electronic specific heat coefficient on the assumption that all of the deviation of C_V from C_D is due to a temperature dependent γ.

4.3. The temperature range of magnetic ordering

Although the nature of the 41° K phase transition is not yet established, it seems quite clear from the neutron diffraction evidence that some sort of superstructure of magnetic moments is involved and that the alignment of moments increases continuously upon cooling from 300° K [4]. The broad temperature range of the anomalous c_{11} temperature dependence may be interpreted as further evidence of a continuous change from a disordered to a fully ordered state. Evidently the increase in ordering below 250° K coincides with or produces a marked negative contribution to the 2nd nearest neighbor central force constant, which far exceeds the positive contribution of the decreasing temperature. Because the neutron diffraction experiments have not yet been extended to temperatures above 298° K, the temperature range in which partial magnetic ordering exists is open to question. If the unusual changes in the temperature dependence of the shear moduli and the lattice specific heat $[C_V(V_0, T) - \gamma_0 T)]$ are assumed to be the result of continuous decrease in magnetic order, it would appear that the contributions to the thermal properties begin to disappear upon heating above 400° K. It is in this range that a change in slope of the c_{55} temperature dependence occurs. From a simple central force model c_{55} is primarily associated with the long range central forces (higher than fourth nearest neighbor distances). The change in slope of the c_{66} temperature dependence in the 650° to 700° K range can in a similar manner be associated with the third nearest neighbor band. Since major changes in character of the temperature dependence of the elastic properties seem to occur in the 600° to 700° K temperature range one may conclude from these results that the magnetic ordering disappears upon heating to the range of 700° K.

The concept of a gradual increase in magnetic spin disorder with increasing temperature may also serve as an explanation for the electrical resistivity vs temperature curves which have been reported for polycrystalline uranium [36]. These data generally show a linear temperature dependence of resistivity in the 25° to 40° K range and an abrupt but small decrease in slope in the neighborhood of 40° K which is characteristic of the antiferromagnetic to paramagnetic transition in certain heavy rare earth metals. In contrast to the rare earths, $d\varrho/dT$ above the transition is only slightly smaller than that below the transition but gradually decreases with increasing temperature and the negative curvature is very pronounced above 300° K. Assuming that there are localized electron spins on the atoms, as in the case of the rare earths, the spin-disorder contribution to the electrical resistivity would increase with increasing and disorder eventually be temperatureinde pendent when the degree of order has become essentially temperature independent.

5. Conclusions

The temperature dependence of the shear moduli and the elastic parameters involving cross-coupling of strains (Young's moduli and Poisson's ratio) in alpha uranium single crystals undergo unusual changes at temperatures above 400° K, with the most significant changes occurring above 600° K. It is shown that the negative thermal expansion coefficient in the [010] direction is probably the result of the anisotropy and temperature dependence of the elastic compliance moduli. The lattice specific heat at constant volume, assuming a temperature independent electronic specific heat coefficient is shown to be relatively normal in the 100° to 400° K range, but attains a significantly positive temperature dependence above 400° K. It is suggested that the anomalies in the thermal properties and in the temperature dependence of the electrical resistivity are caused by the continuous decrease with increasing temperature of magnetic moment alignments, which are indicated by neutron diffraction measurements of Mueller [4].