

Shear's polysaccharide was shown by this method to inhibit the clotting of recalcified plasma; its effect is therefore heparin-like. Comparison with various commercial heparin preparations showed them to be approximately 138-320 times more effective.

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<sup>1</sup> Shear, M. J., and Turner, F. C., *J. Nat. Cancer Inst.*, **4**, 81 (1943).  
Hartwell, J. L., Shear, M. J., and Adams, J. R., *ibid.*, **4**, 107 (1943).

<sup>2</sup> Heilbrunn, L. V., and Wilson, W. L., *Proc. Soc. Exp. Biol. and Med.*, **70**, 179 (1949).

<sup>3</sup> Heilbrunn, L. V., and Wilson, W. L., *Science*, **112**, 56 (1950); *Proto-plasma*, **39**, 389 (1950).

### Surface Tension of Liquid Metals

Atterton and Hoar's<sup>1</sup> communication recalls two papers recently published on this subject. Schytil<sup>2</sup> has shown that the surface-tension  $\sigma$  is related to the melting point  $T_m$  and the atomic volume  $V$  by

$$\sigma_s = K_1 T_m V^{-2/3}, \quad (1)$$

where  $K_1$  is a constant. The other paper, due to Auerbach<sup>3</sup>, contains data to show that, for a considerable number of substances, including metals and even liquid helium,

$$\sigma = K_2 \rho v^{3/2}, \quad (2)$$

where  $\rho$  is the density of, and  $v$  the velocity of sound in, the substance,  $K_2$  being another constant. As Schytil points out, expression (1) can be converted to one similar to that due to Wen Po<sup>4</sup>:

$$\sigma = K_3 A \nu_D^2, \quad (3)$$

where  $A$  is the atomic weight,  $\nu_D$  the Debye frequency, and  $K_3$  another constant.

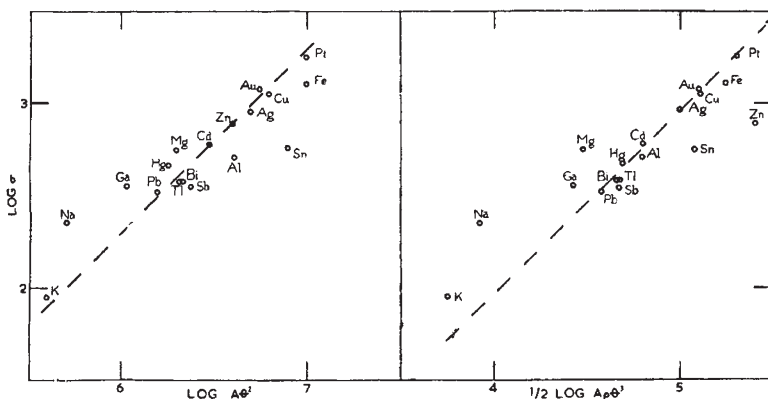
If we postulate (a) that the cube of the transverse velocity,  $c_t$ , is small as compared with that of the longitudinal velocity,  $c_l$ , or (b) that in many cases there is a linear relation between the two<sup>5</sup>, Debye's expression for the number of oscillators assumes the form:

$$V \nu_D^3 = K_4 v^3, \quad (4)$$

where  $V$  is the atomic volume and  $K_4$  a constant. Combining (4) with (2) and introducing the Debye temperature  $\theta_D$  instead of the frequency  $\nu_D$ ,

$$\sigma^2 = K_5 A \rho \theta_D^3 = K_5 \rho, \quad (5)$$

where  $K_5$  is a constant.



In order to reveal the discrepancies for small values of  $p$ , it is better to plot the logarithms of both sides of this equation. The values of  $\rho$  are taken from the International Critical Tables; those for  $\theta_D$  are given by Seitz<sup>6</sup>. The data for  $\sigma$  are obtained from Atterton and Hoar's graph and from the International Critical Tables. They refer to temperatures at or near the melting point. It will be seen that the semi-empirical expression (5) is fairly successful in several instances. If the linearity of the data is compared with that to be expected from equation (3), it will be realized that there is little to choose between the two. The lines have slopes equal to unity: it would seem that slopes somewhat smaller than this would provide a better fit for each set of points. The best-fitting straight lines calculated from the regression coefficients have slopes of 0.861 and 0.856 corresponding to equations (3) and (5) respectively; they are not inconsistent with the theoretical values of unity. The fact that both expressions (3) and (5) are roughly satisfied is probably due to the inaccuracy of the experimental data, and also suggests that the empirical expression (2) is only another form of the one due to Wen Po<sup>4</sup>.

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<sup>1</sup> Atterton and Hoar, *Nature*, **167**, 602 (1951).

<sup>2</sup> Schytil, *Z. Naturforsch.*, **A**, **4**, 191 (1949).

<sup>3</sup> Auerbach, *Experientia*, **4**, 473 (1948).

<sup>4</sup> Wen Po, *Phil. Mag.*, **23**, 33 (1937).

<sup>5</sup> Joos, "Theoretical Physics".

<sup>6</sup> Seitz, "Modern Theory of Solids".

In a communication in *Nature* of April 14, Messrs. Atterton and Hoar recorded the conclusion that "surface tension is approximately inversely proportional to atomic volume". May I venture to recall that this is a conclusion which I put forward some thirty-seven years ago, based upon determinations of the surface tensions of some of the commoner metals, which I had made at the Royal Mint, by measuring the depths of depressions in carbon tubes of small bore<sup>1</sup>. By plotting the reciprocals of the surface tensions of these metals against their atomic weights and side by side with their atomic volumes, the resemblance to Lothar Meyer's well-known curve became apparent. The resemblance was even closer when these reciprocals were plotted side by side with atomic volumes raised to the 2/3 power<sup>2</sup>. I felt justified, therefore, in suggesting that the surface tensions of molten metals, like other properties, are periodic functions of their atomic weights and that they vary inversely as some function of their atomic volumes. Now that figures for the surface tensions of more elements are available, it is satisfactory to find that Messrs. Atterton and Hoar have arrived at the same conclusion.

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