

Lifel**ines**

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Biology/Allied Health Department

Insights From the Professor

Nature's Toxic Dark Side

By Aaron Corbit



The natural world is full of majestic beauty. As I pen these words, I can look out the big picture windows in my dining room at the wooded area that adjoins my backyard and see a glorious mosaic of fall colors abutted against a clear, deep blue sky. It is this kind of beauty that fills our hearts with worship for the One who created it all. However, as a biologist, I also know that this is a fallen world. Scratch through the veneer of breathtaking beauty and you quickly find that nature has a dark side marked by competition, struggle, and death. It is in this dark side of nature that my research finds its roots. For I have developed a macabre fascination with the toxic organisms of this world.

Toxins abound in nature and have been part of the human story since the beginning. In Numbers 21, we find the account of the children of Israel traveling through the wilderness and, once again, complaining about their circumstances and rebelling against God's providence. As a result of this complaining, venomous snakes infest their camp and many are bitten and die. Bites from venomous snakes continue to cause disability and death in our modern world. While only 5-10 people die of venomous snakebite in the U.S. each year, global estimates suggest there could be as many as 1.8 million people envenomed by snakes each year of which 90,000 die (Kasturiratne, et al. 2008). Most of these deaths occur in poorer countries in the tropics which has led the World Health Organization to classify venomous snakebite as a neglected tropical disease.

Snakebite may be one of the more sensational examples of how organisms use toxins,

particularly in relation to us as humans. However, the diversity of ways that organisms use toxins is breathtaking. Animals, plants, fungi, even bacteria, all have representatives that utilize toxins.

Recently, I was part of an effort to refine how scientists classify this diverse array of toxic secretions (which usually contain more than one toxin) used by living things (Nelsen, et al. 2013). We organized these toxic mixtures into three categories – venoms, poisons, and toxungens.

Venoms are toxic substances that are delivered to the insides of another organism via mechanical injury. Venomous organisms include those creatures that actively inject their venom into their victims via fangs (snakes) or stingers (bees and wasps) as well as those that deliver their venom in more passive ways. The caterpillar of the Brazilian saturnid moth (*Lonomia oblique*) is covered with numerous sharp, urticating hairs that penetrate and deliver venom only when an attacker initiates contact. As an aside, these caterpillars may cause more mortality in Brazil than venomous snakes (Mebs 2002)! It isn't just animals that can be venomous. Stinging nettles, which deliver their toxins via hair-like structures, called trichomes, are also venomous. Besides plants, one can find examples of venomous fungi, bacteria, and protozoa. Even a virus injecting its DNA or RNA into a host cell could be considered venomous.

Poisons are toxic substances delivered passively to the insides of another organism without mechanical injury, usually through ingestion or absorption across the body surface. Numerous examples of poisonous organisms exist in just about every major taxonomic group. Many plants produce poisons in their leaves to keep plant-munching insects at bay. In animals, being poisonous is often associated with having bright warning coloration to let would-be attackers know that trying to eat them would be a mistake. Monarch butterflies and dart



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frogs may be beautiful, but their beauty advertises their poisonous nature.

The last category is toxungens, a term we coined and defined for the first time in our paper. These are toxic secretions that are actively applied to the external surface of another organism without mechanical injury. The toxic secretions of creatures that smear or spray them onto intended victims are in this category. A prime example would be spitting cobras. These snakes are toxungenous when they spray their toxins into the eyes of an attacker. However, this snake is also venomous when it delivers its' toxins via a bite.

Why is this important? Well, one of the important principles in biology is that form follows function. For example, the way toxic secretions are delivered affects their chemical composition. Poisons and toxungens tend to be composed of small, robust molecules (secondary metabolites) that are small enough to be absorbed across the skin or tough enough to survive in an organism's digestive tract. Venoms, on the other hand, tend to be composed of proteins which are too large to be ab-

sorbed across the skin and are readily broken down and absorbed in the digestive tract. In fact, it is possible to drink snake venom without suffering any ill effects (though I don't recommend trying this). However, these protein toxins allow for a much wider range of toxic effects.

Understanding the properties of these biological toxins can help us utilize them for our own purposes. In the story in Numbers 21, God provided healing to the Israelites if they looked at a bronze snake that Moses had crafted and put on a pole—a representation of the very thing they needed healing from. The same is true of toxins, they may be a source of injury and death, but we can also look to them for healing. Numerous medicines have been derived from biological toxins. Penicillin is a prime example of a fungal poison that turned out to be toxic to many harmful bacteria but not to us. Snake venom has also been a rich source for numerous medications including Captopril, used to treat high blood pressure, and Eptifibatid, which is a blood thinner used to reduce the

risk of heart attacks.

