Of the theoretical relationships that have been proposed for viscosity as a function of volume, that of Batschinski[7] has been the most useful. His equation states that viscosity is related to the specific volume in the following way

$$\eta = c/v - \omega.$$

c and ω are characteristic constants of the liquid. Batschinski showed that if the change of fluidity of normal liquids, such as benzene and ethyl ether, was expressed with change of volume caused by change of either temperature or pressure, a linear relation resulted as demanded by his equation. But the data on viscosity and volume as functions of pressure were so limited in range of pressure available at that time, that both quantities could be fairly well expressed as linear functions of pressure. It is well known that such functions do not remain linear through the range of pressure now available.

Batschinski's equation has been used lately by Bingham and Brown,[8] Bingham and Coombs,[9] and Lederer[10] in deducing theories of viscosity. Although there is little experimental information concerning lubricants in this respect, R. N. J. Saal[11] in discussing the influence of pressure on the viscosity of a nonplastic, asphaltic bitumen, considered that his experimental data showed that the decrease of viscosity as the temperature rose was due to the effect of thermal expansion. Thus in addition to what has already been established without any assumption as to theory, namely, that viscosity is not a function of volume only, it is desirable to call attention to the failure of Batschinski' equation at high pressures, for this limitation does not seem to have been generaly established.

Bridgman[4, 12] has published viscosity-volume data for several normal liquids. His results gave curves similar to the figures of this paper. An examination of Batschinski's equation by substitution of Bridgman's data gives a general result that in no case is a linear relation obtained between fluidity and specific volume. Benzene, ethyl ether, pentane, etc., obey the Batschinski equation at atmospheric pressure, that is when the equation is applied for change of temperature, but at higher pressures the invalidity of the equation is beyond experimental error.

Consequently, on referring to Figs. 1, 2, and 3 again, it is not unexpected that the fluidity curves would not bear a linear relation to the volume, and the observed displacements of the curves show that the viscosity, or fluidity, is also a function of temperature. Accordingly, the constants c and ω of Batschinski's equation vary with pressure and temperature for these three oils. These data establish a point of much theoretical interest, namely that pressure and temperature changes affect viscosity differently.

Bridgman[13] in a recent paper on some of the theoretical aspects of high pressure phenomena has discussed the effects of temperature and pressure on the energy of solids, showing that in the case of NaCl the change of energy internal to the atom is nearly three times as great when a definite change of volume is brought about by a change of pressure as when brought about by a change of temperature. His explanation considers a compressible atom as demanded by a theorem of Schottky. It is likely that the fundamentals of the situation apply to liquids and give a possible explanation of the different effects of pressure and temperature on viscosity, although the problem remains to be treated quantitatively. The experimental evidence for the compressible atom is uncontrovertible to such an extent that Batschinski's conception of atomic volume constants cannot be valid over a wide experimental range. It is the desire of the author to call attention to these serious limitations of Batschinski's theory as demanded by the experimental data, rather than to question the usefulness of the relation at atmospheric pressure.

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