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I had the opportunity to sit down and speak with Dr. Charles Amsler and Dr. James McClintock, who is also my honors biology research advisor, about their exciting research in Antarctica. Dr. Charles Amsler is a marine algal ecophysiologist and chemical ecologist, who has completed 11 expeditions to Antarctica, 7 of those to Palmer Station and four to McMurdo Station. He has recently been honored with the naming of an island in Antarctica after he and his wife, Margaret, for their contributions to Antarctic marine biology. At the undergraduate level, Dr. Amsler teaches cell biology, phycology (the study of marine plants), and an introductory biology course. Dr. McClintock is recognized as a world authority in marine chemical ecology and echinoderm biology. He is an Endowed Professor in Polar and Marine Biology and had an Antarctic point of land named after him, McClintock Point, in 1998 by the United States Board on Geographic Names. Dr. McClintock teaches invertebrate zoology and advanced invertebrate zoology. Dr. McClintock has also been team teaching field biology courses in the study abroad program with Dr. Ken Marion every May term for the past 15 years. They teach tropical ecology in the Bahamas, rainforest ecology in Costa Rica, and recently added a course on the ecology of the Galapagos Islands. This coming May, the course will focus on the tropical ecology of the Bahamas.

Dr. James McClintock

Dr. Charles Amsler

Q: How did you become interested in research?

McClintock: Well, that began back when I was an undergraduate student at the University of California in Santa Cruz. The most formative experience I had was the opportunity to live and work for an entire semester at a research lab on the coast of California, an opportunity which brought together students from all of the University of California campuses. That was my first exposure to doing hands-on research—how you set up hypotheses and test them, gather data, and present this information to others. I really got caught up in the excitement of doing science!

Amsler: I wanted to be a biologist since I was in middle school. And, essentially, I slowly started to recognize that that meant doing research. Really, where I learned what research was about and what really set my career goals was when I was an undergraduate at Duke University. I got the opportunity to do research in the summer at the Duke Marine Lab, but then, especially coming back to the main campus and spending a lot of time there doing research with my faculty advisor and with graduate students and an adjoining group, is really where my passion set in for doing science.

Q: Where did you attend graduate school?

Amsler: I did my masters at the University of North Carolina in Wilmington, and my Ph.D. at the University of California in Santa Barbara.

McClintock: I did both my masters and doctorate degree at the University of South Florida in Tampa.

Q: So how long have you been at UAB and what persuaded you to come here?

McClintock: I've been at UAB for 20 years now. I did a post-doctorate at the University of California at Santa Cruz, and when I interviewed at UAB 20 years ago, I was very impressed and would go so far as to say surprised by what an exciting institution it was. It was young; it was vibrant; and I knew it was a place where I could be supported in my work and I got very excited about coming here. It's been a very good place to do research and teach.

Amsler: I started here in the Fall of 1994. I came because I was really excited by the department, and they happened to have a job for someone like me. The department was and still is very vibrant, and it emphasizes aquatic biology, systems, and organisms, which is what I work on, at the graduate and research level. While we have a large undergraduate responsibility to pre-medical and pre-professional students, at the graduate level, we're different, and that works out very, very well for me.

Q: How long have you two been collaborating and how did that come about?

Amsler: I was and still am interested in chemical cues that are involved in the settlement of marine organisms, both the spores of algae, which is what I usually work on, and also the settlement of larvae of invertebrates. I wanted to start a project that blended that with applied antifouling research, that is, how to prevent things from settling on ships or pilings without killing them. Dr. McClintock had a previous graduate student who was just finishing and had a project very much along those lines. I wanted to pick up on that work and use what he had found to start asking questions myself. So we developed a collaboration there. I had already been working in Antarctica in the past, and a few years later, there was an opportunity to collaborate there. We worked very well together. It was very successful, and we've been collaborating ever since. Pretty much, we began working together in 1996, so it's been over ten years now.

Q: Tell me a little about your current research project.