In John 3:14, we learn that the bronze venomous snake Moses held up for the Israelites was really a representation of Christ, the ultimate healer. While biological toxins and the animals that use them are fruitful areas of scientific research at present, we look forward to the day when Christ will restore things to their intended perfection and nature will no longer have a toxic dark side.

References

Kasturiratne, A., Wickremasinghe, A. R., de Silva, N., Gunawardena, N. K., Pathmeswaran, A., Premaratna, R., Savioli, L., Lalloo, D. G., & de Silva, H. J. 2008. The global burden of snakebite: a literature analysis and modelling based on regional estimates of envenoming and deaths. *PLoS medicine*, 5, e218.

Mebs, D. 2002. *Venomous and Poisonous Animals: A Handbook for Biologists, Toxicologists, Toxinologists, Physicians and Pharmacists*. CRC Press.

Nelsen, D. R., Nisani, Z., Cooper, A. M., Fox, G. A., Gren, E. C. K., Corbit, A. G., & Hayes, W. K. 2013. *Poisons, toxungens, and venoms: redefining and classifying toxic biological secretions and the organisms that employ them*. Biological reviews of the Cambridge Philosophical Society

Students In Service

A Call to Tanzania

Like most Biology majors, I enjoy a good challenge. I am captivated and inspired by the pursuit of something that pushes me beyond my capabilities, furthering me to new limits that I never thought possible. In the three years that I attended Southern, the idea of going as a student missionary always caught my attention because it was a type of challenge that was far different than any that I had experienced or might experience anywhere else. After completing my third year of college and taking the Medical College Admission Test (MCAT), I was finally able to say, "Student missionary? Challenge accepted."

So here I am, living in an extremely remote village in Tanzania, stumbling over words in Swahili, and gaining new perspectives each day. I teach kindergarten, first grade, and recorder to the 118 children at our orphanage.

I also help teach English to the house mothers that take care of the children. Each day, I get to laugh and play with the kids for hours, wipe teary eyes, and hold precious children in my arms. This may not sound quite as rigorous as a semester of Cell and Molecular Biology, but let me tell you, it has challenged me to love more than I thought I could. It has pushed me into a job far out of my comfort zone. It has reaffirmed my passion for a career in medicine. It has made me increasingly more aware of my weaknesses and God's strengths. In my opinion, you would be hard pressed to find all of these different elements in a semester's worth of classes.

This challenge of being a student missionary is far from over, but already I can say that every ounce of difficulty or discomfort is completely worth it for this invaluable experience. If you are

like me, looking to be inspired by a new challenge, this just might be the perfect place to start.



Allison Cool, senior biology major, with a Tanzanian friend and orphan.

Alumni Spotlight

Tiffany (Larson) Hodgson

Q: Where did you get your Physician Assistant (PA) degree?

A: Loma Linda University (LLU).

Q: Why did you choose to go there?

A: I should say something like, they have a great program and I value Adventist education (which is true) but the real reason I ended up there is because I only applied to two schools and LLU is the one I got accepted into. But it was meant to be because they had over 2000 applicants that year and only 26 spots.

Q: How did you end up becoming the first PA in New Zealand (NZ)?

A: I wasn't the first PA here, but I was the first to be permanently employed. I moved here right after finishing PA school and taking my boards because I was engaged to a Kiwi, and we knew we wanted to live in NZ. So I took a leap of faith in hopes that my expensive degree would be of use in this country someday.

When I arrived, the first trial of two PAs in surgery was just finishing but had not gotten much publicity. I told everyone I could about PAs and ended up meeting some important people like the President of the College of General Practitioners (GP) and the Medical Director for the largest network of GP clinics. Those two meetings started to spread the word a bit. I went to Wellington, the Capitol, and knocked on the door of the Ministry of Health (the equivalent to the U.S. Health Department) and being the only PA in New Zealand at the time, they listened to me and employed me as a contractor to help

set up the trial that is going on now.

The way I got a job as a PA was through meeting a nurse at church that worked for a forward thinking doctor who had heard about PAs. I sent him my CV but didn't hear much so I showed up at his office. It was that day he interviewed me and a week later offered me a job! I have been working for Radius Medical in Hamilton, NZ for a year and half now and I love it! Also, there are six other PAs here now as part of the trial.

