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**Metal-Organic Polyhedra Arising from Products of Template-Directed Synthesis in the Solid State.**

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Metal-mediated self-assembly is a flourishing branch of coordination chemistry that has implications in the fields of host-guest chemistry and materials science. Congruous design of the metal-bridging ligand is imperative, as it must contain appropriate functionalities to recognize the metal and form the desired assembly. Most self-assembling systems studied to date have been based on symmetrical ligands, those with multiple copies of identical binding functionalities. We have used template-directed synthesis in the solid state to produce unsymmetrical tetrapyrrolyl cyclobutane molecules in quantitative yield and in gram quantities. When these polyfunctional molecules self-assemble with metals, they give rise to metal-organic polyhedra. In addition, the outer surfaces of these polyhedra can be decorated with organic groups, opening doors to applications in anion transport and biomedical chemistry. That template-directed synthesis is used to produce molecules otherwise difficult or impossible to obtain, and that these molecules, in turn, assemble with metals to produce interesting and useful metal-organic assemblies augurs well for the future study of the crystalline solid state as a reaction medium.