results on CeF_3 agree with those of Sher *et al.* on LaF_3 in that, the rate of temperature variation of a_a is less than that along the basal plane. The present results also show that the values of the two principal coefficients of expansion are equal around 200° C, and above this temperature the value of a_a is greater than that of a_c. Since there is no crystallographic transition in CeF_3[8], the observed anisotropy in expansion might be only due to the interplay of different ionic interactions that are present in this crystal. However, a detailed discussion on the similarities and differences in the behaviour of the expansion characteristics of these substances *vis-a-vis* the structure would be incomplete till such data on other isotypic compounds PrF_3 and NdF_3 become available. This work has been undertaken by the authors.
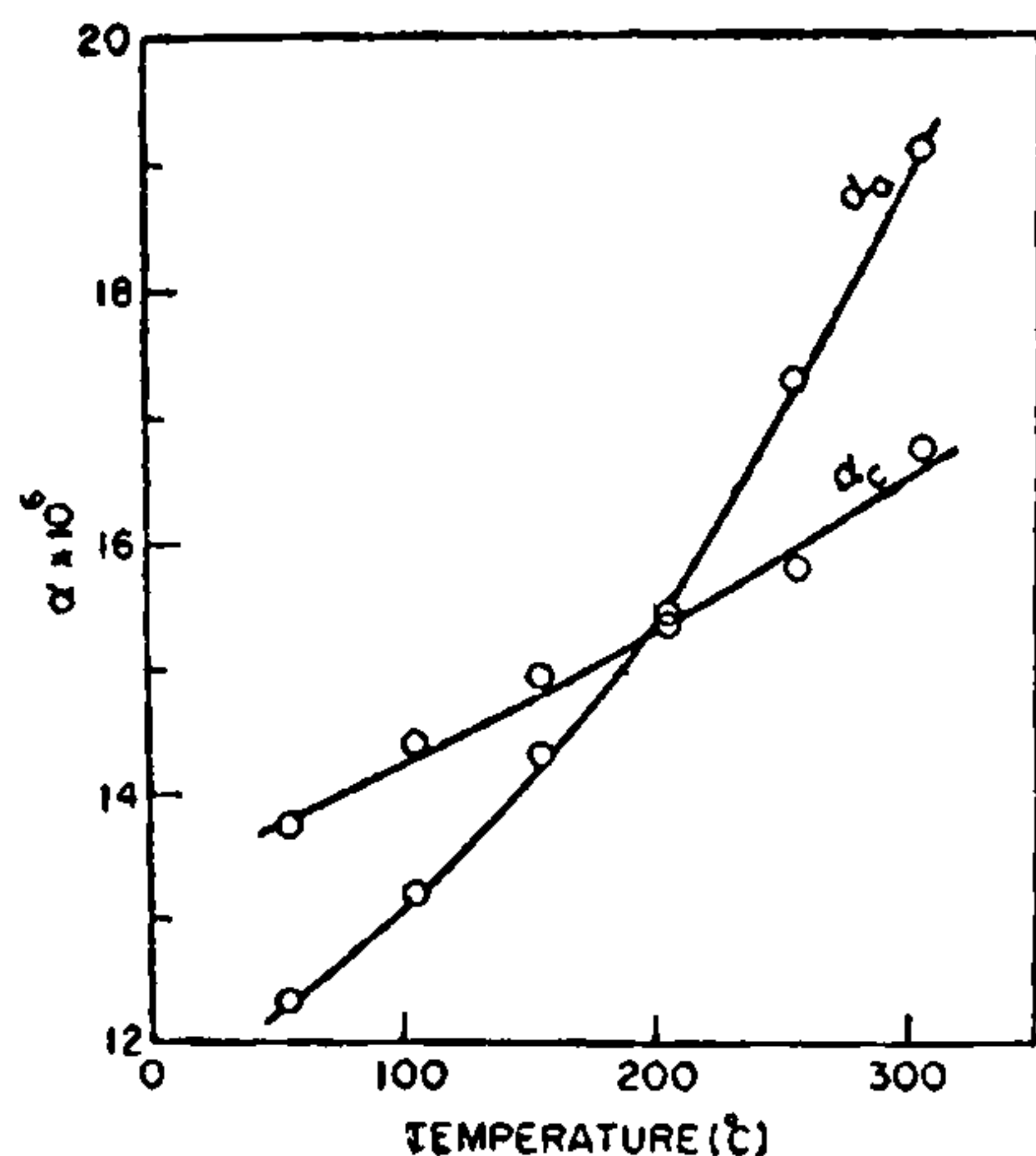

FIG. 1. Temperature variation of a_a and a_e of CeF_3.

