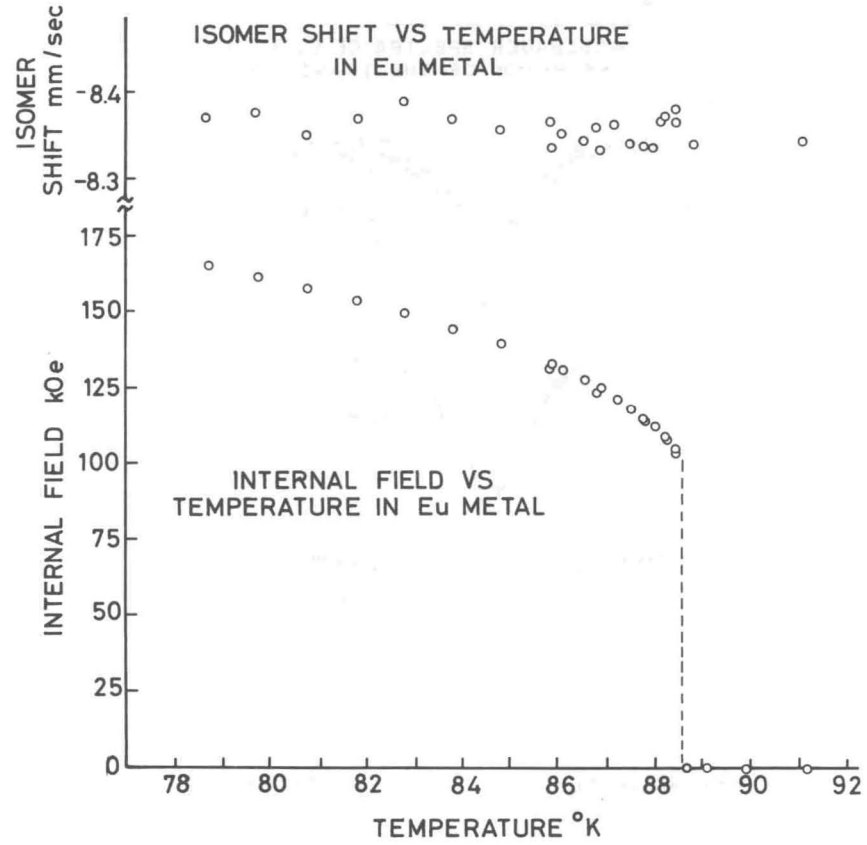

FIG. 2a. — Observed internal fields plotted as a function of temperature. Note the sudden drop of the field at T_t. The (1σ) error flags are about the size of the points.

FIG. 2b. — Observed isomer shifts as a function of temperature. Note that there is no substantial discontinuity at T_t. Isomer shift values are relative to an Eu_2O_3 absorber at 78 °K.

magnetic transition from the paramagnetic (bcc) phase existing at high temperatures to the spiral antiferromagnetic structure, below $\sim 89°$, established by neutron diffraction studies [1]. We present here unequivocal evidence from Mössbauer studies, that this transition is in fact of first order. Mössbauer effect measurements of the hyperfine structure in this material provide two useful pieces of information; the isomer shift, which is a sensitive indicator of the configuration of the rare earth ion, and the magnetic hyperfine interaction. The latter results from the interaction of the magnetic moment of the nucleus being studied (in this case, Eu^{151}) with the internal field at the Eu nucleus. In the case of Eu metal, the internal field comes primarily from core polarization resulting from the magnetically ordered 4f electrons, and is approximately proportional to the 4f moment [6]. Thus, Mössbauer effect hyperfine structure measurements serve to measure the sublattice magnetization. The measurements are performed at zero applied field (therefore eliminating problems due to the high anisotropy in this material) [7], and are essentially microscopic; i.e., if a range of hf fields is present in the sample, the spectrum will show that fact rather than simply indicating an average value for the field. In this respect, Mössbauer measurements tend to be, like the other resonance techniques, superior to bulk measurements such as susceptibility and dilatometry.

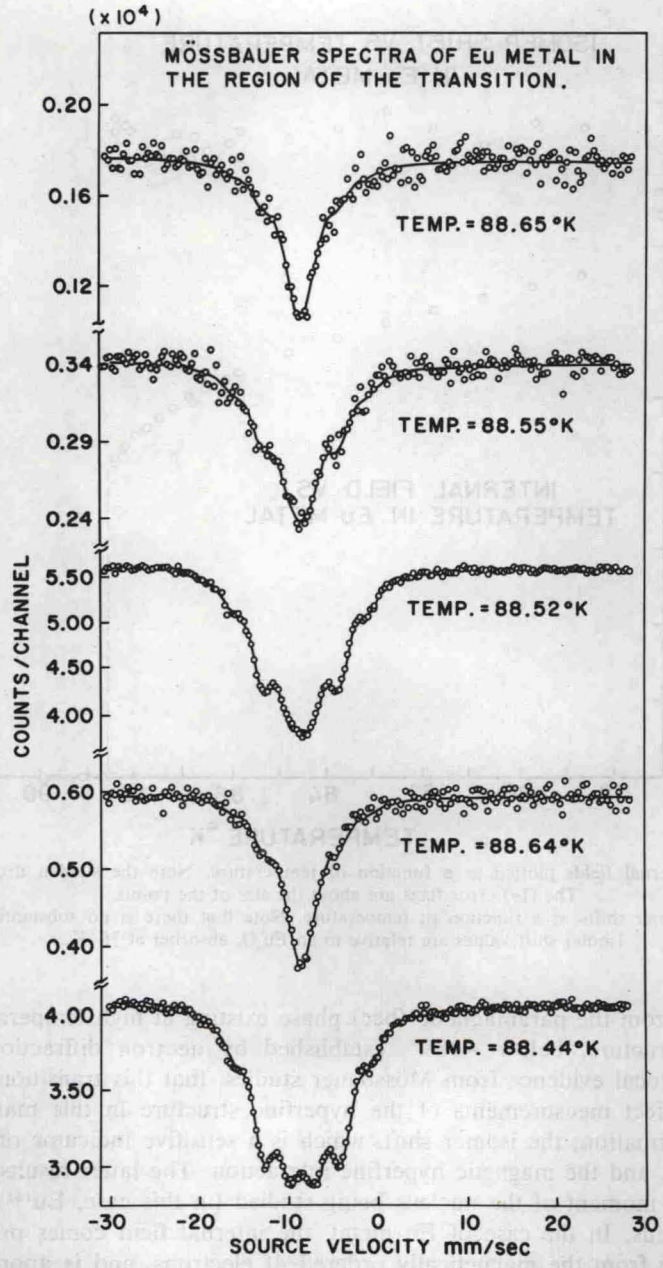

FIG. 3 .— Spectra of Eu metal in the temperature region of the phase transition. The spectra are shown (from the top) in order of the time at which they were taken. The solid line is the result of a least-squares fit assuming that the absorption resulted partly from a " split " spectrum like those in Figure 1 and partly from a single line. This is equivalent to the assumption that paramagnetic Eu (unsplit spectrum) and ordered Eu (split) coexist over a narrow temperature range. Parameters evaluated from the least-squares fits are plotted in Figures 4 and 5.

In brief, what the Mössbauer spectra show in this case, is that (see fig. 1) as the temperature is increased from 5 °K, the large hf splitting decreases as we approach 89 °K, but then (see fig. 2) suddenly vanishes at approximately 88.6 °K. This shows that the sublattice magnetization