tively, has been very satisfactory. In the accompanying graph, we show the experimental points of Bryan and Beard[3] giving the average induction time (in days) of papillomas induced in rabbits versus $\ln 1/c_0$, where c_0 is the applied concentration (in grams) of the carcinogenic papilloma virus from extracts of cottontail rabbit warts, together with the theoretical curve deduced from our theory and fitted to the experimental points quoted. The fact that this logarithmic dependence of induction time on concentration may be deduced unambiguously from the assumptions of our theory strongly supports the feasibility of applying the quantum hit theory to the problem of cancer production.

A detailed account of this theory applied to virus-induced cancer will shortly be published in *Acta Path. Microbiol. Scand.*

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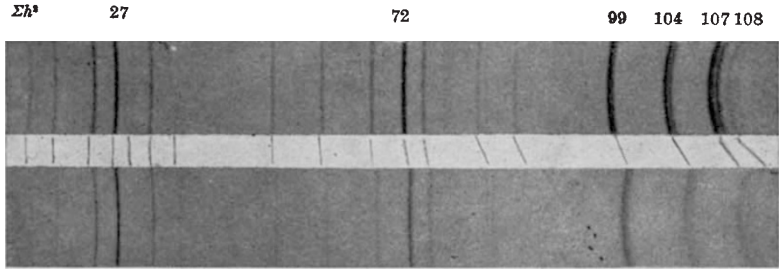
A New Complex Eta-Carbide

THE crystal structures of many carbides occurring in alloy steels have now been elucidated. One of their most striking characteristics is that they exist over quite extensive ranges of composition by permitting a high degree of atomic substitution to occur. A typical example is the η-carbide of high-speed steel, which extends over the range Fe_4W_2C to Fe_3W_3C. Structurally similar carbides have been shown by V. Adelsköld, A. Sunderlin and A. Westgren[1] to occur in the systems cobalt–tungsten–carbon, nickel–tungsten–carbon and iron–molybdenum–carbon. The stability of these η-carbides seemed to decrease in the order Fe_3W_3C, Co_3W_3C and Ni_3W_3C, and it was concluded that the reason for the non-occurrence of this type of carbide in the systems cobalt – molybdenum – carbon and nickel – molybdenum–carbon was due to their low stability, which caused them to decompose in cooling from the melt. In the chromium–tungsten–carbon alloys a quite different cubic carbide phase was found having the same structure as the cubic carbide $Cr_{23}C_6$.



Debye–Scherrer patterns of (above) η-carbide (Fe_4W_2C) from high-speed steel and (below) extract from an iron-free nickel-base alloy. Manganese $K\alpha$ radiation, 9-cm. diameter camera

The structure of the double carbide Fe_3W_3C has been shown by Westgren[2] to be of cubic symmetry, having the space group $Fd\bar{3}m$, and lattice parameter 11·08 kX. The number of atoms per unit cell is 112, of which 96 are metal atoms and 16 carbon. The unit-cell dimensions of the η-carbides are quite close to each other, being 11·08 kX. for Fe_3W_3C; 11·09–11·12 kX. for Fe_3Mo_3C; 11·01 kX. for Co_3W_3C; and 11·15 kX. for Ni_3W_3C.

During a recent examination of a complex iron-free nickel-base alloy containing cobalt, chromium, molybdenum and tungsten, a micro-constituent, thought to be a carbide, was extracted by electrolysing a ½-in. diameter bar of the alloy in a solution of commercial methylated spirits containing 5 per cent hydrochloric acid for 260 hr. at an initial current density of 0·011 amp./cm.². The Debye–Scherrer pattern of the extract shown in the accompanying figure was closely analogous to that of a sample of η-carbide (Fe_4W_2C) kindly supplied to us by Mr. H. J. Goldschmidt; but its lattice parameter was very much lower, namely, 10·951 kX. against 11·0246 kX. for the reference sample, and 11·08 kX. given by Westgren for Fe_3W_3C.

Chemical analysis of this new η-carbide revealed, in addition to nickel and carbon, the presence of appreciable amounts of silicon, chromium, cobalt, tungsten, molybdenum and nitrogen. By grouping these elements in accordance with their positions in the Periodic Table and assuming that silicon atoms occupy positions normally occupied by a transition element, the structural formula of the new carbide becomes

$$(Ni_{0\cdot58}Co_{0\cdot30}Si_{0\cdot12})_3(Mo_{0\cdot49}W_{0\cdot07}Cr_{0\cdot44})_3(C_{0\cdot95}N_{0\cdot05}),$$

which is analogous to the complex high-speed steel η-carbide $Fe_3(W,Mo)_3C$ reported by Goldschmidt[3] in his review of the structure of carbides in alloying steels.

So far as we are aware, this is the first occasion on which an iron-free chromium-rich η-carbide has been reported. Basically it is the complex double-carbide $(Ni,Co)_3Mo_3C$ which Westgren *et al.*[1] were unable to synthesize. Presumably the structure is stabilized by the presence of chromium and silicon. These atoms are appreciably smaller than the atoms of tungsten, molybdenum and iron, which they replace in the structure, thus causing the lattice parameter to fall substantially below the normal value. It would also be anticipated that this new η-carbide would extend over a wide range of composition without change in the pattern of atomic sites in the same way as the cubic chromium carbide varies from $Cr_{23}C_6$ to $(Cr,Fe,W)_{23}C_6$.

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