by Peletier *et al.*⁹ and by E. Schmidt *et al.*¹⁰. Very recently, Pastell¹¹ has reported ignitions in an engine to give regions of auto-ignition, also regions of so-called 'cool-flames'. The boundaries of the separate regions have been defined for *n*-heptane, *iso*-octane and *n*-pentane.

It should be emphasized that the present experiments do not in themselves prove that there is a cool-flame region with methane, but simply indicate that there appears to be at least two distinct modes of ignition under adiabatic compression conditions. Experiments are also being made by Downs *et al.*¹² in the laboratories of Messrs. Ricardo and Co. We wish to acknowledge helpful discussions with them of the experimental methods in the early stages of the work here presented.

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Structure of the Sigma-Phase in the Iron-Chromium and Cobalt-Chromium Systems

THE application of X-ray single-crystal and powder methods has shown that the σ -phase structure is based on a tetragonal unit cell, containing 30 atoms, with space group $P4/mnm$, $P4mn$ or $P4n2$. For the σ -phase of iron-chromium, $a = 8.790$ Å., $c = 4.559$ Å. This cell is not the same as found by Duwez and Baen¹ using powder methods only.

While engaged in analysing this structure, we had the opportunity of seeing a paper on the atomic arrangement in β -uranium by Tucker², and were extremely interested to note that the β -uranium structure appears to be essentially the same as that of the σ -phase. The discovery of this relationship (the evidence for which is reviewed elsewhere³) thus affords a solution of the long-sought-for atomic structure of this intermetallic compound, which is of such high technical importance. The refinement of the structure of σ -phase of cobalt-chromium is now proceeding, and it is intended to investigate the phase where it occurs in other systems—in particular, accurate determination of the intensities of X-ray reflexions for the σ -phase of iron-molybdenum should enable any ordering of the different atoms to be detected.

According to Tucker, the atoms in β -uranium lie approximately in sheets perpendicular to the (tetragonal) *c*-axis, with a marked pseudo-hexagonal

symmetry along this axis. A discussion of the relationship between the σ -phase, the body-centred cubic and the α -manganese structures, and accurate determinations of electron distributions for both β -uranium and σ -phase structures, will be of great theoretical interest.

We are indebted to Mr. Charles W. Tucker, jun., for his willing co-operation in making available to us, prior to publication, the full details of his β -uranium structure.

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Anomalies in the Absorption Curve of Cosmic Rays in Lead

IN connexion with the work of E. Fenyves and O. Haiman¹, the results obtained in this Institute² may be of interest. In 1947, we repeated the measurements made by Boethe and Kolhörster³, Rossi⁴, and Auger, Leprince-Ringuet and Ehrenfest⁵, in order to obtain the absorption curve of the vertical component of cosmic radiation in lead, at sea-level, in Buenos Aires (lat. $34^{\circ} 35' 30''$).

For this work, we used triple-coincidence counters with counter-telescopes, their cathodes being coated with silver and anodes with molybdenum, containing a mixture of argon and amyl acetate. The pressure of this mixture was 10 cm. mercury, and we placed above the counter tubes blocks of lead of thickness 2, 5, 7, 10, 12, 15 and 20 cm.

Our curve was not in agreement with those obtained by the above-mentioned authors. It showed a maximum at 12 cm. thickness of absorber. However, we could not be sure whether this maximum was real or was within the standard deviation, due to the fact—as in the work of E. P. George and V. Appapillai⁶—that the intervals between the thicknesses of lead taken were too great.

Repeating the experiments in this range, varying the lead thickness by 0.5 cm. at a time, we obtained the maximum at 13 cm. absorber thickness, that is to say, 2.5 times the standard deviation (see graph).