Amsler: Our main project is also our main collaborative project, and that's focused on work in Antarctica. Our project is examining the role of very small, shrimp-like organisms, called amphipods, which are extraordinarily abundant. We have come to believe they are a major consumer in the community, both as a major herbivore and carnivore. We are focusing on the interactions between those tiny but incredibly numerous organisms and how the pressure of their herbivory on the seaweeds, and potentially their carnivory on the invertebrates, may be the primary force in structuring the community. That's the focus of our main project.

Q: Do you have any other side projects?

Amsler: In looking at predation pressure exerted by these small organisms. One of the things we're looking at currently is how they prey on small, filamentous algae. These little filamentous algae, which look like brown and green fuzz balls, are difficult to tell apart, so we have developed some taxonomic techniques to help us. These have actually led into some interesting taxonomic and evolutionary questions within these algae that are only tangentially involved with our main project. We've actually got an undergraduate student looking at just that particular point. We've also continued to be interested in the settlement factors as measured by motion of spores and larvae, and have got another undergraduate looking at physical and chemical factors that influence the movement of spores and hopefully unicellular red algae at very small spatial scales. They all revolve around chemical, physical influences of the environment or of other organisms on each other.

Q: And this is all within the Antarctic environment?

Amsler: Well, not necessarily. There are two taxonomic questions that we're looking at—one deals with Antarctica and one does not. With the spore swimming, we are doing some of it in Antarctica and have a graduate student looking at these questions with some of the Antarctic organisms we're interested in, but we also have an undergraduate student who is doing a project with aquatic life from the Gulf of Mexico and hopefully from all over the world, but not from Antarctica.

Q: What impact does this project have on the world of science? What's the big picture?

McClintock: Well, I think its big impact is in understanding more about the basic ecology of these Antarctic communities that we're studying, and understanding more about the factors that are regulating community structure. If you're looking for something that's of a more applied nature, ever since we've been working on this marine chemical ecology project in Antarctica, we've been fortunate to have a natural products chemist who's been working with us, Dr. Bill Baker, from the University of South Florida. His work includes drug discovery and we've been fortunate to interface with him in this regard. As we work on Antarctic organisms, whether they're algae, sponges or tunicates, their organic chemical extracts or pure compounds are sent to the National Cancer Institute, the UAB Cystic Fibrosis Research Institute, the Ford Hospital in Detroit, Michigan, and various pharmaceutical companies. They all get screened for a variety of human diseases including cancer, AIDS, and cystic fibrosis. We actually currently have a compound found from an Antarctic tunicate that is very active in a National Cancer Institute screen against melanoma, a very potent and dangerous type of skin cancer. This particular chemical compound is being looked at further by the National Cancer Institute and also by a drug company.

...Antarctica provides us an opportunity to look at how systems function in ways that contrast or complement things that happen in other places in the world.

Amsler: Getting back to the basic ecology, some of the questions we're looking at are really focused on understanding how the Antarctic ecosystem functions. But as part of that and actually in addition to that, Antarctica provides us an opportunity to look at how systems function in ways that contrast or complement things that happen in other places in the world. So what we learn about how ecosystems function from a predator-prey perspective in Antarctica have repercussions and help us understand how communities are structured and how chemical defenses evolve all over the world. Some aspects of our project I think of as first using Antarctica to tell us about the big picture and tell us something about Antarctica, and other aspects are things that tell us about Antarctica and then secondarily tell us about the big picture.

Q: Why did you choose Antarctica for the site of your research program?

McClintock: Antarctica has some very unique characteristics that lends itself to asking specific questions that can only be asked in Antarctica.

