale.

At length mercury was proposed as a fluid preferable to any yet employed in the construction of thermometers. The first idea of this is usually ascribed to Dr Halley ; but he did not put it in practice, on account of the small ex­pansibility of mercury. Boerhaave says the mercurial ther­mometer was first constructed by Olaus Roemer ; but the honour of this is generally given to Fahrenheit of Amster­dam, who described it to the Royal Society of London in 1724.

Mercury is superior to alcohol and oil, except for very low temperatures, and is much more manageable than air. Of all liquids it is the most easily freed from air. It sus­tains a beat of 680° of Fahrenheit’s scale, and does not congeal till it fall 39 or 40 degrees below 0°. It is the most sensible of any fluid to heat and cold, even air not excepted. Count Rumford found that mercury was heated from the freezing to the boiling point of water in 58 se­conds, while water took 133 and air 617 seconds. The ex­pansion of mercury is only about 1/6th of that of alcohol, but it is sufficient for most of the purposes of a thermome­ter. As to what is usually esteemed the chief thermometric property of mercury, that of its variations of volume being nearly proportional to the variations in its absolute heat ; this at best only argues the mercurial thermometer to be a toler­ably good measure of the variations of its own heat, or of that of any other mass of mercury, which certainly is a property of very limited importance, if, after all, it leave us in the dark regarding the relation which subsists between the degrees of the mercurial scale and the corresponding variations of the absolute heat in other bodies.

Perhaps the simplest mode of filling a mercurial thermo­meter is to put the mercury into a paper funnel tied round the top of the tube. But unless the bore be unusually large, no mercury will enter it till the air be more or less expelled by heating the bulb ; and then, on allowing it to cool again, the atmospheric pressure will force in the mer­cury. This operation should be done cautiously, by alter­nately heating gently and then cooling the bulb, and at length making it boil so as completely to expel the air. It is almost needless to add, that the tube as well as the mer­cury should be perfectly clean. To close the extremity of the tube, it is first softened by heat and drawn to a capil-