information may make the concept less repugnant to some minds. The situation is described for cases where gravitational effects are of minor significance for the phenomena considered, as they probably are in the actual universe. If they are not, similar results would still hold good, but with some general restrictions on the statements. The principle of impotence, for example, would apply to any not too great departure from free motion.

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Some Properties of Neptunium Metal

A PRELIMINARY study has been made of the properties of a small piece of neptunium prepared elsewhere in these laboratories by a bomb reduction process. The principal impurities present in the metal were, by weight per cent, as follows: calcium, 0·34; uranium, 0·22; nickel, 0·06; magnesium, 0·03; chromium, 0·03; plutonium, 0·03; aluminium, 0·02; molybdenum, not more than 0·05; vanadium, not more than 0·06; figures for fluorine and oxygen, which were probably also present in small quantities, are not available. A powder photograph on unannealed filings agreed with that previously reported[1] for the orthorhombic α-phase stable at room temperature.

The density of the specimen was found to be 20·2 gm./c.c. at 20° C. Three determinations of its specific heat by immersion in water were highly consistent and averaged 0·0319 $\text{cal.gm.}^{-1}\ {}^{\circ}\text{C.}^{-1}$, the range being 29–99° C. Allowance for specimen cooling during transfer might lower this figure by 1–2 per cent, whereas correction for impurities might raise it by 1–2 per cent. It lies in any event between published figures for uranium and plutonium.

A representative section was prepared for metallographic examination in a 'glove box' using standard methods. Inclusions were present to the extent of about 3 per cent by volume and at least two types were recognized, although not positively identified. The larger inclusions had segregated to a narrow band at one surface whereas the remainder, in the main body of the material, appeared to outline a dendritic structure. Porosity was mainly confined to a single cavity, probably produced by contraction during solidification, and was estimated at less than 0·1 per cent of the specimen as a whole. The difference between the observed density and the theoretical (20·45 gm./c.c.) is, therefore, attributed mainly to the presence of impurities. Reasonably good grain contrast was obtained under examination in polarized light after the specimen, in the mechanically polished condition, had been allowed to oxidize for some hours in air. There appears to be a close relationship between these grains and the original dendritic structure. The grains, which had a mean diameter of about 0·3 mm., were very irregular in size and shape and somewhat similar to those in cast uranium, although no clear evidence of sub-grains was obtained. Deformation twins observed near hardness impressions were long, thin and parallel-sided, and were frequently restricted to a single system in a given grain.

A Meyer hardness analysis[2] with a 1-mm. steel ball under various loads from 1 to 120 kgm. gave the following relationship between the load L (kgm.) and the diameter d (mm.) of the impression for loads greater than about 15 kgm.: $L = 360\ d^{2\cdot19}$. The Meyer index is thus 2·19 and the ultimate ball number is 458. Diamond pyramid indentations with loads greater than 10 kgm. gave a Vickers hardness figure of 355. The metal therefore appears to be considerably harder than uranium in a similar condition. On the basis of the derived stress–strain curve and the semi-empirical relationships between hardness and tensile strength, these results suggest that the ultimate tensile strength of neptunium in this condition is in the region 80–90 tons/sq. in.

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Annular Detonation in Cast T.N.T.

WHILE studying the setting up of detonation in cylindrical T.N.T. charges initiated by relatively weak primers, we have repeatedly observed the immediate appearance in the charge of an annular detonation wave. The wave originates near the surface of the charge, grows in width as it is propagated through the charge, and finally coalesces over the full charge-width.

The charges were cast by pouring the molten explosive into cylindrical metal moulds at room temperature, and had the crystal structure shown in Fig. 1. Three regions of particular relevance to our work are the finely crystalline surface-chilled layer, the axial and radial crystal systems originating at the mould surfaces and the conical surface along which these systems meet.

Bare charges of this type, 1·25 in. in diameter and of various lengths, were initiated in the axial direction by the shock from one or more ¼-oz. tetryl pellets of the same diameter and 0·25 in. long. A

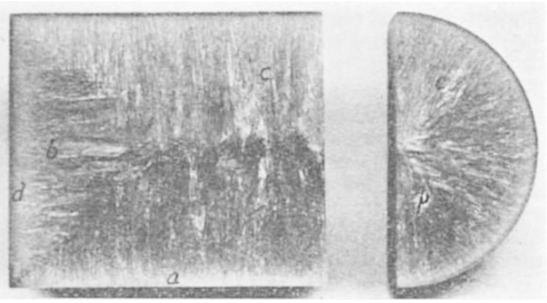

Fig. 1. Section illustrating the crystal structure of a cast T.N.T. charge: (*a*) finely crystalline surface-chilled layer; (*b*) conical volume of axial crystal system; (*c*) radial crystal system; (*d*) 'cast end' of charge formed at the base of the mould