One of us[4] has put forward an alternative theory in which the anisotropy is attributed to the relief of magnetostrictive stresses by gliding during the process of cooling in a magnetic field. According to this theory it is possible that the magnetic field influences embryos well below the critical size for stable nuclei. The presence of fully developed nuclei is improbable since most of the temperature range in which the field is effective lies in a single phase field.

Further work will be required to decide whether either or both of these processes occur.

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Susceptibility and Magnetic Anisotropy of Indium Single Crystals

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It is well known that small quantities of impurities have a great influence on the magnetic properties of metallic single crystals. Some interesting measurements have been made in this respect by Goetz and Focke,[1] Hart,[2] Rao and Sriraman,[3] Rao and Narayanaswami,[4] who investigated, respectively, single crystals of Bi, Sb, Cd, and Tl. For the same purpose we have made susceptibility measurements on indium single crystals.

Since no data of susceptibility of In have been published except those of Honda and Owen,[5] we want to give the results of our measurements on the susceptibility and anisotropy of that element.

The In, obtained from a Belgian firm, being impure, was purified several times by an electrolytic process. From the material obtained we made samples in the form of thin cylinders by melting in vacuum and molding in pure graphite. Following the Gouy method we determined the magnetic susceptibility by use of a microbalance. Since even after such a procedure the rods showed slight paramagnetism, we had to reheat them several times in their molds, bringing the temperature slightly below the melting point and etching their surfaces after each process. Thus we were able to remove almost all remaining impurities and we obtained reproducible results for the diamagnetic susceptibility.

A difficulty arose from the fact that we were unable to find the crystal axes by splitting the single crystals, owing to the softness of the metal, even after cooling in liquid air.

If ϕ represents the angle between the principal crystalline axis and the axis of the rod, θ the angle between the field and the vertical plane going through the principal crystalline axis, then the expression:

$$K_H = (K_{\parallel} \sin^2\phi + K_{\perp} \cos^2\phi) \cos^2\theta + K_{\perp} \sin^2\theta$$

enables us to find the value of $K_{\perp}$ by measurements on different samples. We also made polycrystalline samples and by measurement of their susceptibility, which is the same in all directions, we obtained $K_{\parallel}$ by using the formula:

$$K_H = \tfrac{1}{3}(2K_{\perp} + K_{\parallel}).$$

Our results are as follows:

Indium single crystals, density:	7.3082.
Polycrystalline material, density:	7.2985.
Principal susceptibilities:	$K_{\parallel} = -0.886 \times 10^{-6}$, $K_{\perp} = -0.398 \times 10^{-6}$.
Magnetic anisotropy:	$K_{\parallel} - K_{\perp} = -0.488 \times 10^{-6}$.

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The Ca^{45} Beta-Distribution Obtained in a Split Crystal Scintillation Spectrometer*

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Within the last year scintillation spectrometry has been improved to the point where it is possible to determine beta-distribution end points with fair precision, and when the maximum energy of the distribution is great, the high energy portion of the distribution appears to fit the shape of the theoretical curves. However, one always observes an excess of low energy betas relative to those of higher energy. This is presumably due to high energy betas giving up only part of their energy within the scintillation medium before being scattered out. Thus one not only observes a small light pulse but he fails to record one which should have been large. In spite of this difficulty, Bell *et al.*[1,2] have been able to obtain useful information concerning the beta-spectra of Be^{10} and K^{40}. However, as the maximum energy of the beta-distribution under study is reduced, the difficulties of studying its shape increase. Figure 1 shows an extreme example in the Kurie plot of Ca^{45} which was obtained using a detection arrangement shown in the insert. The source was mounted on a Formvar film 25 $\mu g/cm^2$ thick placed against the crystal with a 0.2 mg/cm^2 aluminum foil reflector surrounding the optical system. The electronic equipment is similar to that previously described.[3] In Fig. 1 the solid squares represent the original data and the solid circles are the results after correction for the resolution of the instrument, using the method of Owen and Primakoff.[4] Macklin *et al.*[5] have shown that the Ca^{45} disintegration gives an allowed beta-distribution with an end point at 254±3 kev. The straight line in Fig. 1 is drawn from this end point through the high energy experimental points. If the end point were not known, one would be unable to obtain a satisfactory value from this set of data. Also, the discrepancy between the experimental points and the straight line demonstrates the problem of studying the shape of the distribution of such a low energy beta.

