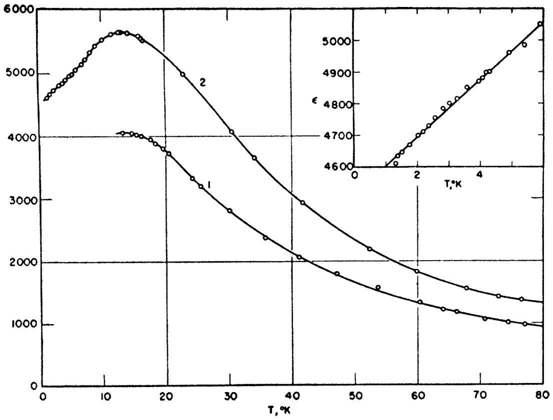

FIG. 1. Dielectric constant of $KTaO_3$ at low temperatures.

with $C=6.1\times10^4$, $\theta=14.0°K$, (No. 1), $C=8.3\times10^4$, $\theta=14.6°K$, (No. 2). Below 52°K, ϵ was smaller than is predicted by Eq. (1), and passed through a maximum at 13.2°K. At liquid helium temperature ϵ showed an almost linear decrease which continued down to 1.3°K, as shown in the inset of Fig. 1. Below 13°K the polarization-field curve exhibited a small reversible spontaneous polarization superimposed upon a high induced polarization; at the maximum field strength of the present experiment, 5000 volts/cm, the crystal was far from saturated, so that a reliable value of the spontaneous moment was not obtained.

The relatively good agreement between θ and the temperature of the maximum of ϵ demonstrates once again the validity of using the Curie-Weiss law to estimate the position of a ferroelectric Curie point. Smolenskii[2] has recently concluded from an application of this law to the dielectric constants above room temperature of calcium, strontium, and cadmium titanate that the last two substances have ferroelectric Curie points at 10° and 50°K, respectively. However, as yet unpublished measurements by Hulm ($SrTiO_3$) and Matthias ($CdTiO_3$) to 80°K gave negative values of θ, while further measurements by Hulm on $SrTiO_3$ showed that this substance is not ferroelectric above 1.3°K.

The absence of spontaneous polarization from the above mentioned titanates evidently indicates that the Ti-O_6 octahedra are much more sensitive to a change of lattice constant or structure than are other similar octahedra, such as Nb-O_6 and Ta-O_6, which give ferroelectric behavior in a number of different compounds and structures.[1,3]

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[1] B. T. Matthias, Phys. Rev. **75**, 1771 (1949).

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[3] B. T. Matthias and J. P. Remeika, Phys. Rev. **76**, 1886 (1949).

A New Long-Lived Krypton Activity

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IN the course of a study of branching in the neutron induced activities of bromine,[1] I had cause to examine the isotopic constitution of the krypton distilled from a sample of sodium bromide which had been subjected to prolonged and intense neutron radiation. From this krypton all other elements except argon and xenon had been removed chemically and a slight amount of pure atmospheric krypton had been added for purposes of standardization. The gas was found to consist principally of the isotopes Kr^{80} and Kr^{82} from the reactions $Br^{79}+n\rightarrow Br^{80}\xrightarrow[\beta^-]{}Kr^{80}$ and $Br^{81}+n\rightarrow Br^{82}\xrightarrow[\beta^-]{}Kr^{82}$. In addition, a small ion peak was observed at mass 81 which, after the usual tests common to mass spectrometric technique, proved to be due to Kr^{81} and not due to an impurity element or to a rare krypton compound ion such as KrH^+. The formation of Kr^{81} is attributed to the second-order reaction $Kr^{80}+n\rightarrow Kr^{81}$. The value of the percentage abundance of Kr^{81} at the time of measurement was sufficient in itself to place a lower limit on the half-life of this nuclide of 30 days, using a value of 200 barns for the maximum neutron absorption cross section of Kr^{80}. 200 barns safely exceeds a preliminary value for this cross section due to Thode.[2]

An aliquot of this gas was introduced to the interior of an argon-ethanol filled Geiger tube. By manipulating a Toepler pump and reading a manometer, it was possible to study the counting rate as a function of the total gas pressure in the counter tube. This quantity, corrected for background, gave a linear plot which intersected the origin when extrapolated to zero pressure, showing clearly the presence of a radioactive gas in the counting system.