TABLE II

Comparison of the values of the coefficients of thermal expansion of LaF_3 and CeF_3 at room temperature

Substance	$a_a \times 10^6$	$a_c \times 10^6$	Reference
LaF_3	15·8	11·0	Sher *et al.*[9]
	20·0	10·0	Klein and Croft[10]
CeF_3	12·1	13·6	Present study

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Physics Department,   S. RAMACHANDRAN.
University College of   S. V. SURYANARAYANA.
Science,   K. VENKATARAMIAH.
Osmania University,
Hyderabad 500 007, *September* 16, 1974.

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SMALL ANGLE GRAIN BOUNDARIES IN HEULANDITE CRYSTALS

THE study of the configuration of grain boundaries is important to get additional information about the growth of a crystal. Burgers[1], Bragg[2] and Vogel *et al.*[3] have shown that low angle tilt boundaries are formed by array of edge dislocations. Amelinckx[4] investigated the geometry of dislocation nets and grain boundaries for different crystallographic structures. In the case of small angle grain boundaries it can be shown that $n = n_b + n_e$, where n_a, n_b, n_e are the number of dislocations per microns in the three branches. Recently Loiacono *et al.*[5] have confirmed this in the case of synthetic lead molybdate crystals—Here we are reporting some of the results obtained from the study of grain boundaries in heulandite crystals. Heulandite belongs to Zeolite family of minerals and is a hydrous calcium aluminium silicate. The chemical formula of heulandite is $Ca(Al Si_7 O_{18}).6 H_2O$. Heulandite is monoclinic and has a very good cleavage along (010) plane. It is found in the mountain regions

of Switzerland, Italy, U.S.A. and Australia. In India it occurs near Poona.

Etching of the (010) cleavage faces of heulandite crystals in ammonium bifluoride solution revealed closely spaced etch pits arranged in rows. Figure 1
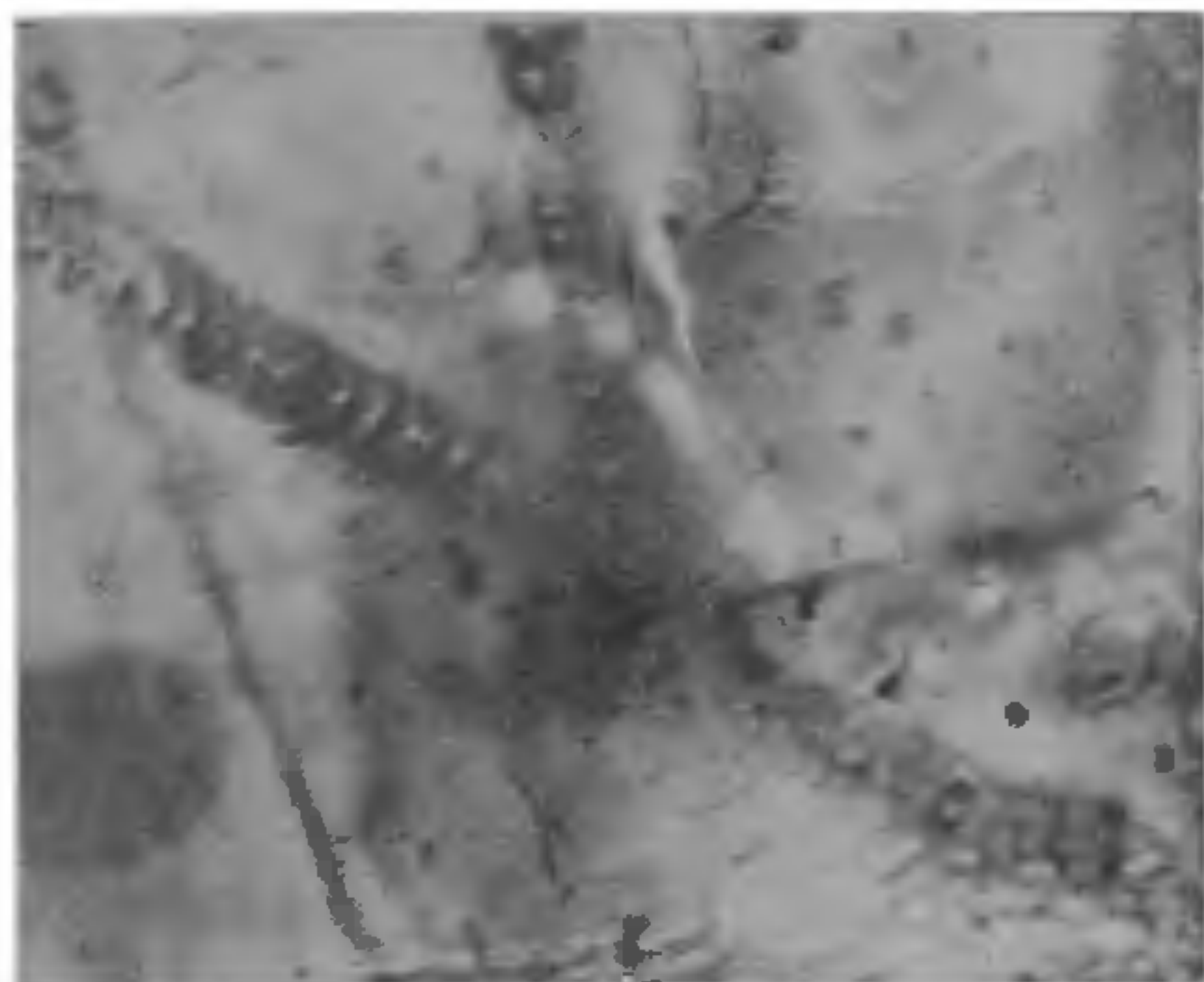

