gallium garnets and Ga_2O_3(7),and for this reason was chosen as a flux for the orthoaluminates. Sample volumes of approximately 0.054 cc. each were packed into separate platinum containers. During all runs, two materials were pressed simultaneously at 32.5 kilobars and 1200°±10°C, for a period of four hours. After quenching, the apparatus was allowed to cool over night, the pressure released, and the subsequent recovery of the sample containers effected. Each platinum cell was then broken open and immersed in distilled water. The NaOH rapidly dissolved leaving small, rectangular parallelpiped-shaped, transparent crystals. The crystals of the Ho, Er, and Tm compounds were colored pale yellow, pale pink, and pale green respectively, while those of Dy, Yb and Lu aluminate were colorless. All the crystals were strongly birefringent.

X-ray powder films were taken of Eu-$LuAlO_3$ crushed crystals with a Guinier camera using KCl as internal standard and CuKα radiation ($K\alpha_1$ = 1.5405 Å and $K\alpha_2$ = 1.5443 Å). None of the powder films showed any trace of garnet lines after 24 hrs. exposure. They were all indexed on the basis of the orthorhombic cell, space group Pbnm, with lattice constants given in Table 1.

TABLE 1

Orthorhombic Cell Data for the Series $SmAlO_3$-$LuAlO_3$. The standard deviations are less than 10^{-4}, except for those of $EuAlO_3$ and $GdAlO_3$ which are twice as large.

	a,(Å)	b,(Å)	c,(Å)	Vol. Å
$SmAlO_3$	5.2912	5.2904	7.4740	209.22
$EuAlO_3$	5.267	5.294	7.459	208.0
$GdAlO_3$	5.250	5.302	7.447	207.3
$TbAlO_3$	5.2317	5.3097	7.4196	206.11
$DyAlO_3$	5.2053	5.3172	7.3950	204.68
$HoAlO_3$	5.1811	5.3229	7.3741	203.37
$ErAlO_3$	5.1595	5.3271	7.3539	202.12
$TmAlO_3$	5.1435	5.3277	7.3335	200.96
$YbAlO_3$	5.1251	5.3310	7.3146	199.85
$LuAlO_3$	5.1012	5.3317	7.3000	198.55

The lattice parameters were refined from values of 2θ which were $\leq$ 2θ(224), excluding overlapped lines. The lattice parameters for $SmAlO_3$ were determined by a simplified version

of Bond's method (8, 9). The powder patterns for Eu-$LuAlO_3$ are listed in Table 2.

Discussion

The lattice parameters of $SmAlO_3$-$LuAlO_3$ are plotted against atomic number in Fig. 1. Atomic numbers rather than ionic radii were chosen as abscissae since the variation in coordination number across the series is not known. One can see that while the a and c parameters decrease in a nearly linear fashion from Sm-Lu, b increases asymptotically to the Lu value. The behavior of the b parameter resembles that of $REGaO_3$ (10) compounds between Ce and Gd and the b parameter of the $REFeO_3$ series between La and Gd (11). However, in the case of the two latter series, the b values eventually decrease for smaller rare earth ions, but no decrease occurs for the $REAlO_3$ compounds.

The entire series of $REFeO_3$ structures have been refined from single crystal data in order to fully understand the mechanism underlying this anomalous behavior (4). It is now clear that the oxygen polyhedron around the rare earth ion is distorted and this distortion varies drastically across the series. The rare earth ion has approximately an eight fold

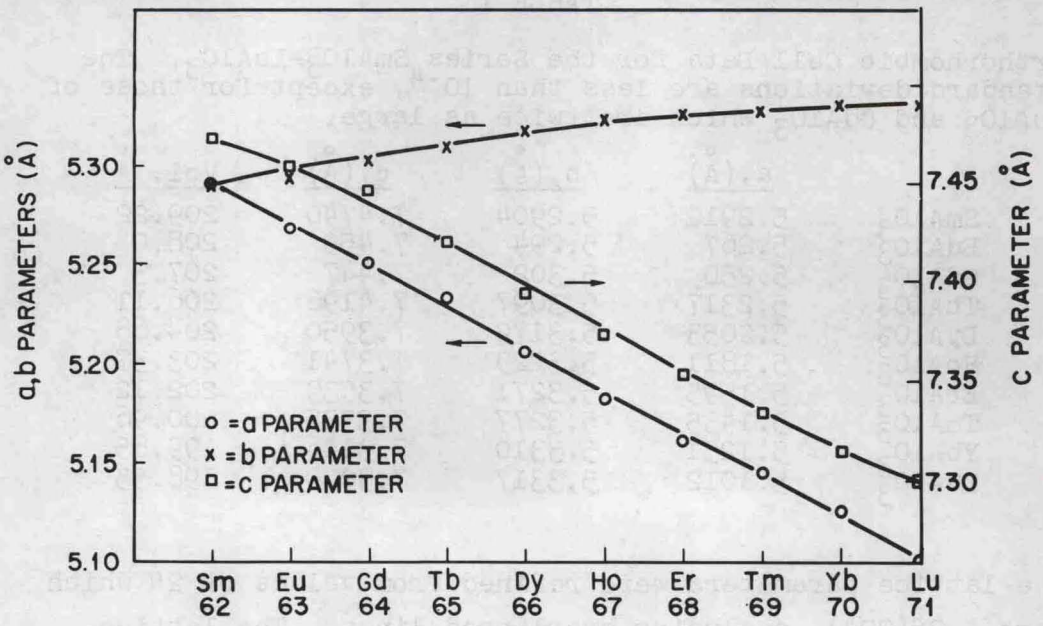

FIG. 1

Lattice parameters a, b, and c versus atomic number for the rare earth orthoaluminates.