on the secondary anticathode, they should have appeared as scattered radiation. What is one to think of the scattering with change of frequency considered by Hirsh and apparently the object of an inexact formula in his text? Myself, I should not have melted the sample even "gently" in order to insert it into the hole in the anticathode, in view of the presumptive properties of element 87.

The search for a stable isotope of element 87 in a mixture of heavy, volatile, and absorbing alkaline substances is difficult, even if the element should be present in proportions of 10^{-4} or 10^{-5}. The methods of spectrum analysis and the conditions of excitation must be the best attainable. Our observations were generally made by primary excitation, with tubes constructed specially for great stability of operation even when volatile substances are present. My spectra do not allow me to come to the same conclusion as that reached by Dr. Hirsh. For the reasons expounded above, I feel that his investigation does not help in the least to settle the question of the existence of a durable isotope of element 87.

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The Magnetic Quenching of Superconductivity

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IN a letter with the above title Sienko and Ogg[1] suggest that for the "soft" superconductors Pb, Hg, Sn, In, Tl, CuS, Au_2Bi, Zn, and Cd the threshold magnetic field, H_T, for the destruction of superconductivity, is better represented by the expression $H_T=A(T_c^{\frac{3}{2}}-T^{\frac{3}{2}})$ than by the parabolic relation $H_T=B(T_c^2-T^2)$. T_c is the temperature at which the metal becomes superconducting in zero field. Careful measurements of the threshold magnetic fields have been made on Sn[2, 4, 5], Hg[3, 4], In[3, 5], Tl[3, 5] and Pb[4, 5]. Within the accuracy of the measurements neither the parabolic nor the $\frac{3}{2}$-power law exactly fits the data. However, the parabolic law is in all cases the better approximation. The variation in the constants A ($\frac{3}{2}$-power law) and B (parabolic law) between about 1°K, and the transition temperature are: Sn (A 30 percent; B 10 percent), Hg (A 18 percent; B 3 percent), In (A 12 percent; B 8 percent), Tl (A 9 percent; B 5 percent), Pb (A 19 percent; B 8 percent). The values quoted are the averages obtained by the various experimenters. In general the variations among the measurements from different laboratories are less than the deviation from either the parabolic or $\frac{3}{2}$-power relation.

It is true that the constant A is more nearly the same for different elements than is B, but A as determined from the initial slope of H_T *vs.* T varies from 90 for Cd[6] to 46 for Sn, a variation well outside the experimental error and sufficient to make it doubtful that A is a combination of universal constants as Sienko and Ogg suggest.

From an expression for the threshold curve and the well-known thermodynamic relation

$$C_s-C_n=(VT/4\pi)\{(dH_T/dT)^2+H_T(d^2H_T/dT^2)\},$$

one can calculate the difference in heat capacity, C_s-C_n, between the superconducting and normal states. V is the volume. For the $\frac{3}{2}$-power relation one obtains

$$C_s-C_n=(VA^2/4\pi)(3T^2-\tfrac{3}{4}T_c^{\frac{3}{2}}T^{\frac{1}{2}}),$$

and for the parabolic relation

$$C_s-C_n=(VB^2/2\pi)(3T^3-T_c^2T).$$

Measurements on Sn[7] and Tl[8] indicate that the heat capacity of these two metals in the superconducting state obeys a T^3 law. For metals in the non-superconducting state the experimental heat capacities at low temperatures are in agreement with the theoretical prediction of an electronic heat capacity proportional to the temperature plus a lattice heat capacity which in simple cases varies as T^3. The parabolic relation predicts a difference in heat capacity of superconducting and normal metal in agreement with these considerations. The absence of a term linear in temperature from C_s-C_n obtained from the $\frac{3}{2}$-power law is inconsistent with the experimental and theoretical results for the heat capacity of metals in the non-superconducting state.

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Bounded Linear Harmonic Oscillator and Phase Transitions of Second Order

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IN a recent letter in the Physical Review, Corson and Kaplan[1] have put forth the idea that the concept of a linear bounded harmonic oscillator in the theory of solids may be of help in understanding anomalies in the specific heat-curve of a crystalline solid. Similar ideas were developed by the author in 1945 and were reported in a lecture at Central College, Bangalore City, South India. These ideas were not published at the time, but in view of the considerations of Corson and Kaplan, it has seemed desirable to place them on record.

