LETTERS TO THE EDITOR

Prompt publication of brief reports of important discoveries in physics may be secured by addressing them to this department. Closing dates for this department are, for the first issue of the month, the twentieth of the preceding month; for the second issue, the fifth of the month. The Board of Editors does not hold itself responsible for the opinions expressed by the correspondents.

Discontinuities of Magnetoresistance

In a recent paper[1] the writer has described experiments in which sudden jumps of resistance were found to be associated with jumps of magnetization in a strained nickel wire. Alocco and Drigo[2] have studied the magnetoresistance of nickel and observed apparent discontinuities which they found were due to disturbance of bridge balance arising from induced electromotive forces. They suggest that the writer's results may be similarly explained.

As a matter of fact the writer was well aware of the source of error mentioned by Alocco and Drigo, having previously performed experiments on the phenomenon.[3] Hence special precautions were taken to eliminate the spurious effect. When the balance of the bridge was disturbed by the resistance jump, the galvanometer suffered a permanent deflection of about 200 mm, superposed on a steady drift, due to temperature changes, of about 4 mm per minute. Any induced e.m.f. would, of course, have thrown the bridge out of balance only temporarily. The period of the galvanometer used was sufficiently short and the temperature drift was sufficiently small so that the bridge could be rebalanced by adjustment of resistance arms, and the resistance jump calculated in this way. In the interests of accuracy, however, a method involving the reading of galvanometer deflections was actually used.

It seems probable that Alocco in his work[4] did not find discontinuities of magnetoresistance because his specimens did not exhibit sufficiently large jumps. His hysteresis loop for nickel is quite like the writer's, but he has indicated observed points on the steep branch where the writer was unable to obtain them because of the large discontinuity.

C. W. HEAPS

The Rice Institute,
November 18, 1934.

[1] C. W. Heaps, Phys. Rev. **45**, 320 (1934).
[2] G. Alocco and A. Drigo, N. Cimento **11**, 224 (1934).
[3] C. W. Heaps, Phys. Rev. **43**, 945 (1933).
[4] G. Alocco, N. Cimento **10**, 153 (1933).

An Equation for X-Ray Crystal Curves

Parratt[1] has found that the shapes of all $(1, -1)$ curves of calcite and quartz are symmetrical and fall between the Gaussian error function and the classical dispersion shape revived by Hoyt.[2] Both of these curves may be expressed in the form $1/y=1+Bx^2+Cx^4+\cdots$, where $y=1$ when $x=0$ and $y=1/2$ when $x=1$. In the case of the classical dispersion shape, which is a witch, $B=1$, the remaining constants being zero. A closer approximation may be had by evaluating one more constant, C. The half maximum condition gives $B=C-1$. The curve may be made to pass through a third point x, by properly choosing C. Let the value of $1/y$ at x be z. Then the solutions of B and C are

$$B=(x^4+1-z)/(x^4-x^2), \qquad C=(z-x^2-1)/(x^4-x^2).$$

Fig. 1 shows a family of curves of the form of $1/y=1+(1-C)x^2+Cx^4$. A comparison of these curves with Figs. 5 and 6 in Parratt's[1] paper will show a remarkable resemblance (most crystal curves using values of C between 0 and 1/4).

There is need to check the equation for larger values of x. The writer used data on calcite crystal pair No. 2,[3] which gave a full width at half maximum of 5.2 seconds at $\lambda=0.71$A. The value of C at $x=2$ was 0.1 but was zero from $x=4$ to $x=12$.

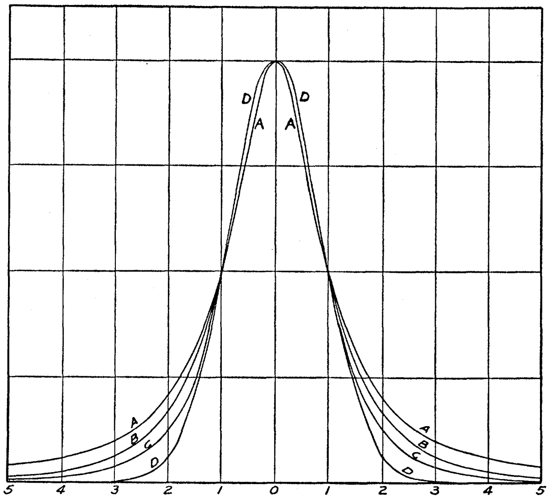

FIG. 1. Curves A, B and C of form $1/y=1+(1-C)x^2+Cx^4$ with C equal 0, 1/12 and 1/4. Curve A shows the classical dispersion shape and curve D the Gaussian error function.

An interesting case of a variable C is where a cracked crystal has two planes each represented by a witch but displaced $\pm\alpha$. The average of the two witches will have a maximum ordinate equal to $1/(1+\alpha^2)$ while the other ordinates will be little effected. The drop in the maximum forces the adoption of a greater half maximum width, which gives a finite value for C for small values of x, but reduces to zero for large values of x.

The writer has checked mathematically the rule that if the shapes of both crystals and x-ray lines are witches, the width of the experimental curve should be the sum of the two widths. Therefore, the failure of this rule[4] must be linked with the failure of the original curves to be witches. The exact law of correction, then, should depend on the departure from the witch and hence on the constant C. This should be determined by using moderate values of x, as the effect on the width is negligible for large values of x.

