Interview with ETT-Fellow Prof. Dr. John (Jack) H. Werren

By Mohammed Errbii "Simo"

Jack is an evolutionary geneticist at the department of biology, University of Rochester, USA. His research focuses on… Well wait! Read on the interview to find out more about both, Jack the person and the scientist!

Q: Can you tell us about your research interests and what is so cool about you research questions?

A: Well, you know when you've been doing research for a long time you wander around pursuing things that interest you. That changes over time and that's part of what makes science fun. Right now, I guess the thing I am having the most fun with are lateral gene transfers from bacteria into insect genomes. I enjoy many different research areas and my general area is evolutionary genetics. But the thing that I enjoy doing even when I don't feel like working is looking for a microbial lateral gene transfer into animal genomes. This is an important question because it relates to how new genes and evolutionary innovations arise. There are many genomes coming out, almost on a daily basis. We have a pipeline in my lab that screens for these transfers. But then once the pipeline generates candidates, considerable work remains for looking at each candidate and figuring out whether it's a real transfer or not. That is something I just find fun. The topic is very important because it ties into a very fundamental question which is, where do genes come from and how do genes evolve. It was not appreciated until very recently that eukaryotes can pick up genes from bacteria and some of these can end up evolving into functional genes, which can expand the biochemical repertoire of the host organism. So, to me that is both interesting, fun and important. I got into this topic through Wolbachia because Wolbachia are a very common microbe associated with insects, and other invertebrates. They're in the germline because that's how Wolbachia typically propagate …so the opportunities for transfer are there. Wolbachia turns out to be the most common source. So that is how I got into this topic – I evolved from working mostly on Wolbachia and other inherited microbes, to working on microbial to host gene transfers That's what I mean when I say that your pursuit of scientific questions can take you from one place to another. It's fun to pursue the topics wherever they might go, sometimes they go somewhere where it's a dead end and another times it opens up new exciting aspects. Enjoy the journey.

Q: After earning your PhD, you worked a couple of years in the U.S Army. Tell us about that experience and what has your journey been to this point?

A: When I started undergraduate school it was during the Vietnam era and I needed economic support to go to school. I received a scholarship through the U.S military as part of an officer training program. They paid my way to college and then afterwards I had an obligation for four years. At that time, you know one could possibly be drafted into the military or you can go into these programs which were called Reserve Officer Training. When I finished my undergraduate degree, which was an odyssey from being a history major, to anthropology, and then to biology, the Vietnam war was coming to an end. They had way too many officers, so the military allowed me to delay going in until I had completed a PhD (without any monetary support). So that is what I did. I did a PhD in behavioral ecology and evolution mainly, first doing theory on parental control of the sex of their offspring (sex ratio), and then testing the theory using the small parasitoid wasp Nasonia, which I still work with these many years later. Following where the research pointed, I became interested in genetics, and happened upon some genetic curiosities that we now call selfish genetic elements. So, I completed my PhD on this esoteric. However, the Army had not forgotten me. After I finished my PhD, I had four years obligation. But what do you do with a PhD in behavioral ecology and a little bit of genetics? They looked and said "He's got a PhD in Biology and so he can be a microbiologist".

I was stationed here in Germany for two years, and my main job was checking the laboratories that tested water for bacteria, to make sure they had proper quality control.
So, I learned microbiology courtesy of the US Army. And in one of those odd coincidences in life, I began to uncover some microbes that manipulate reproduction in Nasonia, along with colleagues in Germany and the United States. This, of course, is a matter of coincidence. But it is also taking advantage of opportunities when they arise.

Q: What are the challenges that you had to overcome during that journey?

