upon the viscosity of a large number of liquids of initially low viscosity has, however, been measured by Bridgman,[1] and correlated with the complexity of the molecular structure. Similarly, the effect of temperature upon viscosity has been related by Sheppard[2] to the effective molecular weight in the liquid state. Wolarowitsch and Leontjewa[3] have used Sheppard's theory to calculate the number of associated molecules in glasses of SiO_2 and B_2O_3; they find that the effective molecular weight corresponds, in B_2O_3 glass, to 53 molecules at 500°C, to 73 at 350°. These considerations lead us to anticipate an important effect of pressure upon the viscosity of glasses of even the simplest chemical composition.

In order to reduce the viscosity of most glasses, especially of silicate glasses, to an order of magnitude such that many of the more reliable methods of measuring viscosity can be applied, the temperature must be raised to from 400° to 1000°; there are evident difficulties in combining these temperatures with enough pressure to give measurable effects. There is the further serious difficulty that the dependence of viscosity upon temperature is so great that extremely close control of the temperature is essential. With these two factors in mind, we have chosen for an initial study a material of no geological importance, but one which is characterized by a low viscosity and also by an unusually low temperature coefficient of viscosity. This material is anhydrous boric trioxide, B_2O_3; an additional advantage in using this glass is that it has recently been the subject of a number of studies of its density, viscosity and other properties, as functions of temperature at ordinary pressure.[4] The reasonably good agreement between the results of different investigators for the viscosity-temperature curve indicates the reliability of B_2O_3 for the present purpose. Studies with the rotating-cylinder viscometer have demonstrated, moreover, the absence of a "yield point," or of any departure from purely viscous behavior, for temperatures above approximately 300°.

The method which we have adopted was originally used by Barus;[5] with refinements of technique and of theory, it has been employed by Hersey and Snyder[6] for a study of the effect of pressure on the viscosity of oils. The material under investigation is forced from a high pressure cylinder in which a constant pressure is maintained, through a capillary tube into the open air, where it is collected and weighed after a measured time interval. The rate of flow is found as a function of the pressure at the inner end of the capillary and from this relation may be derived the dependence of the viscosity upon pressure.

2. Apparatus and Procedure

With this method, the parts in which the high pressure is established, including the capillary, must all be maintained at the required high temperature. We have used one variety of stainless steel (Allegheny 44), for the pressure cylinder, and another (Allegheny metal), for the capillary and connecting pipe. The arrangement of the principal parts is shown in Fig. 1. The cylinder (A) is surrounded by a heavy copper cylinder (B), which in turn is placed centrally in a much longer tubular, wire-wound resistance furnace. Pressure is generated in a hydraulic press, of the type used by Bridgman, and measured by the change of resistance of a 200-ohm manganin coil, mounted in a cylinder at room temperature. The pipe (F) leads from the high temperature cylinder (A) to a block with two valves outside the furnace; from this block runs another pipe to the hydraulic press. The two valves are arranged to permit the sudden application or release of the pressure in the cylinder (A). The glass is extruded from the capillary (E) at the bottom, where it is collected by appropriate methods.

The pressure medium was nitrogen; originally the gas was allowed to act directly upon the glass

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