Amsler: For example, with respect to algae, Antarctica is unique in that nutrients—nitrogen, phosphorous—are extraordinary plentiful in the seas that surround the continent. They have been for millions and millions of years, and that's very different from all of the other world's oceans. You might find a place where that happens here and there or over small areas, but nowhere has there been a flora that has evolved under this lack of nutrient limitation—light is what limits things. This means that what's most valuable to the organisms is different. What's valuable to you is what you have the least compared to what you need. So, in other places in the world, what's valuable to marine plants is usually nitrogen, because in the big picture that's what they have the least of. When one considers the investment in chemical defenses, one must realize that if you're making a chemical to defend yourself from a predator, you're using resources, both energy and nutrients, that you could use to grow or make babies—they're trade-offs. The organisms in Antarctica are paying for these things in a different currency, because what's most valuable to them is the carbon that they get from carbon dioxide that they fix with the sunlight, which is limiting over the course of the year. It's allowed us to test ideas from other parts of the world that are based on cost and benefit defenses from systems that operate under a different currency. And if the ideas are right, then it shouldn't matter what the currency is, but if a particular currency is what shaped the idea or observations that the ideas are based on, then that's telling us that we need to back up and think at a basic level about the evolution of defense and what's driven it, so it really gives us a powerful tool.

McClintock: And I would add from the invertebrate perspective, in looking at these predator-prey interactions that drive the evolution of chemical defense mechanisms, Antarctica is also unique. For example, sponges, soft corals and other organisms that use toxic chemistry to defend themselves because they can't get up and run away from predators have predators that are quite different from what you would find on a typical tropical coral reef. The primary sponge predators in Antarctica are sea stars. Sea stars actually extrude their stomach out of their mouth and lay it against the surface of their prey, so it's quite remarkable. If you're going to defend yourself most efficiently against this mode of predation, what you want to do is concentrate your chemical defenses in your outer layers, rather than invest in chemistry throughout the body. So these unique predator-prey interactions that occur in Antarctica lends themselves to some interesting questions that fall under the guise of what is known as Optimal Defense Theory, that is, where should you invest your resources to best insure defense of your most vulnerable body components or your offspring?

Q: How many scientists work in your lab?

McClintock: I have a Research Associate, Maggie Amsler, and then a current doctoral student, Gil Koplovitz. I also have two current Masters students, Jonathan Huang and Hamel Sevak, and then, well, you [Christina Ho] doing undergraduate honors research.

Amsler: I have three Ph.D. students, Kevin Peters, Craig Aumack, and Philip Bucolo, and two undergraduates working with me, Ben Huang and Karma Nelson. Dr. McClintock and I are also co-advising a postdoctoral fellow, Dr. Jill Zamzow.

Q: Have you always been open to working with undergraduate students?

McClintock and Amsler: Yes, definitely.

Amsler: I often talk to freshmen coming into UAB or people looking at different universities, and I tell them that the opportunity to get involved in research and be part of the process of science is one of the things that is special about being at a research university. I encourage students to do research and definitely do everything I can to help facilitate this. And I think you'll find that's true in the vast majority of our faculty.

Q: Have you ever taken, or do you plan to take, an undergraduate student to Antarctica?

McClintock: Well, we'd like to.

Amsler: As a matter of fact, in a research proposal that we've got submitted right now, we specifically wrote in a field team spot for an undergraduate student. The problem normally is that there isn't even enough space to take our graduate students along, or to take all of them, because the stations we work in are very bed-limited and space-limited. This new proposal is to work on a ship, where we'll have more space available. We came very close to taking an undergraduate for a short time last year, and actually our colleague Bill Baker took an undergraduate from his lab. Had he not been able to go, then one of our UAB undergrads would have filled that spot.

Q: What advice would you give to undergrads who are considering research activities, both now and as a career?

McClintock: My advice is to not to be bashful about approaching faculty that they're interested in working with, particularly at UAB, where there are so many opportunities to work with faculty who are active in their research. The best way to find out if this is really something you want to do as a career is to get in there and do it. You'll find out really quickly if it is something that really grabs you or not.

Amsler: That's exactly the same as my advice. It's probably not something that you can start as a freshman or sophomore, in most cases because you really need that introductory biology background, but don't wait past your sophomore year if you're interested.