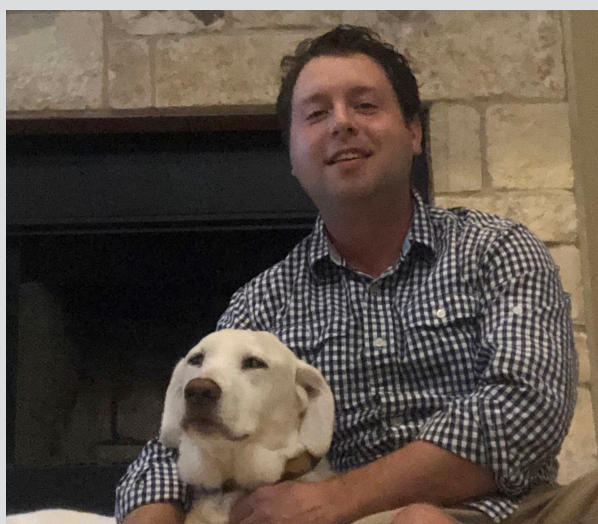


Young Career Focus: Dr. Caleb Martin (Baylor University, USA)

Background and Purpose. SYNFORM regularly meets young up-and-coming researchers who are performing exceptionally well in the arena of organic chemistry and related fields of research, in order to introduce them to the readership. This Young Career Focus presents Dr. Caleb Martin (Baylor University, USA).

Biographical Sketch



Dr. C. Martin

Caleb Martin grew up in Waweig, New Brunswick, Canada. He began his studies in chemistry at Mount Allison University (Canada) where he obtained his BSc in 2007 working with Glen Briand and Steve Westcott on indium and palladium chemistry, respectively. He completed his PhD on group 16 cations at Western University (Canada) in 2012 with Paul Raggona. Upon completion of post-doctoral studies on carbene chemistry at UC Riverside and UC San Diego (USA) with Guy Bertrand, he began his independent career at Baylor University in Waco, TX (USA) in the Department of Chemistry and Biochemistry in 2013. His group's research interests are focused on the synthesis, reactivity, and properties of unusual tricoordinate boron species.

INTERVIEW

SYNFORM *What is the focus of your current research activity?*

Dr. C. Martin My group's research is centered on investigating conjugated boron heterocycles, spanning synthesis, reactivity, metal complexation, and molecular properties. Our targets typically have unusual bonding arrangements or electronic structures that have an effect on their reactivity and properties.

SYNFORM *When did you get interested in synthesis?*

Dr. C. Martin I started research as a second-year undergraduate student at Mount Allison University and had the opportunity to pursue synthetic inorganic projects, working with Glen Briand and Steve Westcott on indium and palladium chemistry, respectively. I quickly realized making unique molecules was fascinating. Being the first person or team to make a particular molecule is a thrilling experience that I now share with my own students. It is exciting to think about the potential impact that a single synthetic discovery can have, whether it is a particular property of that species, unusual reaction that initiates a new direction, or how it will impact or motivate other studies in the chemistry community in the future.

I have always enjoyed cooking and find my interest in synthesis can be related to their similarities. In cooking and synthesis, we commonly follow recipes but there are aspects of art and skill that are integrated in developing new products. In both, we do not always know the outcome when attempting something and that is the motivation to conduct the experiment.

SYNFORM *What do you think about the modern role and prospects of organic synthesis?*

Dr. C. Martin It is clear that synthesis is evolving and has a critical role in modern society. Whether it be in pharmaceuticals, fertilizers, electronics, or other ubiquitous substances,

we are becoming reliant on synthesis to both sustain and improve our quality of life. There is always the potential for a more efficient compound, a more economical route, or a new compound that could revolutionize a field. Accordingly, I think that there is a necessity for synthesis, and more importantly, as an academic, a need to train the next generation of synthetic chemists.

SYNFORM Could you tell us more about your group's areas of research and your aims?

Dr. C. Martin Our program is focused on the synthesis of boron heterocycles. Within this field, our interests are broad and directions are primarily guided by the reactivity and interests of the group members. Below I have summarized the major projects in the group.