Since the resolution correction is large only near the ends of the distribution, it would be desirable to utilize the data in the midregion for determining the end-point energy. Furthermore, these data can be obtained with better counting statistics. However, this can be done only if the extraneous low energy pulses can be eliminated. If the above explanation of their origin is correct, it should be possible to eliminate the difficulty by placing the source between two crystals in such a manner that the probability of observation of the scattered beta in the second crystal is great. Whereas this might be accomplished by using two crystals and two photo-multipliers, the arrangement shown in the insert of Fig. 2 has been used. The two anthracene crystals were matched to give equal pulse heights and resolution individually for the Cs^{137} conversion line. When this source was placed between the crystals, the observed number of pulses doubled, but the pulse height of the peak was unchanged and the resolution remained

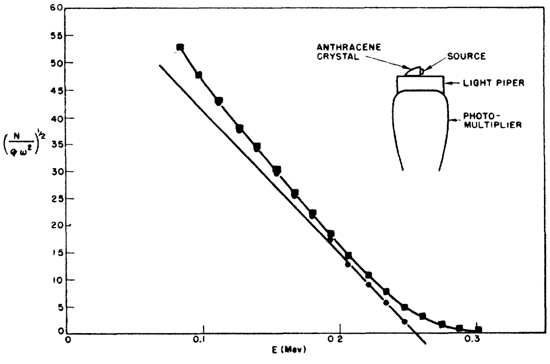

FIG. 1. Kurie plot of Ca^{45} obtained with the apparatus shown on the figure.

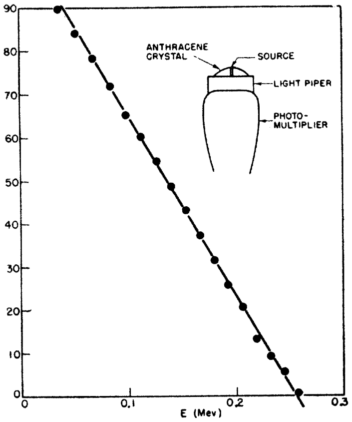

FIG. 2. Kurie plot of Ca^{45} obtained with the experimental arrangement shown on the figure.

equal to that of each crystal alone, 6.5 percent half-width at half-height. The Kurie plot of Ca^{45} shown in Fig. 2 was obtained with the source mounted between 25 $\mu g/cm^2$ Formvar films placed between the two crystals which were in contact. The resolution correction has been made. Since the plot is linear from 50 kev to the end point, one can now rely largely upon points obtained with good statistics to obtain the end point. The value obtained is 255±4 kev in good agreement with the value previously reported,[5] as is also the spectrum shape. Thus, it appears that this split crystal spectrometer can give reliable information about the shapes and maximum energies of low energy beta-emitters.

Credit for the success of this study is due in large part to helpful discussions with C. J. Borkowski, A. R. Brosi, and H. Zeldes and to R. A. Dandl and E. Fairstein who designed and calibrated the electronic circuits.

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* This document is based on work performed for the AEC at the Oak Ridge National Laboratory.

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Decay of Y^{87} and Sr^{87m}

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Y^{87} and its daughter Sr^{87m} were investigated by using a double thin-lens beta-ray spectrometer, scintillation counters, and Geiger counters in coincidence. The activities were produced by bombarding strontium with deuterons. (The authors are indebted to the cyclotron staff at both the University of Washington in St. Louis and the University of Chicago for these bombardments.)

