As the new melting curve, corrected somewhat arbitrarily for the mechano-caloric heat leakage, cuts the temperature axis about 0.4°K when extrapolated, it seems reasonable to check for the triple point of helium (the "ordinary" triple point) in the magnetic region of cooling.

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[*] This work is carried out under a grant from the National Research Council of Canada.

[†] A brief account of this work was given at the meeting of the Physics Section of the Royal Society of Canada on June 3, 1952.

[‡] After writing this letter, the author read in a recent article in the Physical Review [P. Closmann and R. T. Swim, Phys. Rev. **86**, 576 (1952)] that Dr. K. Mendelssohn, F. R. S., suggested an experimental investigation of the thermal gradient in the "helium wire." The experimental results reported there are in complete agreement with views expressed in this letter.

[1] C. A. Swenson, Phys. Rev. **79**, 626 (1950).

Geiger-Nuttal Relation and α-Ray Spectra

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ATTEMPTS have been made by Berthelot and others[1,2] to improve the original Geiger-Nuttal[3] curves by choosing the "same charge number Z," instead of the "same neutron-excess" as the basis for joining the points. However, recently Perlman *et al.*[4] showed that in fact all nuclei except the even-even ones deviate considerably from the above linear relation. Besides, the deviations of the spectral components of lower intensities are usually more serious.

In view of this well-known difficulty in correlating different elements, we consider here each alpha-spectrum (i.e., each element) individually with regard to the relation logλ *vs* decay energy E. Partial α-decay constants λ_k are plotted against the corresponding decay energies of all the spectral components, and the points for the "same Z and same mass-number A" have been joined. The curves obtained will be discussed in detail in a separate paper, while some typical ones are shown here in Fig. 1 (solid lines), along with the usual Geiger-Nuttal curves (dotted lines).

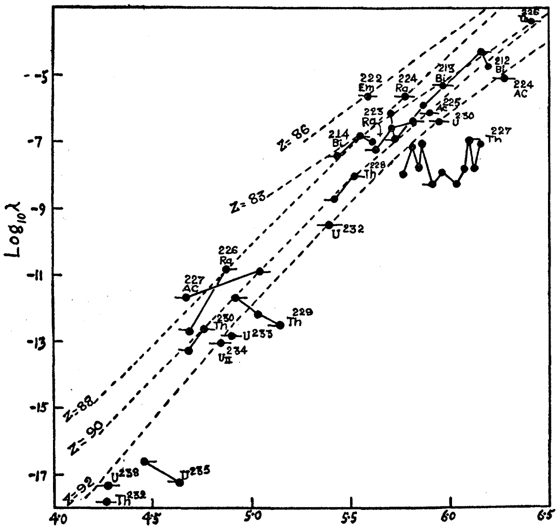

FIG. 1. A dotted line is the usual Geiger-Nuttal curve for the same Z, while a solid line represents a logλ_k *vs* E curve for an α-spectrum. -●- represents an α-spectrum with single line. ●- represents a maximum intensity group, -● a minimum intensity group, and ● means a group of intermediate intensity of an α-spectrum.

It may be seen from the solid line curves in the figure that in α-ray spectra, instead of the positive gradient of the Geiger-Nuttal relation (i.e., a linear increase of logλ with increasing E), both positive and negative trends exist in the variation of λ with E. In this respect striking similarity is exhibited by all the fifteen α-spectra known at present. The simplest spectra are the doublets, which give either the positive trend only (e.g., Th spectra) or the negative trend (e.g., U^{235}). For the triplet spectra, a positive trend is followed by a negative one (e.g., Bi^{214}) or vice versa, while in the case of the Th^{229} triplet only a negative trend exists. For more complex spectra (a typical example being Th^{227} in Fig. 1), regular alternations of the two opposite trends occur in general.

Now from a theoretical standpoint these negative trends present serious difficulties. For the α-decay theories of Gamow[5] and others gave λ as a function of Z, nuclear radius r_0, and decay energy E. In an α-sprectrum, since Z and r_0 ($\partial A^{\frac{1}{3}}$) are constant, λ becomes an exponential function of E alone, giving only a steep rise in λ with increasing E. From the above discussion it follows that some compensation of the increasing effect of E on λ should be postulated. In the paper to be published we have theoretically discussed the nonlinear curves for α-spectra in the light of various recent suggestions, *viz.*, nonzero values of azimuthal quantum number (Gamow[5]) or delay in formation of the α-particle (Perlman *et al.*[4]), etc., which have been made in connection with the stated deviations from the Geiger-Nuttal relation. It will be seen that none of these is very useful in the case of α-spectra.

It may be pointed out that so far in α-decay theories, the field outside the nucleus has been assumed to be purely Coulombian. However, when the alpha-particle is just emitted, a short-range Yukawa field, say V', would operate between the four nucleons of the emitted α-particle and those on the surface of the residual nucleus. So if the resultant field outside the nucleus is taken to be $\{2(Z-2)e^2/r-V'\}$, the wave equation for the α-particle would be

$$\Delta\psi+(8\pi^2M_\alpha/h^2)[E+V'-2(Z-2)e^2/r]\psi=0.$$

Obviously, in the final formula for λ, V' would be involved. Now what form of V' would lead to a fluctuation of λ or to the observed negative trend is a matter for further study. It is, however, probable that since V' is spin-dependent, the excitation shells within the nucleus of the four nucleons forming the alpha-particle may have different spin values and affect V' differently in the different cases, as observed.

Finally, I wish to express my gratitude to Professor M. N. Saha, F. R. S., for his kind interest in this work and for his encouragement. I wish also to thank Dr. D. Basu for the facilities and encouragement given.

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Shock Waves in Low Pressure Spark Discharges*

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ASSUMING that an expansion of hot gas follows the passage of a columnar current through a gas at low pressure, a shock wave should precede the advancing hot gas front (through the quiescent medium surrounding the column). Treating the expanding gas as a moving piston and measuring its velocity of advance by means of its own luminosity,[1] the Rankine-Hugoniot equations will give the velocity of advance of the shock front.

We have found two situations in which the shock fronts make themselves visible by the excitation they produce, and computations of the sort suggested above verify the correctness of this description of the expanding spark channel. A mirrorgram which shows both situations at the same time is shown in Fig. 1. In the first case the shock fronts become self-luminous upon reflection from an obstacle to the flow so that the original shock path can be inferred by the point at which the reflection occurs. In the