Fig. 1. Limiting cases for the effect of alloying elements on the $\delta \rightleftharpoons \delta'$ transition in plutonium

two-phase region $\delta + \delta'$ has zero slope (thereby minimizing the effect of alloying elements on the transition temperature) the other will have a slope of absolute value 620° C./atomic per cent. In Fig. 1 (a), the impurity addition does not affect the lower limit of the pure δ' region, whereas in Fig. 1 (b) the region is effectively eliminated by the addition.

The probability of the effect of any specific impurity being one of these limiting cases is thought to be small. Since the slopes of the phase boundaries must both have the same sign, it is probable that in most cases corresponding to Fig. 1 (a) the phase boundaries meeting at T (the pure metal transition temperature) will both be tilted downwards. For alloys corresponding to Fig. 1 (b), both boundaries will be tilted upwards—making it even less likely that the δ' plutonium structure will be observed. In view of the
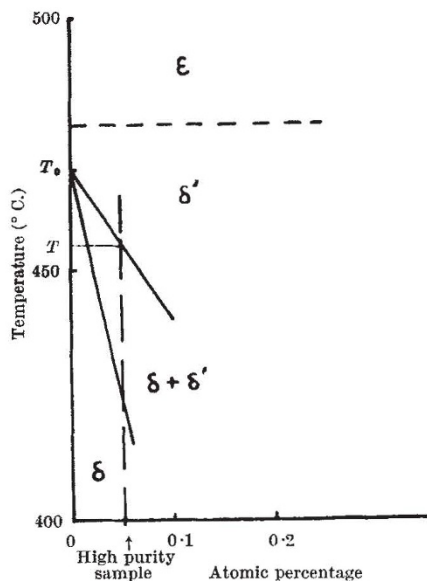

Fig. 2. Possible experimental case

appreciable concentration of impurities present in nominal 'high purity' plutonium, in those materials where the pure δ'-phase is observed, the situation must be represented by a variation of Fig. 1 (a), which is shown diagrammatically in Fig. 2.

From this figure it is obvious that the transition T observed in 'high-purity' metal may be a low approximation to the true transition temperature T_0. This observation is of particular interest owing to the small temperature-range of existence of δ' (about 25 deg. C.).

R. G. COPE

Development and Research Department,
The Mond Nickel Co., Ltd.,
Acton.

[1] Lord, W. B. H., *Nature*, **173**, 534 (1954). Ball, J. G., Robertson, J. A. L., Mardon, P. G., Lee, J. A., and Adams, E. T., *ibid.*, **173**, 535 (1954).

[2] Dean, D. J., Kay, A. E., and Loasby, R. G., *J. Inst. Metals*, **86** (10), 464 (1957–58).

[3] Wilson, A. J. C., *J. Inst. Metals*, **70**, 543 (1944).

CRYSTALLOGRAPHY

Growth of Single Crystals of Copper

IN his communication on the growth of single crystals of copper, published in *Nature* of April 2, p. 33, Mr. D. S. Kemsley is good enough to refer to a paper by Andrade and Roscoe[1], in which was described a method suitable for growing single crystals of metals of low melting point.

He makes, however, no reference to a paper published some years later by Andrade and Henderson[2], which specifically states that this method is not suitable for growing crystals of metals of higher melting point and describes a method using a split graphite mould in a high vacuum. This method was used for preparing single crystals of gold, silver and nickel in the first place, and was afterwards used by Andrade and Aboav[3] for preparing single crystals of copper, which proved perfectly satisfactory.

Those who wish to prepare single crystals of copper may possibly find this method simple and well adapted to the purpose.

E. N. DA C. ANDRADE

Department of Metallurgy,
Imperial College of Science and Technology,
Prince Consort Road,
London, S.W.7.
April 4.

[1] Andrade, E. N. da C., and Roscoe, R., *Proc. Phys. Soc.*, **49**, 152 (1937).

[2] Andrade, E. N. da C., and Henderson, C., *Phil. Trans. Roy. Soc.*, A, **244**, 177 (1951).

[3] Andrade, E. N. da C., and Aboav, D. A., *Proc. Roy. Soc.*, A, **240**, 304 (1957).

Crystal Structure of Potassium Trivanadate

WHEN solutions of potassium vanadate are made weakly acid, with pH less than 6·5, the orange polyion $V_{10}O_{28}^{-6}$ is formed. These solutions are unstable, and on long standing or on heating, insoluble light-orange, flaky crystals of potassium trivanadate, KV_3O_8, are precipitated. This compound was evidently first described by Norblad[1].

Buerger precession and Weissenberg X-ray diffraction patterns of crystals of potassium trivanadate