# The Preparation of Neutral Metal Carbonyl–Borane and Polyborane Species

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IT is known that a variety of metal carbonyls, and basic transition-metal anions, react with diborane[1] or borohydride ion,[2] *e.g.*

$$[Re(CO)_5]^- + Et_2O{\cdot}BH_3 \rightarrow [H_3B{\cdot}Re(CO)_5]^- + Et_2O$$

$$Mn_2(CO)_{10} + NaBH_4 \rightarrow [HMn(CO)_4]_3$$

The first metal-carbonyl polyborane, $Mn_3(CO)_{10}(BH_3)_2H$, (I), was obtained as a by-product of the latter reaction, and structurally identified[2] (by *X*-ray diffraction) as containing boron linked to the metal atoms by bridging hydrogen atoms. We have prepared this compound, together with a possible precursor, manganese pentacarbonyl borohydride, $Mn(CO)_5BH_4$, (II) from the reaction of manganese pentacarbonyl bromide with aluminium borohydride in mesitylene or isopentane at 20°. The use of aluminium borohydride (m.p. −44·5°) avoids the necessity of elevated temperatures and even solvent, compared with the reactions involving ionic borohydrides. The borohydride (II) was distilled from the reaction flask, and trapped at −60° under vacuum. It is a yellow liquid (m.p. *ca.* −78°) which decomposes smoothly and rapidly, at 25°, yielding a red viscous liquid containing the carbonyl polyborane (I) and other products not yet identified. It is also possible to prepare (I) directly by carrying out the initial reaction in toluene (at 20°). Both (I) and (II) are conveniently identified by their mass and i.r. spectra.

Aluminium borohydride also reacts with $Fe_3(CO)_{12}$, $Fe(CO)_4Br_2$, $Fe(CO)_5$, and $Co_2(CO)_8$, but the reaction products in these cases are dark-coloured reactive solids which have not yet been fully characterised.

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[1] G. W. Parshall, *J. Amer. Chem. Soc.*, 1964, **86**, 361.
[2] H. D. Kaesz, W. Fellmann, G. R. Wilkes, and L. F. Dahl, *J. Amer. Chem. Soc.*, 1965, **87**, 2755.