

This Week's Citation Classic

Chatt J & Duncanson L A. Olefin co-ordination compounds. Part III. Infra-red spectra and structure: attempted preparation of acetylene complexes.
J. Chem. Soc. 1953:2939-47.
[Imperial Chemical Industries Ltd., Butterwick Res. Labs., Welwyn, Hertfordshire, England]

By 1951, the pieces for the understanding of olefin-metal bonding were available. This paper describes their assembly into a bonding scheme and its experimental verification just in time to meet the need of chemists in the petrochemicals industry. [The SCI® indicates that this paper has been cited in over 520 publications since 1961.]

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"It is gratifying to know that my first major independent research has become a *Citation Classic*. Its significance in its day was summed up for me by one, since a Nobel laureate, 'Nice little field you have carved out for yourself Chatt, but...' who then indicated kindly that it was not of general interest. Its importance only emerged with the development of the petrochemicals industry and attempts to understand the mechanisms of relevant reactions of olefins catalysed at transition metal centres (1950-1970). I arrived in this unfashionable area of organometallic and coordination chemistry by chance around 1940 and found it fascinating. Its pursuit has earned me many medals (one gold) and other awards including the Wolf Prize for Chemistry, 1981.

"Four main stimuli brought me into metal chemistry: first, an uncle in an industrial laboratory who there introduced me to experimental inorganic chemistry and electrochemistry from about age 11 (1925); secondly, my school geography master whose remark (1930) that the Romans had mined gold in the hills (Caldbeck Fells) behind my parents' farm started me collecting minerals, mainly of Cu, Pb, Zn, W, and Mo;

thirdly, my school chemistry master who helped me identify them by qualitative analysis (H_2S , etc.) and provided much encouragement; fourthly, N.V. Sidgwick's *Electronic Theory of Valency*.¹ Thus, transition metal chemistry acquired a fascination that my Cambridge University tutors failed to dispel, but added an equal interest in synthetic organic and stereochemistry.

"Fortunately, I was able to combine those interests in my PhD with F.G. Mann (1937-1940). 'F.G.' also aroused my interest in olefin complexes. In his undergraduate lectures (1936), he suggested that the π -electrons of an olefin probably served the same function as a nonbonding electron pair on the common ligand atoms. To establish this seemed to me important for the development of the theory of the coordinate bond, but World War II intervened.

"After the war, I returned to the problem in ICI's Butterwick Research Laboratories. It was shown that the simple donation of π -electrons to the metal was not sufficient to explain the bonding² but that back donation of d -electrons from metal to olefin (dubbed dative π -bond, now back-bonding) was probably essential.³ The recipient orbitals of the olefin were suggested by Dewar.⁴ It was now necessary to establish which, if any, of the many proposed structures was correct. Our laboratory just then acquired its first IR spectrometer operated by L.A. Duncanson. We came together; he provided the IR expertise and I the background and bench chemistry.

"This paper has been highly cited for the following reasons. It provided the classical prototype structure for olefin-metal bonding. It has become a basic part of texts on organo-transition metal chemistry and the catalysis of reactions involving olefins at transition metal centres.^{5,6} For me this work laid the basis for a lifetime's fascinating research and more immediately it helped to clarify a classification of metal ions which also formed the subject of a *Citation Classic*.⁷

1. Sidgwick N V. *Electronic theory of valency*. Oxford: Clarendon Press, 1927. 310 p.
2. Chatt J. Olefin co-ordination compounds. Part I. Discussion of proposed structures: the system ethylenetriethylborane. *J. Chem. Soc.* 1949:3340-8.
3. ----- . The co-ordinate link in chemistry. *Nature* 165:637-8, 1950.
4. Dewar M J S. A review of the π -complex theory. *Bull. Soc. Chim. Fr.* 18:C71-9, 1951.
5. Masters C. *Homogeneous transition-metal catalysis*. London: Chapman and Hall, 1981. 277 p.
6. Mingos D M P. The bonding of unsaturated organic molecules to transition metals. (Wilkinson G, Stone F G A & Abel E W, eds.) *Comprehensive organometallic chemistry*. Oxford: Pergamon Press, 1982. Vol. 3. p. 1-88.
7. Ahrland S, Chatt J & Davies N R. The relative affinities of ligand atoms for acceptor molecules and ions. *Quart. Rev. Chem. Soc.* 12:265-76, 1958.
[Citation Classic. *Current Contents/Physical, Chemical & Earth Sciences* 20(24):10, 16 June 1980.]