

to measure it, and found a deficiency of about 7 per cent of the volume indicated by the excise gauge. It was thought that the effect of the extreme cold might have something to do with the apparent loss, and for the satisfaction of all parties, it was concluded to refer the matter to the writer for decision.

The published tables of the expansion of alcohol by heat do not go lower than a temperature of 30° F., and the statements of authorities as to the general rate of expansion for each degree of heat do not correspond. According to Tralles, alcohol expands between -26° C. and $+37^{\circ}$ C., with tolerable uniformity; the dilatation is given at 0.00047 of the volume for each degree, Fahrenheit. From the tables of Guy Lussac, the average rate of contraction between $+74.14^{\circ}$ C. and O.C. may be calculated at 0.00059 for each degree, Fahrenheit. As the rate of expansion of alcohol varies with the amount of dilution, it is probable that this want of coincidence is due to the spirit used for experiment not being of the same degree of strength.

Being therefore unable to find any data which suited my purpose for the calculation of the expansion of spirit of the desired degree of strength, and at a sufficiently low temperature, I determined to make a few experiments, which, though performed with apparatus of a somewhat imperfect description, would still afford results sufficiently accurate for practical purposes.

A burette graduated into 250 equal divisions, was employed as a dilatometer. As the tube thermometers at command could not conveniently be immersed in the liquid, an ordinary thermometer, of the kind used for general purposes, was suspended, side by side, with the burette. The spirit used was of the strength usually sold, being 65 over proof on Sykes' scale, corresponding with sp. gr. .820, and containing about 91 per cent, by weight, of absolute alcohol, or 94 per cent, by volume. The burette was filled with this spirit at a temperature of 60° F., and was subjected to exposure in situations where the temperature appeared constant.

A number of observations were made in this way at temperatures ranging from 60° F. to 10° F. Recourse was then had to a mixture of snow, common salt, and nitrate of ammonia, whereby the thermometer fell to -20° F. These observations were repeated three times, but on comparing the results it was found that there were