Investigating the reactivity of anti-aromatic boroles (Figure 1): Boroles are BC_4 heterocycles with four π -electrons making them antiaromatic (**A**). This electronic state makes them high in energy and reactions are driven by thermodynamics.¹ Accordingly, the ring can undergo insertions,^{2–10} ring opening,¹¹ Diels–Alder type reactivity,^{12,13} and addition reactions.^{14–16} We have been taking advantage of the diverse reactivity to access boron frameworks and examine their properties. This chemistry has been extended beyond monocyclic boroles to derivatives with fused aromatics to the BC_4 ring (i.e. **B**) to access unsaturated molecules with extended conjugation.^{17–22}

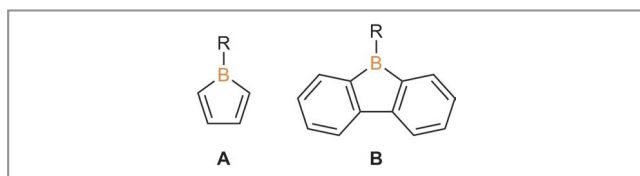


Figure 1 Borole (**A**) and borafluorene (**B**)

The synthesis of pseudo T-shaped boranes (Figure 2): Boranes are effective Lewis acids for a variety of stoichiometric and catalytic transformations. VSEPR rightfully predicts a trigonal planar geometry as the ground state for boranes (**C**). Our efforts have focused on using pincer ligands as a method to perturb the geometry at boron to access pseudo T-shaped Lewis acidic boranes (**D**).^{23,24}

The coordination chemistry of unsaturated boracycles (Figure 3): Since the discovery of ferrocene, organometallic chemists have been using unsaturated cyclic π -systems as ligands. Efforts have primarily focused on carbon-based systems, particularly cyclopentadienide and benzene (**E**). Our

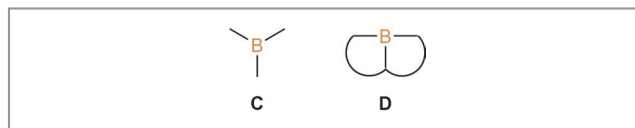


Figure 2 Typical trigonal planar boranes (**C**) and target pseudo T-shaped boranes (**D**)

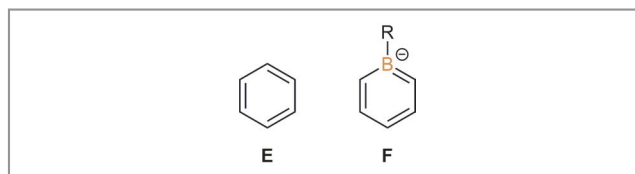
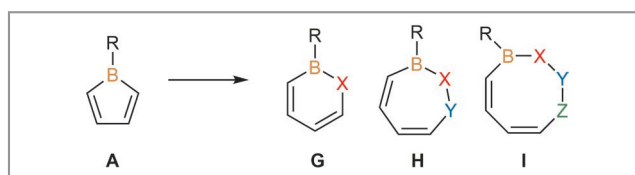


Figure 3 Benzene (**E**) and anionic boratabenzene (**F**) as a ligand for metals.

group is studying in the coordination chemistry of boron-containing analogues of these species (**F**) and examining the properties of their metal complexes.

SYNFORM What is your most important scientific achievement to date and why?

Dr. C. Martin Our group's most significant achievement to date has been ring insertion reactions into antiaromatic BC_4 ring systems.¹ Although these species have been known for over 50 years, their reactivity had not been investigated. This was the subject of our group's first publication and has been developed in many another manuscripts. We have been able to prepare six-, seven-, and eight-membered-ring boracycles via the reactions of boroles with small molecules (**G–I** in Scheme 1). In the six-membered rings where a heteroatom with a lone pair is introduced, the products are six π -electron aromatic ring systems.²⁵ We are still using this foundational route to target ring systems with desirable properties for electronic materials or biologically active molecules.



Scheme 1 Synthesis of six-, seven-, and eight-membered boracycles from boroles

Martin Farber

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