(1) That the effect which ether-oxygen exerts on the viscosity of a liquid differs to a marked extent from the effect exerted either by hydroxyl-oxygen or carbonyl-oxygen, and that

(2) The viscosity of the formate is abnormally large when compared with that of other esters, and indicates that the exceptional behaviour of formic acid is to some extent retained by its ethereal salts.

"On the Determination of Freezing Points." By J. A. Harker, D.Sc. Communicated by Professor Schuster, F.R.S. Received June 15,—Read June 18, 1896.

(Abstract.)

Of recent years great improvements have been made in the construction of accurate thermometers. For their graduation and study, the position of the thread for at least two fixed temperatures must be known with certainty, and one of these is generally the freezing point. According to many observers, the methods at present in use for the determination of this point are unsatisfactory and cannot be relied on, even when considerable precautions are taken, to more than about 0·001° to 0·002°. The object of the present communication is to describe a method by which more consistent results can be obtained, and which is applicable to all kinds of thermometers.

The method adopted is to cool distilled water in a suitable vessel, protected from radiation, to a temperature below 0°, to insert the thermometer, and then bring about the freezing of the water by dropping in a crystal of ice. The thermometer then rises, and finally attains a steady temperature, differing only very slightly from the true zero.

Within the space allotted to this abstract, it is not possible to describe in detail all the precautions to be adopted and the apparatus employed, and for these reference must be made to the original paper. The following brief outline may, however, be given.

The apparatus consists of two portions, the thermostat and the cooler. The former is a rectangular copper vessel, filled with some liquid, which can be cooled below 0° without solidifying.

Generally either refined petroleum or a strong solution of common salt is employed. This vessel communicates by means of two wide tubes with a system of coils in the cooler, through which the liquid can be pumped by a rotary stirrer. These coils are surrounded by a freezing mixture at about −8°, and by this means the circulating liquid can be cooled and maintained for some time at about −2°. The distilled water to be frozen is contained in a tube of about 300 c.c. capacity made of clear glass. This is first placed directly

into the circulating liquid, and cooled quickly to $-0{\cdot}5^\circ$ or $-0{\cdot}7^\circ$. It is then transferred to a copper cylinder lined with polished metal, placed in the centre of the thermostat, an annular space of about 1 cm. being left between them. The thermometer whose zero is to be taken is then quickly fixed in position in a spring clamp, the bulb and a considerable length of the stem above the zero being immersed in the water. A crystal of ice is dropped in, and the temperature quickly rises to the freezing point.

For the details of the arrangement for the illumination of the divisions, and taking the readings through the mass of the liquid containing the ice crystals in suspension, reference must be made to the paper.

The amount of ice formed in the liquid varies of course with the undercooling. Experiments made with good mercurial thermometers showed that if ice be present in sufficient quantity, the final temperature attained by the mixture of ice and water is not influenced perceptibly by variation of the temperature of the circulating liquid within fairly wide limits. As, however, it is extremely doubtful whether the indications of any mercurial thermometer can be relied on beyond $0{\cdot}001^\circ$, it seemed desirable to control this result by some other means.

A platinum thermometer and bridge were therefore designed, capable of indicating with certainty a change of $0{\cdot}0001^\circ$, and a description of the whole arrangement employed to attain this degree of accuracy forms the second half of the paper. The resistances in the bridge were of manganin, whose temperature coefficient is only about $\frac{1}{20}$ that of the usual resistance alloys, and the plugs usually employed for short circuiting the coils were replaced by copper bars and mercury contacts of specially low resistance. The thermometers employed were of about 10 ohms resistance, and were provided with the compensating leads, devised by Mr. Callendar. The maximum current which can be used in accurate measurements with these thermometers is about $0{\cdot}02$ ampère, and therefore the galvanometer employed required to be extremely sensitive. The instrument selected was a low resistance astatic one with vertical needle system of the type described by Weiss, and gives at the greatest sensibility at which the zero is steady one scale division for 1×10^{-10} ampère at 2500 scale divisions distance.

With this arrangement the influence of various conditions on the final temperature attained by the mixture of ice and water was studied. The results were found to be in close agreement with the theoretical deductions of Nernst, and it was found that with the right conditions, it was quite easy to keep the temperature in the freezing vessel constant, to within one or two ten-thousandths of a degree for an hour at a time.

The conclusion drawn from the previous experiments made with mercurial thermometers as to the small influence of changes in the external temperature, and in the temperature of the circulating liquid on that of the freezing vessel, was also confirmed, and it was found that in the final form of apparatus adopted, a change of two or three degrees in the temperature of the circulating liquid only caused the temperature of the mixture in the tube to alter by three or four ten-thousandths.

"Étude des Carbures Métalliques." By M. Henri Moissan. Communicated by Professor Ramsay, F.R.S. Received June 11,—Read June 18, 1896.

Les combinaisons définies et cristallisées du carbone avec les métalloïdes et les métaux étaient très peu connues jusqu'ici. On savait seulement que certains métaux tels que le fer, pouvaient dissoudre du carbone, et donner des fontes.

Les connaissances des chimistes sur ce point étaient peu étendues parce que ces combinaisons ne se produisent qu'à une température très élevée. L'application que j'ai faite de l'arc électrique comme moyen de chauffage d'un appareil de laboratoire m'a permis d'aborder cette question. Je résumerai mes recherches sur ce point dans cette note.

À la haute température du four électrique un certain nombre de métaux, tels que l'or, le bismuth, le plomb, et l'étain ne dissolvent pas de carbone.

Le cuivre liquide n'en prend qu'une très petite quantité, suffisante déjà pour changer ses propriétés et modifier profondement sa malléabilité.

L'argent à sa température d'ébullition dissout une petite quantité de carbone qu'il abandonne ensuite par refroidissement sous forme de graphite. Cette fonte d'argent, obtenue à très haute température, présente une propriété curieuse, celle d'augmenter de volume en passant de l'état liquide à l'état solide. Ce phénomène est analogue à celui que nous rencontrons dans le fer.

L'argent et le fer purs diminuent de volume en passant de l'état liquide à l'état solide. Au contraire, la fonte de fer et la fonte d'argent dans les mêmes circonstances augmenteront de volume.

L'aluminium possède des propriétés identiques.

Les métaux du platine à leur température d'ébullition dissolvent le carbone avec facilité et l'abandonnent sous forme de graphite avant leur solidification. Ce graphite est foisonnant.

Un grand nombre de métaux vont, au contraire, à la température du four électrique produire des composés définis et cristallisés.