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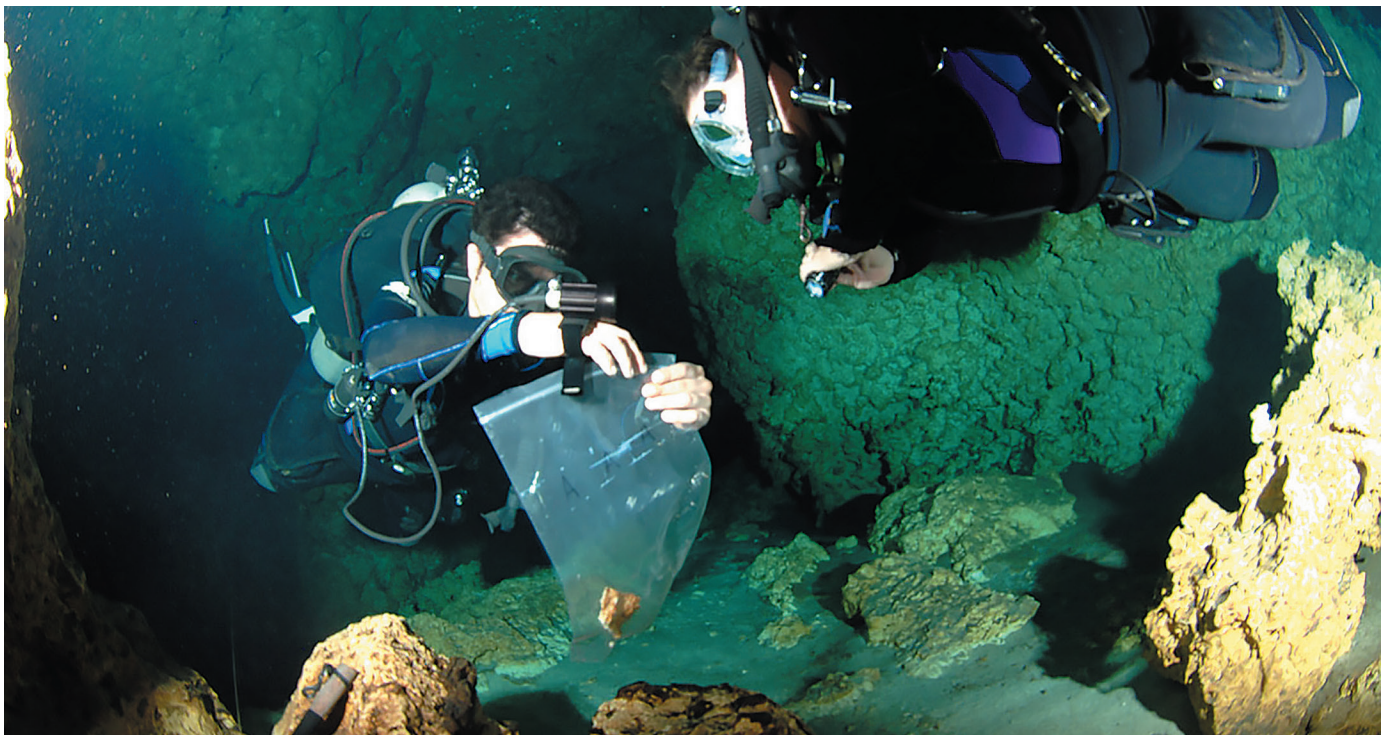

Emiliano Monroy-Ríos samples rocks from a cave off the eastern coast of Mexico with adviser Patricia Beddows.

MENTORSHIP

A chance to grow

Knowing when to hand-hold and when to step back is crucial for helping junior scientists.

Supervisors can help to shape the lives and careers of their students and trainees. Sometimes, they become lifelong mentors and eventual collaborators, contributing to a new generation of scientific discovery. And students can forge meaningful relationships with those senior scientists even at the earliest stages of their science careers.

In *Nature*'s 2017 global PhD survey, 34% of respondents said that a supervisor helped them to reach their current career decision (*Nature* **550**, 549–552; 2017). Most respondents said that they were happy with their adviser, but nearly 25% said they would switch if they could.

However, supervisors must often learn to lead from their own experiences and mistakes. Here, four researchers at different career levels share stories of good supervisor relationships they have experienced, and what made those relationships so effective.

BRYONY JAMES
Identify what works

Materials engineer, University of Auckland, New Zealand

My PhD supervisor, Barry Welch, treated me as a junior colleague, not just as a graduate student. I was part of the team, and so I had to step up. If I didn't know what I was meant to be doing, I was expected to try to work it out for myself before asking for help.

In my first year, I was developing new experimental techniques using high-temperature furnaces to look at the oxidation of carbon. The furnaces were built in-house and were incredibly temperamental. My supervisor's attitude was: "Well, it's your furnace, figure it out." So I did.

When one of the heating elements broke, I started taking the furnace apart and fixing it. My PhD was not on designing and building furnaces — it was on the oxidation of carbon. But because I had to take the furnace apart, rebuild it and think about how it was operating, I gained a much more intimate understanding of the equipment I was using, which allowed me to understand the context of my results. Taking the ground-up approach of stripping something right down to its basic components and building it again — if you have the time to do it — is a powerful learning experience. None of that is going to end up in your thesis, but it gives you enormous confidence in the results you get from your equipment.

That worked really well for me because ▶

I'm an independent learner. If someone had tried to be more hands-on, supervising every step of my PhD path, I would have found it absolutely claustrophobic. I'm now supervising my own students, and I take a similar approach to that of my PhD supervisor. I expect my students to have a really good go at things before they ask for help.

