The employment of molecules, not atoms, as a basic building block to construct solids has lead to the development of new classes of materials exhibiting commercially useful properties.\textsuperscript{1,2} These include electrical conductivity, ferroelectricity as well as magnetic ordering. Molecules, in contrast to atoms, enables the modulation of the commercially useful properties by low-temperature organic-synthesis methodologies, that can lead to the improvement of the properties, and lead to the development of materials with a combination of properties that will expand their desirability. Herein, we focus solely upon work related to molecule-based magnets. Molecule-based magnets are defined as substances prepared from molecules (or molecular ions) that maintain aspects of the parent molecular framework, and magnetically order.

Harden H. McConnell in 1963 suggested a mechanism for ferromagnetic coupling between radicals that required a specific spatial arrangement.\textsuperscript{3} In 1967 McConnell discussed another approach for stabilizing ferromagnetic coupling between radicals that involved the admixing of a charge transfer excited state into the ground state.\textsuperscript{4} Although these models only discussed ferromagnetic coupling between a pair of radicals, not magnetic ordering, experimental research focused toward the testing these models began to appear more than a decade latter.\textsuperscript{5, 6}

H. Hollis Wickman, Anthony M. Trozollo \textit{et al.} reported in 1967 that $S = 3/2$ ClFe$^{III}(S_2CNEt)_2$ 1, was a ferromagnet with a critical or magnetic ordering temperature, $T_c$, of 2.46 K.\textsuperscript{7} R. L. Martin and co-
workers at the University of Melbourne in 1970 reported that another \( S = \frac{3}{2} \) complex, manganese phthalocyanine, 2, was a ferromagnet.\(^8\) However, in 1983 William E. Hatfield's group showed that it was a canted-ferromagnet with 8.3 K \( T_c \).\(^9\) Claudine Veyret and co-workers in 1973 reported that bis(2,2,4,4-tetramethyl-4-piperidinol-1-oxyl), 3, tanol suberate, was a ferromagnet with a \( T_c \) of 0.38 K.\(^10\) Additional data led to the characterization of tanol suberate as being a metamagnet, \( i.e., \) it had an antiferromagnetic ground state; however, above a critical applied magnetic field of 100 Oe and below a \( T_c \) of 0.38 K it had a high moment, ferromagnetic-like state.\(^11\) In 1979 \([\text{Fe}^{III}(\text{C}_5\text{Me}_5)_2][\text{TCNQ}] \) \( \text{TCNQ} = 7,7,8,8\text{-tetracyano-p-quinodimethane}, 4\), \([5][4]\), was characterized to be a metamagnet below the \( T_c \) of 2.55 K with a critical applied magnetic field of 1600 Oe.\(^12\)