Q: What are some challenges?

A: Well, Physician Assistants don't have their full scope of practice here yet because it's not a regulated profession. We can't prescribe or order tests without asking for our supervising doctor's signature. Hopefully, those things will come in time.

Q: What are some rewards?

A: We get to be pioneers of a very important profession in an amazing country. Just the other day we formed the NZ PA Society which is one step closer to getting regulated. We are making history really.

New Zealand is also a great place to live with gorgeous landscapes, genuine people, and lots of outdoor activities to participate in.

Q: Tell us about your family.

A: Well, I'm married to Superman ;), and we have a three month old little girl named Alaska Jade! We live in a lovely little farm town in the middle of the north island and I commute about an hour to work in Hamilton.

Amongst many other things, Russ (my husband) and his business partner, own and operate a Canyoning business in the Coromandel. It's called Canyonz and the Sleeping God trip has been called the most adventurous thing you can do in New Zealand. You can check that out

at www.canyonz.co.nz.

Interview by Valerie Lee



We want to hear what you have been up to since you graduated. If you or someone you know would like to be in the Alumni Spotlight, please email us at biology@southern.edu.

*Tiffany (Larson) Hodgson, December 2007
Southern Allied Health graduate with
husband, Russ, and daughter Alaska Jade in
New Zealand.*

Undergraduate Research

Vitamin C Supplementation Enhances Detoxification of the Pesticide Permethrin

For the past year, I have been working on a research project of how varying levels of ascorbic acid affect the activity of cytochrome P450s in fruit flies. Cytochrome P450s are enzymes that aid in detoxification of chemicals. This oxidation makes them more soluble in water and therefore easier to excrete as waste. I began this project in the Fall of 2012 as an assistant to Naomi Jackson. Her previous work found that when male fruit flies were exposed to a solution of 15% ascorbic acid they became less susceptible to permethrin, but in females the same exposure had no effect. She had further noted that varying levels of ascorbic acid exposure could affect resistance to this pesticide.

My question looks at one possible mechanism by which ascorbic acid has this effect. Permethrin is a widely used pesticide in the United States and throughout the world. Cytochrome P450 enzymes are, in part, responsible for the detoxification of permethrin. We believe that if ascorbic acid can increase P450

activity in fruit flies, it may also increase human P450 activity as well and thus enhance detoxification.

After Naomi graduated in December 2012, I began the process of completing the research she had begun. I raised countless fly cultures and exposed them to varying levels of ascorbic acid. In total, I froze 54 vials of fruit flies. I ran three exposures with three replicates of flies each exposed to various solutions such as 15% ascorbic acid with 20% sucrose as a food source. Once exposed, cytochrome P450 activity was quantified using a spectrophotometric fluorescent assay. Cytochrome P450s are, in part, responsible for detoxifying permethrin and other pesticides. I plan on presenting the results of my work at the Association of Southeastern Biologists' meeting in April 2014.

After I graduate, I plan on taking a year to be a student missionary and then attending Loma Linda University to work on a Ph.D. in Epidemiology. After earning my Ph.D., I want to work for the Centers and Prevention for Disease Control (CDC) in Atlanta, Georgia. In the future, I would like to return to Southern Adventist University as a professor.



Brianna Taylor, May 2014, graduating senior biology major.

In The Beginning

New Apologetics Sabbath School Class

The Collegedale Seventh-day Adventist Church has held an apologetics class for about two years. Pastor Sam Chetty is the moving force behind the class success. Up until this semester, the focus has been on belief in the Bible, understanding how non-Christians approach life, and how to best interact with all people about religious ideas.

This semester, Dr. Rick Norskov offered to help organize a more scientific slant to the class. It has changed names from "Christian Apologetics" to "Relational Christianity." The

class started with about 25 attending but has grown and moved to a new room. Currently, 60-80 people attend every week. There is certainly a hunger to learn about the relationship between faith and science.

Dr.'s Trott, Hansen, Lange, Snyder, Hill, Spencer, Corbit, and Heflerlin from the Biology and Physics departments have discussed different chapters in the book "Understanding Creation--Answers to Questions on Faith and Science" by Gibson and Rasi. Dr. Greg King, School of Religion chair, has also presented.

Energetic questions, deep thoughts, and daily applications are all intermingled into an engaging and enlightening Sabbath School. The goal is not about winning arguments but about having a conversation and asking questions with non-believers. This opens the door to developing a relationship with them and removing barriers to belief. It is also about providing our youth with scientifically rigorous explanations for their faith.