Decay of ground state of Y^{87}. The half-life of the ground state[1,2] was measured as 80.0±1 hours. At least 98 percent of the 80-hour Y^{87} decays to an excited state of Sr^{87} at 875 kev. This state immediately emits a 485±3-kev gamma-ray and leads to the 390±2-kev isomeric state. In addition to the predominant K-capture process, a very low intensity (less than one percent) positron spectrum exists. The low intensity of these positrons made an accurate energy determination impossible; the data are consistent with the value of 0.7 Mev reported by Robertson, Scott, and Pool.[2] Assuming this energy, the measured K-capture to positron ratio is much higher than the theoretically predicted value of 7 for an allowed transition. The value of $\log(f_K+f_{\beta}+)t=5.9$ and Mrs. Mayer's shell structure theory[3] indicates an allowed transition.

The K conversion coefficient of the 485-kev gamma-ray was measured by comparing the number of its conversion electrons to those of the 390-kev gamma-ray and using the measured K conversion coefficient (0.25) of the latter. The value of $3.3\pm0.5\times10^{-3}$ is consistent with the theoretical values only[4] for either electric quadrupole, magnetic dipole, or a mixture of both.

Upper state of Y^{87}. The upper isomeric state[1,2] of Y^{87} decays with a half-life of 14±1 hours. (When the details of its decay are completely investigated, a paper will be written on the entire decay scheme.) About 50 percent of the 14-hour activity leads to the 80-hour ground state. Although the growth of the 80-hour activity makes this certain, the radiation corresponding to this transition has not yet been identified. The remainder of the 14-hour activity has 374-kev conversion electrons associated with it. There are no 485-kev gamma-rays emitted by 14-hour Y^{87}. The 14-hour activity also has a low intensity positron spectrum whose maximum energy was measured as 1.1±0.1 Mev. The experimental K to positron ratio is 50 while the theoretical value for an allowed transition is 1.6. The log $(f_K+f_{\beta}+)t$ value is 5.5.

Decay of Sr^{87m}. The half-life[1,2,5] of Sr^{87m} was measured as 2.80 ±0.05 hours. This state emits a 390±2-kev gamma-ray which is partially converted. The K conversion coefficient was determined by using coincidence techniques and was found to be $N_e/N_{\gamma}=0.25\pm0.04$. This is consistent with the theoretical values only[4] for either magnetic 2^4 pole, electric 2^5 pole, or a mixture. The ratio of K- to L-conversion as determined in the spectrometer was 6.9±0.4.

The data on the excited states of Sr^{87} are consistent with internal conversion theory, nuclear isomeric theory,[6] and Mrs. Mayer's shell theory if the three energy levels are assigned as $g_{9/2}$, $P_{1/2}$, and $P_{3/2}$. (The spin of the ground state is known[7] to be 9/2.) The assignments of the Y^{87} states and a comparison with beta-decay theory cannot be made until the investigation of 14-hour Y^{87} is complete.

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Double Development of Nuclear Emulsions

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ONE of the most valuable features of the nuclear emulsion technique is the ability of a photographic emulsion to integrate the images of nuclear events which were registered by the emulsion before its development. Generally we have no means of determining at what time or in what order individual tracks were recorded, although this may be of interest in certain cases. Some information can be obtained on this subject from the study of the fading of the track images. The fading is dependent, however, on a number of factors and takes place only gradually and

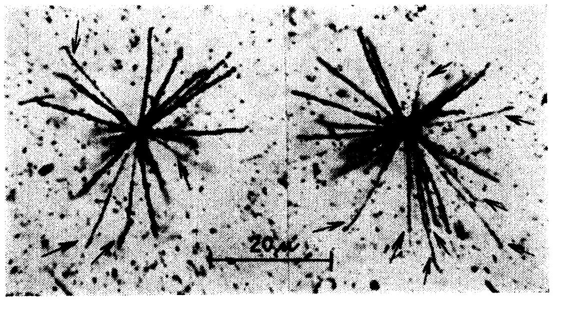

FIG. 1. Two microphotographs of Io (Th^{230}) stars showing distinctly two sorts of tracks registered during two successive one-day periods. The thin tracks registered during the second day are marked by arrows.