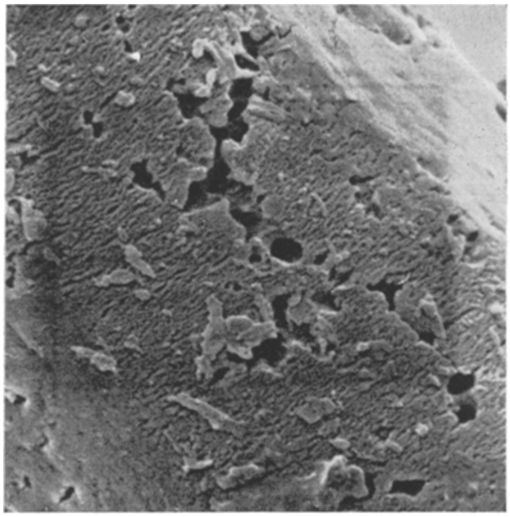

Figure 5 Crazing of filament surface (× 4700).

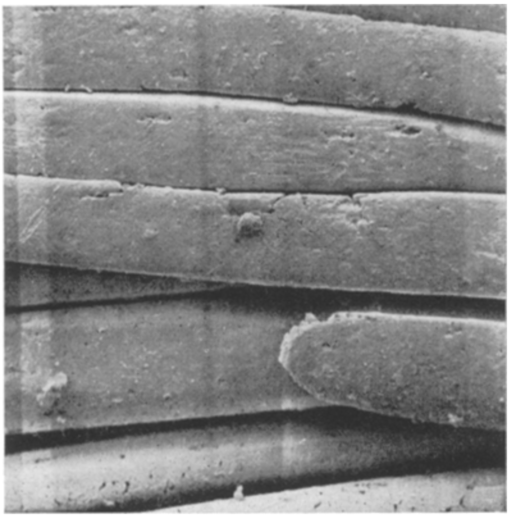

Figure 6 Crown of blue burgee showing some pitting and cracking (× 860).

strength.

Portions of the burgees were examined in the Cambridge Stereoscan scanning electron microscope. The surface of the filaments in the yellow fabric was found to be highly pitted, and some of the filaments on the yarn crowns had broken (Figs. 1 and 2). It was observed that the flag did not tear preferentially in either the warp or weft direction (Fig. 1), but breakdown had resulted from general weakening of the fabric. The broken filaments had a very ragged and pitted appearance (Fig. 3), although there was some evidence of the broken ends beginning to be rounded off, in a way similar to that observed in worn garments made from polyamide and polyester yarns. There were indications of loss of material at some distance along the filaments from the broken ends. Fig. 4 shows such a region of reduction in filament diameter, where the filament would be very susceptible to breakdown, and is taken several fibre diameters back from the broken filament end shown in Fig. 3. Examination of the filaments at higher magnifications showed that besides holes and crevices, the filament surfaces frequently showed many cracks perpendicular to the fibre axis (Fig. 5). However, where filaments were in contact with one another, these surfaces had a smoother appearance but still contained holes and crevices.

The lower level of damage in the blue burgee, which had not been used quite as much as the yellow one, is shown in Figure 6. This is similar in type, but no fine crazing of the surface of the filaments was observed. There was also evidence of a fungus growth on the yarns but not of actual damage to the filaments.

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Preparation and electrical behaviour of Mg_5Hg_3

An intensive study of the electrical characteristics of intermetallic compounds has been performed in order to understand their most important physical properties. The aim of this work is to present our results on the low temperature electrical behaviour of Mg_5Hg_3 – one of the six intermetallic compounds known to occur in the Mg–Hg system.

The congruent melting Mg_5Hg_3 compound belongs to the Mn_5Si_3 ($D8_8$) structure group [1] and has the lattice parameters $a = 8.260$ Å and $c = 5.931$ Å.