By Keith Snyder

Department Happenings

Allied Health Students Attend Health Professions Preview

On October 25th, Andrews University hosted their Health Professions preview. Students and faculty from Southern Adventist University and Oakwood University traveled together to attend this annual event. There were 50 total participants from Oakwood and Southern. The trip provided a great opportunity for students and faculty from both universities to form relationships with one another as they explored options for their future academic pursuits.

The preview consisted of several activities throughout the weekend. During the first meeting, students were given valuable information on options for financing their program at Andrews. They were also given a

very interesting presentation on the importance of leadership and how Andrews' new leadership program is being incorporated on campus. Students were given the opportunity to visit the academic department of the program that they were most interested in. During the visit to their department of choice, they were given department tours and presented valuable information sessions. Several other activities were provided to give students a feel for life at Andrews.

Additional activities included campus tours and a visit to some of the local attractions. Students were given the opportunity to visit Silver Beach and local area shops in St. Joseph, Michigan. During the Sabbath

hours, many of the trip participants attended vespers and worship services at Pioneer Memorial Church. Students and faculty alike were blessed with thought provoking presentations from Pastor David Asherick. After the close of Sabbath, students had the opportunity to visit one of the local area farms and participate in Andrews' fall festival.

The trip was a valuable resource for students to examine options for their future career goals. It was also an opportunity to build positive relationships between Andrews, Oakwood, and Southern.

By Randy Bishop

Alumni Weekend Bird Count

On Friday, October 25th, several Southern Biology/Allied Health Department alumni and current faculty met in the H.H. "Boots" Kuhlman lecture hall (a.k.a., the Anatomy & Physiology Lab) on second floor of the Hickman Science Center. Their goal? To launch the first annual Southern Alumni Bird Count. The group included three current Southern faculty (Rick Norskov, Tony Trimm, and Carl Swafford) plus six alumni. Jay Dedeker (one of the alumni) was responsible for putting this activity together. Evonne Crook (Advancement Director) was more than happy to facilitate Dedeker's idea of an annual Alumni Bird Count. The group divided into two sub-groups: one sub-group counted species and individual birds along the Promenade, and the other worked at the Student Park. After an hour of bird-watching, we returned to the biology department where we reported what we found.

All enjoyed telling old bird-watching and Southern stories all over a continental breakfast provided by food service. Most of the stories centered around the legendary Edgar O. Grundset, and how he influenced biology education at Southern and other Seventh-day Adventist insti-

tutions. Many years ago, Mr. Grundset led bird-watching walks as part of the Southern Alumni Weekend. In his honor, we hope to revive and engender his spirit of love for biology by inaugurating this annual Alumni Bird Count.

By Tony Trimm



Back row (standing) - Victor and Valerie Pohle, Ben and Carol (Olsen) Ringer, Jim Tucker and Tony Trimm. Front row (seated) - Carl Swafford, Rick Norskov and Jay Dedeker.



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Erlanger Research

Biology students are selected as volunteers with the University of Tennessee College of Medicine at Erlanger Hospital assisting with medical research. Seven students are currently assisting residents in the emergency medicine, internal medicine, and surgery departments. The projects vary from developing a stroke database for use by other physicians to actual telephone and in-person patient interviews. Their assistance will aid medical resident's research by recording patient records into database programs. Dr. Rick Norskov, in Southern's biology department, has been working on placing students for several years and noted last year only two students were volunteering there. "The certification and application process is quite extensive for these student volunteers. This is also part of real life in the medical profession," Norskov remarked. "It is good these premedical students are getting a little taste of what medical research is all about."

Origins Speaker

One of the founders of the intelligent design movement is coming to Southern Adventist University. Stephen C. Meyer will be on our campus January 22-23. Meyer has a Ph.D. in the history and philosophy of science from the University of Cambridge. He is a founder and current director of the Discovery Institute's Center for Science and Culture, which is arguably the headquarters of the modern intelligent design movement. Dr. Meyer has authored numerous works in both peer-reviewed and popular literature. His most recent book "Darwin's Doubt: The Explosive Origin of Animal Life and the Case for Intelligent Design" made the New York Times best seller list. In this book, he argues that the sudden appearance of a large diversity of fossil animals near the base of the geological column (referred to as the "Cambrian Explosion") is best explained by the theory of intelligent design.