The problem arose in connection with specific heat anomalies at low temperatures in crystalline solids. It was thought that the concept of the linear bounded harmonic oscillator might be of service in studying these phenomena. The relevant theory has been worked out by Auluck and Kothari.[2] The allowed energy values are no longer $(n+\frac{1}{2})h\nu$, where ν is the frequency of the oscillator, but increase rapidly with decreasing amplitudes of oscillation. However, the present author applied the above concepts to the second-order phase transition or λ-anomalies of Ehrenfest.[3] It is well known that such phase transitions are all accompanied by marked changes in the expansion coefficient of the solid. Therefore, if at the λ-temperature the different oscillators in the crystal are bounded to different extents, the oscillators will be distributed among two well-defined sets of energy states, and these two sets may be thought of as forming the "phases" above mentioned. This may conveniently be taken as a picture of the second-order phase transition, i.e., the crystal oscillators going from one state of bounding to another. Also because the quantum of transition between two states of the oscillator is no longer $h\nu$, a shift or a new line may be possible in the Raman spectrum or infra-red absorption of the *crystal* near the λ-temperature. As there are many substances whose λ-temperatures are near room temperature, the investigation of the Raman spectrum may provide a test of the above ideas. Also, one must consider the current theory that the specific heat change may arise from molecular rotation within the crystal. Experiments on the Raman or infra-red absorption spectrum may lead to a decision between the two conceptions.

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On the Distribution of Electric Charge in Nuclei

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April 21, 1947

In a recent letter[1] by J. G. Winans entitled "A Classical Model for the Nucleus," attention was drawn to the striking relation between the atomic numbers (Z) and corresponding masses (A) of stable nuclei. Winans suggested a crystalline model in which the protons occupy surface positions as an obvious way of explaining the simple relation between Z and A.

The existence of this relation and its possible explanation by surface concentration of protons was already known to us, and we had gone so far as to test the hypothesis that protons are concentrated on or near the surface in the following simple way. In fission, if protons and neutrons are uniformly mixed the (charge/mass) ratios of the fragments should be roughly equal; whereas we should expect a higher relative concentration of charge on the light fragments, if the protons are concentrated near the surface of the nucleus before fission. We have investigated this on the basis of Coryell's tables[2] and have found that the ratio (charge/mass) is very closely the same for the light and heavy fragments. This fact, therefore, coupled with the hydrodynamical explanation[3] of the asymmetry of fission in analogy with the splitting of a classical liquid drop, seems to invalidate the idea that the protons are concentrated on the surface. In principle it is possible that some mechanism might exist to ensure constancy of Z/A for the fragments, but we know of no other nuclear phenomenon which would require such a mechanism.

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A Note on the Long-Lived Radio-Iodine

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The radioactive iodine isotope of half-life about 56 days, reported by Reid and Keston,[1] has been observed in an iodine sample separated from deuteron-bombarded Te in April, 1946, furnished by the M.I.T. Radioactivity Center.

Chemical identity of the activity was established by a series of extractions with iodine carrier. Iodide in aqueous solution was oxidized with nitrite, and the iodine extracted into CCl_4; re-extraction to water was performed with bisulfite as reducing agent. Through three such cycles, the specific activity as AgI remained constant within experimental error.

By use of a Kr-filled Geiger counter, critical absorption measurements of the x-radiations were made in Ag, Cd, In, and Sn foils. The energy of the radiations was observed to lie between the K-edges of Cd and In, characteristic of tellurium $K\alpha$ x-rays. Absorption in Al showed a small amount of an extremely soft component, and a half-thickness of 485 mg/cm^2 for the major fraction of the radiations. This corresponds to an x-ray energy of 27.5 kev, within experimental error of that expected for $K\alpha$ x-rays of Te. The soft component showed a half-thickness of 1.9 mg/cm^2 in Al, and 19 mg/cm^2 in C (polystyrene). The corresponding x-ray energies are 3.8 and 3.7 kev, respectively. The $L\alpha$ x-ray energy for Te is 3.8 kev. No particle radiations were observable from 20 mg samples (AgI or NaI) with a thin window counter, and no γ-rays of energy greater than 30 kev were apparent in the Al absorption curve. The mode of decay of the 56d I, therefore, appears to be pure orbital electron capture, with no accompanying particle or γ-radiations.

It can be shown by various considerations that the mass number of the long-lived iodine is more probably 125 than 129 as proposed by Reid and Keston.[1] The formation of I^{125} directly in the Te targets at the cyclotron is to be expected from the d, $2n$ reaction on Te^{125} (6 percent abundance) and the (d, n) reaction on Te^{124} (4.5 percent abundance). Considerations which render improbable the mass assignment of 129 are: (a) the proposed decay scheme[1] requires either that Te^{129} have a stable isomer, or (for the chain to reach a stable end product) that a unique chain of K-capture followed by two β^- decays occur (i.e., I^{129}—K→ Te^{129}—β^-→I^{129}—β^-→Xe^{129} stable); (b) according to Bohr and Wheeler[2] the most stable nuclear charge (Z_A) for mass 129 is near 54 (Xe); thus I^{129} should have no appreciable probability for decay by K-capture, but should decay by β^- emission to stable Xe^{129}; (c) no radio-iodine of half-life near 56 days is reported among the U^{235} fission products,[3] whereas I^{129} must certainly be formed; the latter is listed as a very long-lived, hypothetical descendant of 70m Te^{129}.

The nucleus I^{125}, however, would certainly decay by K-capture or positron emission to stable Te^{125} and would not be formed in appreciable yield as a U^{235} fission product since it is shielded by stable Te^{125} from formation by β^- decay. Its predicted decay energy for K-capture, calculated from