

Abstracts



FIRST AUTHOR

In 1977, Eric Charnov and James Bull proposed a now widely accepted evolutionary model to explain why the gender of some species of lizard, turtle, crocodylian and fish is determined not by genetics, but by environmental factors such as temperature. Until now, however, no experimental evidence had confirmed an adaptive benefit — and thus evolutionary significance — of temperature-dependent sex determination (TSD). Daniel Warner, now a postdoc at Iowa State University in Ames, took on a risky PhD project and showed that developing at certain incubation temperatures increases the reproductive success of each sex (see page 566). Warner spoke to *Nature* about how his gamble paid off.

What hurdles had to be overcome to do this experiment?

For many years it was impossible to properly compare reproductive fitness in TSD species, because there was no way to produce both genders over a range of temperatures. A further complication was that TSD was known only in long-lived species. Recent work demonstrated that chemicals can interfere with hormone synthesis and allow us to override the temperature control of sex determination. And, in 2000, the jacky dragon, an Australian lizard with a 4–5-year lifespan, was discovered to have TSD.

Why take on such a risky project?

Raising 200 jacky dragon hatchlings in semi-natural field conditions over 3 years was a lot of work. I was worried something might go wrong, like feral cats eating my population. But I knew this was my best chance to test Charnov and Bull's hypothesis. My heart was in it, and I really wanted to give it a shot.

Were you surprised by your findings?

After the first major reproductive season, I assigned fathers to offspring using genetic analyses to measure the reproductive success of parents produced at different temperatures. I was shocked by how clearly the pattern reflected the theory's predictions. I was nervous that more data would swamp that pattern, but they actually reinforced it.

How might global warming affect TSD species?

We could see a major shift in sex ratios — which could affect viability, if not cause extinctions, in some populations.

Have Charnov or Bull contacted you?

Yes, they are both aware of this work, and I think they are pleased to see their theory supported. That's really exciting for me. These are the gurus in the field, and I look up to their work. ■

MAKING THE PAPER

Ronald Cohen

Computational theory reveals an unusual quality in a pure compound.

"If you look at something closely that is thought to be well understood, you often find something new and exciting," says Ronald Cohen, speaking of his latest work with lead titanate. Researchers thought that this simple compound could be "easily understood" as early as the 1950s. But Cohen, of the Carnegie Institution of Washington Geophysical Laboratory, and his colleague Zhigang Wu, revealed an unexpected property, using a new theory developed by computational physicists to calculate the properties of piezoelectrics — substances that convert electrical energy to mechanical energy and vice versa.

When they applied the theory in the context of extreme pressures, Wu and Cohen discovered that lead titanate would undergo a set of unexpected phase transitions never before seen in a pure compound but usually associated with more complex, and commonly used, piezoelectric materials. These structural changes — and the electromechanical responses that accompany them — render such materials useful for a range of applications, from medical ultrasound to sonar.

Wu and Cohen's results suggested that simple compounds could be developed for similar applications. The computed piezoelectric properties of pure lead titanate under pressure were greater than those of any known material.

After celebrating their theoretical discovery, the Geophysical Lab team decided to put the theory to experimental test. The first thing the researchers had to do was create the conditions in which lead titanate was expected to take on the properties in question and find ways to measure these properties. "To do both together is extremely difficult," says Cohen. The team first tried using Raman spectroscopy to measure atomic vibrations at high pressures and



low temperature (10 kelvin). "Those experiments showed interesting behaviour for the compound, but we didn't know exactly what it meant," says Cohen.

They turned to X-ray diffraction, using the Advanced Photon Sources at the Argonne National Laboratory in Illinois, again under high pressures and at cryogenic temperatures. To obtain useful data they had to perform high-resolution diffraction experiments, which take hours rather than minutes or seconds. "It's difficult to get that amount of synchrotron time, and it's also hard to maintain the required pressure and temperature for so long," says Cohen.

But the authors' perseverance paid off. They eventually obtained a high-resolution image of lead titanate undergoing a morphological metamorphosis that Cohen describes as "akin to making a cube switch from sitting on a face to balancing on a corner" (see page 545). This type of structural change is associated with a large electromechanical response.

The team decided to take the work a step further and used this information to design a compound that would have similar electromechanical properties to lead titanate but at ambient temperature and pressure. The next challenge is to actually make this material and confirm its properties.

"If, as I hope, we succeed in developing useful new materials by this route, we will have shown the utility of a materials-by-design approach for the next generation of technological materials," Cohen says. ■

FROM THE BLOGOSPHERE

The journal *Nature Chemistry* will not appear until early 2009, but its chief editor, Stuart Cantrill, is already planning its content ... and writing about it. Cantrill writes on the Sceptical Chymist, the NPG blog that discusses research and events of interest to the chemical community, that the name is the only part of the journal that exists so far — but that things will quickly change. In his series

of 'Journal journeys', Cantrill is keeping a diary of how *Nature Chemistry* is taking shape. Readers can follow the journeys at http://blogs.nature.com/thescpticalchymist/features/journal_journeys/.

The first entry, posted on 21 January, is called 'Day -11', because Cantrill officially begins his new role on 1 February. Until then, he will be handling manuscripts

submitted to *Nature Nanotechnology*, where he is currently senior editor.

His first task for *Nature Chemistry* will begin on 31 January, the closing date for applications for associate editor positions. He will be looking through them all, but seeking out those that contain no spelling mistakes and include all the requested information and documents. ■

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