Wang, Gabe, Calvert & Taylor, 1976; Larson & Gabe, 1978). The space group was determined from precession photographs (hkl: h + k + l = 2n; hkl: 2h + l = 4n) and intensity statistics to be $I4_3d$. The systematic absences were also measured to check the possibility that the crystal had lower symmetry due to ordering (Carter, 1972). In addition, the La$_3$Sb$_3$ data were refined in $I2_3$ to result not significantly different from $I4_3d$. Details for each crystal are given in Table 1. Two complete unique sets, each containing $hkl$ and $hkl$, were measured and averaged. All calculations were carried out on the laboratory computer using the NRC-PDP-8 system of programs (Larson & Gabe, 1978). The structure was refined using the observed reflections with allowance for anomalous dispersion and isotropic extinction (Larson, 1969). For Eu$_4$As$_3$, extinction was negligible and not refined. Refinement was by anisotropic full-matrix least squares with starting coordinates from Hulliger & Vogt (1970).*

For both structures the final difference maps contained no significant details. (A refinement with variable As occupancy did not give significantly different results.) A microprobe analysis (Owens, 1978) of the Eu–As crystal gave Eu$_{4.012}$As$_{2.993}$. The stoichiometric formula was therefore accepted for our crystal.

For comparison, La$_3$Sb$_3$, known to be stoichiometric (Gambino, 1967), was also studied.

**Discussion**

The Th$_3$P$_4$ structure (Meisel, 1939) has been described in detail elsewhere (Heim & Bärnighausen, 1978, and references therein). The anti version of this structure is observed for pnictides of the rare earths, Ln$_4$X$_3$ (Hohnke & Parthé, 1966; Bodnar & Steinfink, 1966; Gambino, 1967; Hulliger & Ott, 1977), but to date no diffractometer single-crystal study is known to us. Structural details are of interest in discussing the superconductivity of Ln$_3$X$_4$ compounds which are an order of magnitude different from the analogous Ln$_3$Y$_4$ (Y = S, Se, Te) compounds with the normal Th$_3$P$_4$ structure. The interatomic distances are given in the Abstract and the average Ln–X values, viz Eu–As = 3.19 Å and La–Sb = 3.34 Å, are equivalent to those expected for Ln$^{3+}$ metallic phases. Each Ln atom is connected to three other Ln atoms (Maas, 1970), forming two distinct enantiomorphic sets of three-connected ten-membered rings (Heim & Bärnighausen, 1978) in which the bonding is comparable to that for the Ln$^{3+}$ metal. For La these are the face-centred cubic and double hexagonal close-packed forms of the element (3.75 and 3.77 Å respectively) and for Eu$^{3+}$ the 12-coordination value is 3.60 Å. Similar geometrically distinguishable Ln sublattices are observed in other lanthanon pnictides, even anion-rich ones, e.g., the high- and low-temperature forms of LaAs$_3$, and in NdAs$_3$ (Wang, Heyding, Gabe, Calvert & Taylor, 1978). The lattice parameter and stoichiometry found for La$_3$Sb$_3$ are in excellent agreement with those of Hulliger & Ott (1977), 9.648 Å and La$_3$Sb$_3$, and consistent with those of Hohnke & Parthé (1966), 9.648 Å, and Gambino (1967), 9.63 Å. For Eu$_4$As$_3$, both lattice parameter and stoichiometry differ from those given by Hulliger & Vogt (1970) and we conclude that our single crystal is stoichiometric Eu$_4$As$_3$.

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**References**


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**International Union of Crystallography**

**Donation**

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