Reactivity of a Terminal Methylidyne

\[(\text{Cy})_2\text{P} \equiv \text{P(Cy)}_2\]

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\begin{align*}
\text{Br} & \equiv \text{W} \equiv \text{C} - \text{H} \\
\text{OC} & \equiv \text{CO}
\end{align*}
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What is a metal? A couple of you in the audience are looking at me like “is he really a scientist, asking what a metal is?” but I’d like to suggest that the metals I work with are vastly different to everyday ones. Sure we have our ‘metallic’ metals – knives, forks and if you’re feeling particularly medieval, swords, and there are also substances like sodium chloride known as metal salts. But as soon as I mention ‘transition metal complexes’ such as tris(ethylenediamine) cobalt (III), my audience tends to shut down faster than my laptop going for a swim.

So what exactly are metal complexes? Firstly we have a transition metal atom in the centre of our molecule, W or tungsten on the screen. Like a soloist in a concerto they are a) incredibly expensive (gold, rhodium, iridium), b) they’re incredibly sensitive (they decompose in the presence of oxygen and you shouldn’t even think of bringing water nearby) and c) unique and talented in that the quantum electronic structure of these metals afford particularly remarkable reactivity over non-metallic elements.

Of course, the orchestra is just as important as the soloist in a concerto and this is where our metal ‘ligands’ come in. Ligand essentially means ‘thing that chemically bonds to the metal’, which is no where near as catchy. And as an orchestra in a concerto complements or contrasts the soloist, we can tune our ligands to create metal complexes that react as we want.

This brings us to the “terminal methylidyne” – the ligand shown in red on the screen. To date, there have only been a handful of examples of compounds with this ligand reported and more significantly, their reactivity has not been explored - almost like an instrument that’s never been used in music. The aim of my project is to explore the reactivity of this ligand by tinkering around with it using chemicals.

So this brings us to the last question – why do we care? Organometallic chemistry pervades our world from producing anti-cancer compounds such as cisplatin to driving the catalytic converters in our cars. They’re also critical for catalysing crucial chemical reactions – approximately 80% of the nitrogen in our bodies has been derived from a process utilizing organometallics to turn atmospheric nitrogen into the fertilizer which now feeds the world.

My research adds to the body of knowledge surrounding the chemistry of metals, ultimately leading to a variety of outcomes intertwined with the amazing reactivity of metals. And failing all of this, much like the memorable motifs of Beethoven, there is an intrinsic beauty and joy in crafting new complexes, delving into foreign chemistry and understanding at a fundamental level, the reactivity of molecules.