I've learnt from well over 20 years of supervising PhD students that what worked for me does not necessarily work for everyone. I suspect that my supervision style works only for people who want independence. So, when I interview prospective PhD students, I am clear about that. Several times I have suggested that potential PhD candidates speak to one colleague or another across the university where I sense there would be a better outcome for the student.

You have to be very honest with yourself and your students. Some people want to be told what to do. I generally don't end up supervising those students. You have to have a good match between supervisor and student.

EMILIANO MONROY-RÍOS
She believed in me

PhD candidate in hydrogeology, Northwestern University, Evanston, Illinois

I was born in Mexico City. My father always took me to the ocean on summer trips, and I wanted to be an oceanographer as a child. I went on to study chemistry as an undergraduate student in Mexico City, did a master's degree in limnology and then moved to the Riviera Maya on the Yucatán Peninsula. That region has the longest underwater caves in the world.

As a research assistant, I met my current PhD adviser, Patricia Beddows. I helped her by entering and mapping a dry cave, and then became a technical cave diver. She examined the side projects I was working on at the time and pushed me to apply for fellowships and scholarships to pursue a PhD in her lab at Northwestern University.

I had always thought about doing a PhD. But after my master's, as a research assistant, I felt stuck. Beddows believed in me and got me thinking about a PhD again. It was like a revival in lost confidence.

I moved to Chicago in January 2011. I had been living in a tropical paradise, and the next day, I was walking in the snow, thinking, "What am I doing here?" Patricia and her husband Edward gave me tips for surviving winter in the city. But I was depressed and seriously thought two or three times about quitting. I was feeling really, really bad and was afraid that my academic performance was declining. I thought, "I cannot make it."

Patricia understood that my health came first, before my research. She stated very clearly that if I made the decision to quit, she would support me. But she also convinced me that my work was worth it. It was important for me to have that balance of, "OK, I understand, and I believe you — that you are passing through a bad time. But your work deserves fighting for." So I took a quarter off to go back to Mexico for the winter of 2013. We talked while I was gone. If it weren't for her, I would have quit.

ADRIANE LAM
Give us chances to grow

PhD candidate in geosciences, University of Massachusetts, Amherst

Neither of my parents went to college. When I transferred to James Madison University in Harrisonburg, Virginia, from a two-year college as an undergraduate, I was shy and uncertain and didn't feel comfortable. I took a palaeoclimatology course with Kristen St. John, who became my undergraduate research adviser. We met weekly. She really showed me the ropes — she told me how to find published studies and how to interpret them. She taught me the importance of networking and how to collaborate early in my career. That came in handy later.

One afternoon, I had been working for many hours in the lab. She came in and said, "The level at which you're working is like a master's student". I had really wanted to do a master's degree, but never thought that I could. But when she said that, I thought, maybe I can.

During my master's-degree programme, my supervisor, Alycia Stigall, knew when to push me and when to leave me alone. I was doing a lot of modelling and I always had coding problems. I would complain to Alycia, and she would say: "You can figure it out." And I always would. I needed a push at that point.

I have published several papers with Alycia, including one with two other alumni of the Stigall lab. Each time, we had an open and honest conversation about the authorship list. She showed me that advisers should have conversations about the authorship protocol when they publish with students, because author order can cause contention among lab members.

Alycia also taught me the value of working with the public, and we did a lot of volunteering together. We visited grade-school students, went to a US national forest to chat about fossils with the public and ran a workshop with teachers at the Cincinnati Museum Center in Ohio. My outreach experiences led me to realize that I love teaching geological concepts to people of all ages and backgrounds.

Supervisors, push your students. Many of us are afraid to step outside our comfort zones. Give us opportunities to grow as scientists.

HANNAH REICH
They pushed me beyond their lab

PhD candidate in biology, Pennsylvania State University, University Park

During the final year of my undergraduate studies at Clark University in Worcester, Massachusetts, my adviser, Deborah Robertson, helped me to pioneer a collaboration with Gretchen Goodbody-Gringley at the Bermuda Institute of Ocean Sciences in St. George's. This collaboration allowed me to conduct research on juvenile coral in Bermuda and to transport samples back to Clark, where I completed molecular lab work for my master's degree.

These researchers hadn't been working together before. Being able to connect them and have my own niche was exciting to me, and the collaborative and explorative approach to science championed by Deborah and Gretchen is something I have continued to follow during my doctoral research. My supervisor, Todd LaJeunesse, unhesitatingly let me spend a couple of summers in Taiwan with oceanographers and chemists to conduct my PhD research.

Mentors have pushed me beyond their labs. In an ideal situation, having a mixture of mentors with different academic strengths, cultural backgrounds and advising styles allows the student to observe and internalize their mentoring expertise and what makes each of them a great scientist. Because I had shifted towards being more globally networked, I knocked on doors that weren't necessarily labelled as open, seeking collaboration and idea exchanges.

Ultimately, excellent mentorship boils down to thinking ahead and supporting students, especially when they are exploring uncharted waters. I am drawn to mentors who encourage a student to have many mentors. Principal investigators have access to different inner circles of people they frequently interact with in academia, where various opportunities are often shared and discussed. Deborah, for example, talked up my work to Clark's media office, which led to this interview. That just goes to show that the best advisers advocate for their students in situations that they wouldn't necessarily be involved in, or even aware of. ■

INTERVIEWS BY EMILY SOHN

These interviews have been edited for clarity and length.

CORRECTION

The Spotlight article 'Science in Colombia on the cusp of change' (*Nature* **562**, S109–S111; 2018) erroneously stated that Colombia is bordered by the Atlantic Ocean. In fact, it is the Pacific Ocean.