Roy C. Spencer

Brace Laboratory of Physics,
University of Nebraska,
November 20, 1934.

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[1] Parratt, Rev. Sci. Inst. **5**, 395 (1934).
[2] Hoyt, Phys. Rev. **40**, 477 (1932).
[3] Spencer, Phys. Rev. **38**, 630 (1931).
[4] Parratt, Phys. Rev. **46**, 749 (1934).

Rectifying Effect in Chrome Cast Iron

I recently noted an apparent rectifying effect in chrome cast iron similar to that of the "Kuprox" rectifiers.

In melting the metal, which contained about 14 percent chromum and 2 percent carbon, it was made the anode in a 220 volt d.c. arc furnace; a graphite rod serving as cathode. When fusion was nearly complete, current was accidentally shut off and the metal cooled. Its surface was badly oxidised as a result of opening the furnace while still hot.

On attempting to start the arc again it was found that no current would pass. But after reversing the polarity so that the metal became the cathode, current readily passed, an arc was struck and the metal was heated to seven or eight hundred degrees in this manner. It was then found that current would again pass in the original direction.

The metal was contained in a magnesia-lined bowl through the bottom of which a steel bar extended, serving as conductor. The cathode extended vertically downward through a hole in the cover.

I have seen no notice of such a rectifying effect in chrome cast iron; which effect seems rather strange in view of the fact that the black iron oxide which is formed on hot iron is a conductor even when cold. The effect seems to have been due to the presence of the chromium, whose oxide (Cr_2O_3) does not conduct until heated to a temperature in excess of one thousand degrees. On the other hand I have noticed that some chromium-iron ores which are relatively rich in iron conduct very readily when cold. Time was not available in which to investigate this phenomenon further.

Leo G. Hall

Spalding Machinery Company,
Chicago, Illinois,
November 24, 1934.

Gamma-Rays from Boron Bombarded with Deutons

Using a Wilson cloud chamber in a magnetic field of 1000 gauss we have studied the spectrum of recoil electrons produced by the gamma-rays from boron bombarded with deutons, and have found it to consist of components of at least five different energies.

A total of 6500 photographs was obtained, of which 1500 were taken with a carbon sheet 1 mm thick across the center of the chamber, 4000 with a 0.25 mm lead sheet, and 1000 with a 3 mm lead sheet. Where the thin absorber was used, it was possible to identify the tracks of recoil electrons and electron pairs which originated in the thin material. Below are shown the energy spectra of the electrons from the thin carbon absorber (Fig. 1), and of those ejected in the forward direction from the glass walls of the chamber (Fig. 2).

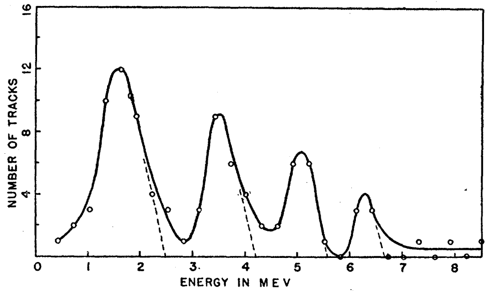

Fig. 1. Energy spectrum of negative electrons ejected from a 1 mm carbon absorber by the gamma-radiation from boron bombarded with deutons. Ordinates represent the number of tracks in a 0.3 m.e.v. energy interval.

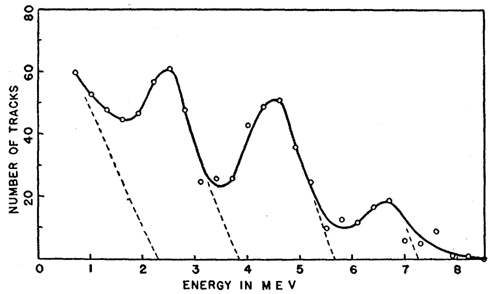

Fig. 2. Energy spectrum of negative electrons ejected from the glass wall of the chamber by the gamma-radiation from boron bombarded with deutons. Ordinates represent the number of tracks in a 0.3 m.e.v. energy interval.

The spectrum in Fig. 1 indicates gamma-ray lines of roughly 2, 4, 5.5 and 7 m.e.v., the intercepts of the curves extrapolated down to the axis being 2.4, 4.2, 5.6 and 6.7 m.e.v., and in addition an appreciable number of tracks of higher energy, extending up to more than 10 m.e.v. The spectrum from the thick glass absorber (Fig. 2) indicates the same lines, and is less subject to statistical fluctuation, since it is composed of a larger number of tracks. It gives intercepts at 2.3, 3.9, 5.6 and 7.2 m.e.v. Here, however, the 2 and 4 m.e.v. lines are not so clearly resolved, and the extrapolation of the 2 m.e.v. line down to the axis obviously cannot be accurate. The presence of four lines of approximately the above energies is further confirmed by the spectra of electrons and of electron pairs from the lead absorbers, the plots of which are not shown. Tracks of very high energy appeared relatively more frequently when the lead absorber was used, and a number of pairs were found having total energies as high as 10 m.e.v.