FIG. 1. Y-shaped grain angle boundaries on (010) cleavage of heulandite, $\times$ 200.

FIG. 2. Polygonized region on (010) cleavage of heulandite, $\times$ 200.

is a photomicrograph of such a row of pits observed on thin flakes when etched in a solution of 2 gm ammonium bifluoride in 10 cc water. Using a high power objective, individual pits in rows could be clearly resolved. The uniformly spaced pits obtained suggest that they are formed due to low angle grain boundaries separating two grains. The average spacing between pits is measured and the angle of tilt calculated. It is about 36 sec. The pit densities of boundary for intersecting boundaries are noted and at the junction the relation $n_a = n_b + n_c$ holds good. The results are listed in Table I.

TABLE I

Number of pits per micron	Branch		
	n_a	n_b	n_c
3		1·31	1·69

The stresses and strains in natural crystals may sometimes produce tilt boundaries due to polygonization. When heulandite cleavage surface is etched in sodium hydroxide solution for one hour at a temperature of about 200° C parallel rows of pits are obtained as shown in Fig. 2. The polygonized region might have formed due to the stresses produced during the process of its growth in nature.

Department of Physics,   M. A. ITTYACHEN.
University of Kerala,   K. SREEDHARAN PILLAI.
Kariavattom,
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THE KINETICS OF ANODIC OXIDATION OF ZIRCONIUM IN 40% H_2SO_4, AND THE EFFECT OF TEMPERATURE

THE kinetics of formation of anodic films on zirconium have been reviewed by Young[1]. In recent times Shatalov and Bondareva[2], and Bacarella and Sutton[3] have made valuable contributions. Recently we reported on the kinetics of anodic oxidation of zirconium in 0·1 M KOH, 0·05 M H_2SO_4[4] and 0·1 M KOH + 0·0005 M Na_2SO_4[5], and the effect of anion impurities from the radiotracer studies.

In the present work an attempt is made to study the effect of temperature on the kinetics of anodic oxidation of Zr in 40% H_2SO_4.

Experimental.—Chemically polished zirconium samples were used and the procedure followed is described already[4].

Closed cells of 200 ml capacity were used. The platinum mesh cathode had 30 cm² superficial area to make the double layer capacitance as large as possible. Specimens were suspended vertically from the heavily anodized tag, the minimum amount of which was immersed into the electrolyte. The relative location of the two electrodes was not very critical. The electrolyte used was 40% H_2SO_4 and