For the preparation of the samples, magnesium

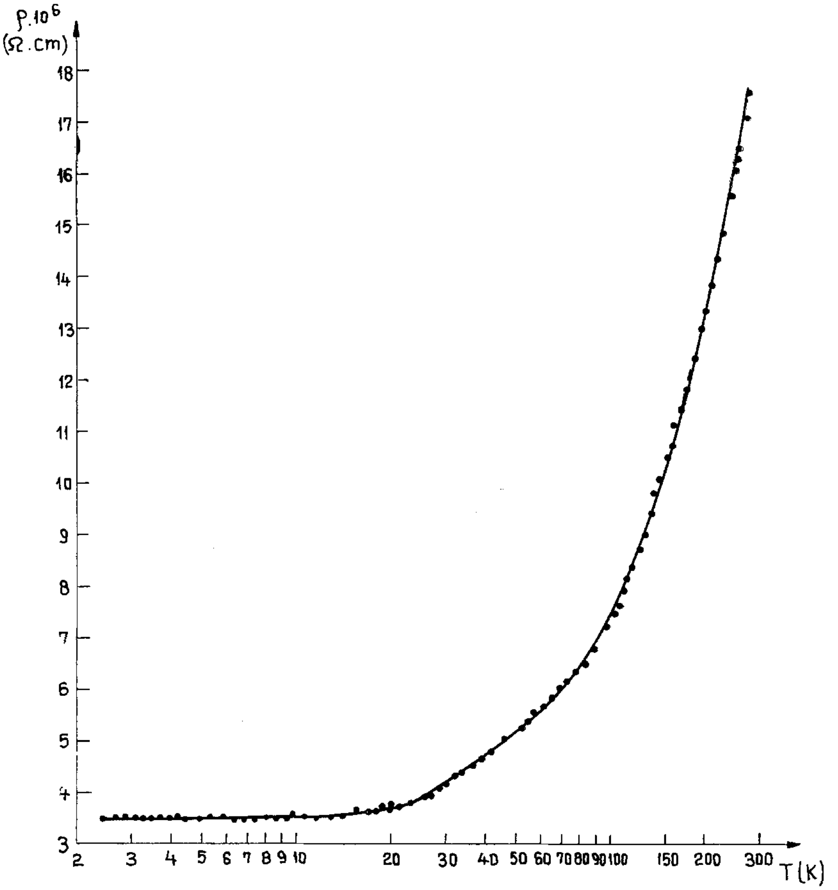

Figure 1 Total electrical resistivity versus temperature for a typical Mg_5Hg_3 sample.

of 99.9% purity and Hg distilled four times were used. The basic elements were weighed within limits of 0.5 mg and then heated to above 562°C, the melting point of Mg_5Hg_3 [2], in an evacuated silica tube. No second phase was observed by metallographic analysis in our samples. In a moist atmosphere, a disintegration of the samples occurred, which was diminished (or eliminated) in dry air.

The electrical resistivity and Hall effect were measured by a conventional four terminal method, using an electronic data acquisition system, within the temperature range from 2.4 to 297 K. Measurements at helium temperatures were performed by cooling the samples first to nitrogen liquid temperatures and then to helium temperatures. Two runs obtained in this manner did not show any systematic differences even in the case when the measurements were performed after a period of a few days.

Fig. 1 shows the variation of the total electrical resistivity of a typical Mg_5Hg_3 sample as a function of temperature. The residual resistivity did not exceed 3.5×10^{-6} Ω cm for all samples and no phase transition was observed over the whole temperature range studied. The absence of a transition at 4.15 K (superconductive critical temperature of mercury) proved that the compound contained no free mercury.

For the best samples the residual resistivity ratio RRR $= \rho_{295}/\rho_{4\cdot 2\mathrm{K}}$ had a value of 5, which is comparable with RRR as determined for other intermetallic compounds (e.g. $AuAl_2$, $AuGa_2$, $AuIn_2$ [3], AuSn [4]). The temperature dependence of the ideal resistivity ρ_i (ρ_i is the difference between the total resistivity and the residual resistivity) has the form

$$\rho_i \approx T^{\alpha} .$$

The value of α is 1.9 in the 11 to 50 K temperature range and 1.0 in the 150 to 300 K temperature range.

The Hall constant, measured at room temperature in 6400 Oe magnetic fields had a value of only 5×10^{-4} cm^3 C^{-1}.

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Martensitic or deformational transformations and molecular crystals

Studies of structure-transformations in crystals containing more than 8 atoms per unit cell suggest that the displacements possible in martensitic transformations should be further examined. It has been claimed that lattice deformations need not be considered for molecular crystals and that a similar view can probably be taken of other crystals [1, 2]: in mineralogy the aragonite-calcite transformation, in which the oxygen atoms which are components of an anion must be disengaged from their cation co-ordination, has been taken as a typical example of a reconstructive transformation [3]. General theory of lattice deformations is available [4]. In compounds, however, it is not always obvious whether the atomic displacements occurring during the proposed lattice deformation will allow the lattice correspondence to be maintained.

The term martensitic in this note implies that during the appropriate deformation which interconverts the lattices the structural units fall into their sites in the new cell through consequential displacements which do not require any units to exchange neighbours (even by passage of rows of atoms over one another by partial dislocations); and that the resulting misregistry between the lattices, unless zero, is accommodated by dislocations or by transformation twinning. More generally the structural relationship and the corresponding mechanism can be described as "deformational". Except in stress induced transformations in polymers [5] the structural units considered have been atoms or diatomic molecules [6] or simple ions [7]. The structures can then snap over into the new configuration in unconstrained regions.

A deformational relationship is evidently maintained in the transformation in the molecular crystal of *p*-di-iodobenzene. It is not a continuous order-disorder change since there is a discontinuous change of lattice parameter (about 1 %) and of birefringence, accompanied by marked superheating and supercooling, yet growth is not random, since a reproducible orientation relation was shown by the optical extinction direction [8]. Here the lattice deformation is small.

In general, molecules pack densely with the humps (atoms) of one fitting the hollows of a neighbour [9] unless held in a less dense configuration by directional interactions such as hydrogen bonding. In inorganic crystals modification of such directional interactions by thermal motion commonly results in transformation accompanied by lattice deformation: in crystals of near-planar molecules it may permit some relative displacement of molecules. Similarly when increasing oscillation of molecules would bring side-groups of neighbours into too close proximity some relative displacement of the molecules may result. Again when a particular polymorph does not correspond to the hump-hollow combination of lowest free energy, an increase in thermal motion of the whole molecule within these crystals of rather low lattice energy may permit relative translation to another hump-hollow combination. Such translation involves a shift of the atoms of each molecule past or around atoms of adjacent molecules. Thus atom neighbours are exchanged but not structural units, which are the molecules. This is, nevertheless, an activated process.

Such an activated process in a martensitic transformation has been shown in rubidium nitrate [10]. Transformation from the calcite-related [11] form II in which the flat NO_3^- ions are co-planar to the cubic NaCl-related form I requires the anions to tilt and the oxygen atoms to be disengaged by thermal motion from their co-ordination by cations Yet this transformation