A larger sample of the gas was then used to fill a Pyrex cell, equipped with a 1.8 mg mica window, which could be installed within the shield of a conventional end window counting arrangement. An aluminum absorption curve of the radiations from the cell, taken with an argon-ethanol filled mica window counter, showed the presence of soft beta-particles. Although the beta-particle counting rate corrected for geometry amounted to only six percent of the total radiation as counted internally, the effect was large enough to mask the absorption characteristics of soft γ-rays in the insensitive end window arrangement.

It seemed probable that this beta-particle component was due to long-lived A^{39} formed by second-order neutron absorption on Cl^{37} impurity in the NaBr. In accordance with this hypothesis, the gas sample was treated by diluting it heavily with pure argon and pumping it briefly from a charcoal trap at dry ice temperature. Prior pumping tests with artificially prepared argon-krypton mixtures showed that under these conditions 99.8 percent of the argon is removed, while only 60 percent of the krypton (and negligible xenon) is lost. The Pyrex cell was refilled with the purified krypton and used to obtain the aluminum absorption curve shown in Fig. 1. A xenon-ethanol filled end window counter

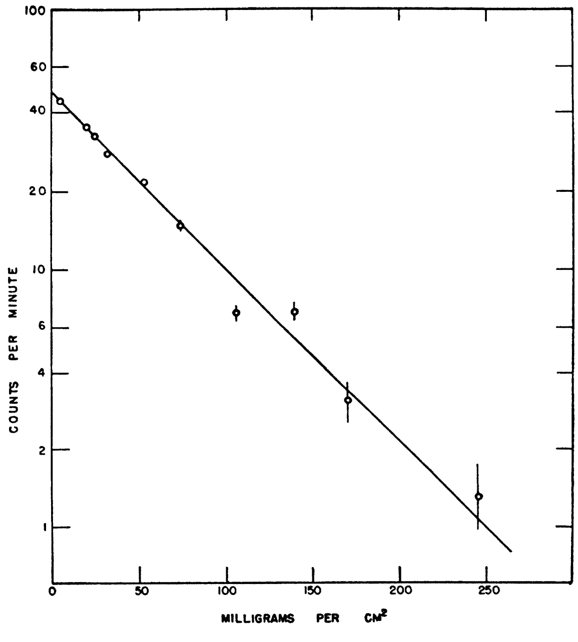

FIG. 1. Absorption in aluminum of radiations from purified krypton distilled from neutron-irradiated NaBr.

was used to increase the counting efficiency for the radiations. As may be seen from the curve, the soft beta-component is now non-detectable, confirming the assignment of this component to long-lived argon. The energy of the γ-radiation as determined from the absorption half-thickness in aluminum is 12.1±0.4 kev. This is in good agreement with the accepted value of 11.9 kev for bromine K_α x-rays.

Finally, internal counting of the purified krypton showed that the radiations so counted had been reduced as a result of the purifying procedure by about 70 percent. This demonstrated that essentially all of the original *internal* counts were due to a krypton activity and not to an argon or xenon activity.

It is concluded that long-lived Kr^{81} decays by K-capture to Br^{81} with a half-life of $2.1\pm0.5\times10^5$ years. The neutron absorption cross section of Kr^{80} for the formation of the long-lived nuclide is 12.5±1.5 barns.

I am grateful to Drs. Mark Inghram and Anthony Turkevich for several helpful discussions.

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Atomic Moments of Ferromagnetic Alloys

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June 28, 1950

THE atomic moments of the ferromagnetic elements and their alloys with each other have been plotted against atomic number by Slater,[1] Pauling,[2] Shockley,[3] Seitz[4] and Goldman,[5] who have discussed the filling of the 3*d*-shell in relation to the magnetic moment of the atom.

