Table I. Comparison of the mean Grüneisen parameter $\gamma_{av,0}$ as deduced from the constant C with other values of γ.

	$\langle\Delta_0 V/V_0\rangle_{av}$	C	$\gamma_{av,0}$	γ_{av}	γ_0	γ
Li	0.149[a]	0.537[b]	0.327	...[c]	0.81[d]	1.17[e]
Na	0.202	1.65	0.560	$(1._2)$	1.1_5	1.37
K	0.340_5	1.61	0.300	0.9_5	1.2	1.41
Rb	0.293	1.62	0.378	1.4	1.6_5	1.86

[a]From data of Bridgman (Ref. 10).
[b]From Kraut and Kennedy (Ref. 1) as converted to values corresponding to use of absolute rather than centigrade temperatures in Eq. (1).
[c]Gilvarry (Ref. 6).
[d]Gilvarry (Ref. 2).
[e]From Grüneisen (Ref. 5) as corrected by Gilvarry (Ref. 2).

of T_M vs $\Delta_0 V/V_0$ by Kraut and Kennedy. Birch's isothermal equation of state[11] in the form $P = (\frac{3}{2})K_0(\epsilon_{av}^{-7/3} - \epsilon_{av}^{-5/3})$ was used to compute $\kappa_{av,0} = \frac{1}{2}(7\epsilon_{av}^{-7/3} - 5\epsilon_{av}^{-5/3})$. One sees that the values of $\gamma_{av,0}$ fall in the normal range (up to about 3)[12] for Grüneisen constants of solids. No theoretical reason exists for $\gamma_{av,0}$ to be identical with γ_{av}, since the latter parameter represents an average along the fusion curve and corresponds to a range of pressure up to only 12 kbar. Clearly, the values of $\gamma_{av,0}$ and γ_0 are consistent with the known positive sign[7] of the derivative $(\partial\gamma/\partial \ln V)_T$ at the initial fusion temperature T_0 for each element.

Contrary to possible implications of the discussions by Kraut and Kennedy[1] and by Kennedy,[13] it would seem from the present results that Eq. (1) represents an interpolation (or extrapolation) formula in the same sense established for the Simon equation in III on the basis of the Lindemann law (and hence the relation does not yield a fundamental criterion of melting). In consonance with this interpretation, the result of II from the Simon equation for the melting point of iron at the boundary of the inner core of the earth, given as $5._9 \times 10^3$ °C with a stated limit of error of ±25%, agrees within the corresponding bounds with Kennedy's estimate[13] of 3725°C from Eq. (1), for a reasonably presumed error limit of ±25%. Note that Kennedy's estimation neglects the effect of the terms of order $(V_0 - V_M)^2$ and $(V_0 - V_M)(T_M - T_0)$ implicit in Eq. (4), which can be evaluated from this work.

These results obviously permit one to find the form of Eq. (1) corresponding to low melting temperatures (as in molecular crystals), when the quantization parameter Q_M of I does not reduce to unity.

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[1]G. C. Kennedy, cited by E. A. Kraut and G. C. Kennedy, Phys. Rev. Letters 16, 608 (1966).
[2]J. J. Gilvarry, Phys. Rev. 102, 308 (1956), referred to hereafter as I.
[3]J. J. Gilvarry, Nature 178, 1249 (1956); J. Atmospheric Terrest. Phys. 10, 84 (1957), referred to hereafter as II.
[4]J. J. Gilvarry, Phys. Rev. 102, 317 (1956).
[5]E. Grüneisen, in Handbuch der Physik (Verlag Julius Springer, Berlin, 1926), Vol. 10, pp. 1-59.
[6]J. J. Gilvarry, Phys. Rev. 102, 325 (1956), referred to hereafter as III.
[7]J. J. Gilvarry, J. Appl. Phys. 28, 1253 (1957).
[8]G. C. Kennedy, J. Geophys. Res. 67, 2559 (1962).
[9]K. F. Sterret, W. Klement, Jr., and G. C. Kennedy, J. Geophys. Res. 70, 1979 (1965).
[10]P. W. Bridgman, Proc. Am. Acad. Arts Sci. 76, 55, 71 (1948).
[11]F. Birch, J. Geophys. Res. 57, 227 (1952). The equation actually involves a correction factor which is nearly unity, depending on a constant parameter ξ. Since ξ vanishes closely for the alkali metals at normal temperature, a corresponding approximation has been made for the melting temperature T_0.
[12]J. C. Slater, Introduction to Chemical Physics (McGraw-Hill Book Company, Inc., New York, 1939), pp. 393, 451, 454; J. J. Gilvarry, J. Chem. Phys. 23, 1925 (1955).
[13]G. C. Kennedy, Trans. Am. Geophys. Union 47, 173 (1966).

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