Because of the rather frequent use of the curve so obtained, this note is written to show that the relation between atomic moment and atomic number is not nearly so simple as the published curves indicate, if the additional available data are used, especially the data relating to the alloys of Co and Ni with Mn, Cr and V. In Fig. 1 have been plotted all of the data which the writer has been able to find on the binary solid solutions of the elements V to Cu. The one point above the curve for Ni-Mn alloys is for well-ordered Ni_3Mn, obtained by annealing for three weeks at 470°C. All of the data were obtained by the French school.[6]

Although a rather smooth curve, corresponding to Pauling's[2] theory, is obtained for alloys between neighboring elements in the periodic table, drastic departures exist for the alloys which are two atomic numbers or more apart. Especially the Co-Mn alloys, but two numbers apart, show no indication that the moments go over a maximum at the electron concentration of 26.3 per atom as they do in the Fe-Co alloys.

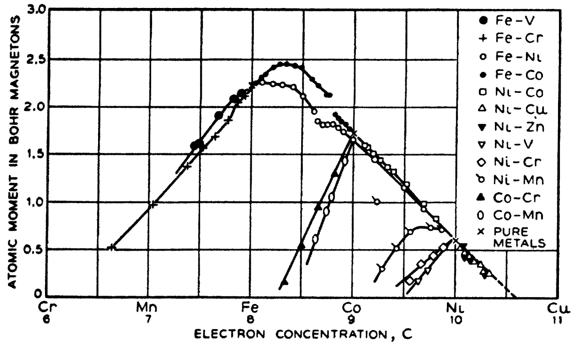

FIG. 1. Average atomic moments of binary alloys of the iron-group elements.

It is commonly believed that in manganese both 3*d*+ and 3*d*− bands are partially filled to the same extent, leaving a net moment of zero, while in cobalt one band is filled. Apparently the tendency for the two partly filled bands to coexist is carried over from manganese to the Co-Mn alloys, for the additional vacancies caused by addition of manganese to cobalt would *increase* the atomic moment if only one 3*d* band remained unfilled, whereas a decrease is observed.

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A New Determination of h/e*

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THIS letter is to present a tentative result of a determination of the ratio of Planck's constant to the charge of an electron through the measurement of an excitation potential of helium (1*s* 2*p*) by a new method.

The basic part of the apparatus consists of an electron gun, a first slit system, an excitation chamber, a second slit system and a Faraday cage all located in a uniform magnetic field directed perpendicularly to the circular electron path through the slit systems. The electron gun and the first slit system are electrically insulated from the rest of the apparatus. A variable potential (ΔV potential) is applied between the first slit system and the second slit system (essentially across the small excitation chamber). Measurements of the excitation potential are made by first determining the ΔV potential (approximately zero) required to make the electrons which do not excite or otherwise interact with helium atoms traverse the second slit system and be detected, then determining the ΔV potential (approximately 21.2 volts) required to allow only those electrons which have excited the 1*s* 2*p* level of helium to pass through the second slit system and be detected. The difference between these ΔV potentials constitutes a measurement of the excitation potential of helium.

The radius of the slit systems is 10 cm and measurements have been made at slit widths of 0.02 cm and at 0.03 cm. The volume of the excitation chamber in which detected excitations take place is approximately 0.02 cm^3. Measurements have been made with electrons of 90, 135, and 180 volts energy.

It should be noted that the difference technique employed eliminates first-order errors due to surface charges, space charges and contact potentials. Second-order surface charge errors have been minimized by carefully cleaning the inner surfaces of the apparatus by positive ion bombardment and by evaporating a fresh coating of gold over all inner surfaces just before each series of measurements. The data taken thus far have revealed no dependence on electron energy, gas pressure, electron currents, initial ΔV potential, and time after gold plating.

Twenty successful runs have been made yielding 96 measurements. A measurement consists of about 15 to 20 observations of the ΔV voltages. The data fall into an approximate Gaussian distribution and lead to an excitation potential (1*s* 2*p*) of helium of 21.2004 international volts with an observational uncertainty of ±0.0016 international volts. The value of the excitation potential was found not to depend significantly on the weighting of these data. The tentative total probable error assigned to the excitation potential is ±0.0053 international volts.

Combining the observed excitation potential with the velocity of light,[1] the ratio of the absolute volt to the international volt[2]