A: Everybody has challenges to overcome! Well, the biggest one for me was unemployment after I had completed my military duty. It was during a time when they were very few jobs in biology and particularly in evolutionary biology and so I wasn't able to find a job at first. And my CV was not a typical one. Some people helped me out and then I was able to set up a little lab of my own at the University of Maryland. I then got a postdoc position at the same university. Eventually I was able to get a grant funded to continue work on Nasonia sexual biology. The way things were that time was, if I didn't have the grant, there is no way that I was going to get a faculty job. Are you familiar with the phrase Catch 22"? It is a military phrase, but also the title of a book and movie. A Catch 22 is rule that makes no sense because you can't do something unless you meet the rule and you can't meet the rule unless you do that something first. In my case, I had asked the University of Maryland to give me an unpaid research faculty title, because that was require to submit grant proposals. In classic Catch 22 style, I was told that I could not have an unpaid research faculty title until I first got a funded grant. Anyway, with the help of a kind colleague, we found a way around the rule, I managed to get a grant funded, and then suddenly universities were willing to take my application seriously. This led to my being hired at the University of Rochester in 1986, and I have been there ever since. As you can imagine, I was very ready and anxious to run my own research program. There are many nice things about Rochester. The university is supportive, Rochester is a good place to live and raise a family and it is just a good working environment.

Q: Is it possible to maintain a balance between life, research and science management?

A: When I was younger it wasn't that easy. There is so much demand on your time. And when you are younger you can be quite ambitious and of course work very long hours. And this is necessary to succeed, because getting your first faculty position is just the beginning. A young professor is under a lot of pressure because they have to get grants, teach, train students and do the administrative work. If they are starting a new lab, they have to be an architect and all these things create a lot of pressure. a challenge to balance things. But I think it is better now because back when I was younger the attitude was work harder and harder but now people recognize that you need to maintain a work life balance and so the expectations are more realistic. And I think it is really important to have a work life balance, not only for your sanity, but because you are more productive when you have more work life balance. In graduate school, it was sports, I played soccer and loved to ski in the Utah mountains. Please don't get me wrong – to succeed in our business you must be very dedicated and work very hard – immerse yourself. But we do have a great advantage of having flexibility in our hours. What I like about being a scientist is that you really do have to work hard but what we do is a great privilege. So, we should all complain a little bit less, because people are paying us to do something that is quite fun.

Q: What advice would you give PhD students who want to stay in academia for a successful career?

A: This may sound contrary to the earlier comments, but my advice is to work hard, immerse yourself in your science, but have outlets to maintain your balance, friends, family, music, sports, whatever gives you pleasure. I think that whatever course you take in your life, whether it be a career in science or elsewhere, it is an honor and privilege to have the opportunity to push back the frontiers of knowledge. So, I hope you take pride and pleasure in that. Some other advice would be to read a lot, both in your field and broadly. Know the literature. This is of great value. I think it is important to pursue things that you discover. Whatever you are working on, make it your own. I am very happy when one of my graduate students knows much more about their topic than I do. Now, that is success for both of us. Another bit of advice is to try to multitask, where you're pursuing more than one thing, because you never know which one is going to open up into something new and exciting. Certainly, once you have your own lab group, I suggest having multiple lines to pursue. This is the way I have always done it and it worked for me. Other researches take a very different approach. They really stay very strongly focused on what they are doing and they become experts in that and that can be a highly successful approach and probably more often successful than my way of doing things. It depends a lot on your personality type. I am a short attention span researcher. I started as a behavioral ecologist then I strayed into genetics and microbiology. I just pursued things that came up. When genomics started to develop, I saw that one can address many long-standing questions in evolutionary biology, using the tools of genomics. So, even when working on your own particular system, my advice is to always have your eye on the larger questions that can be addressed particularly well in the system you work with.

Q: In your research, you are mainly focusing on SGE and the endosymbiont Wolbachia, what lessons did you learn from your own research?

A: Selfish genetic elements are "selfish" in the sense that they are self-promoting in terms of transmission relative to the rest of the genome. As a result, they often reduce the transmission of other genes in an organism, leading to genetic conflict. Studying such elements can give us a much better understanding of the evolutionary process. Once you see that you can have genetic elements that propagate themselves but are harmful to the individual, you then realize that selection can take place at the level of individual genes and also individual level and potentially at the population level and at the species level. This perspective broadens your understanding of evolution, and allows you to think more rigorously about the particular processes that lead to adaptation at different levels. I think it gives you a very broad understanding of nature and selection because a lot of the dynamics in evolution arise from these conflicting selective pressures. So, biological conflict is one side of the coin. The other side of the coin is collaboration. Collaboration occurs among genetic elements, individuals in a group, and between species. So, you have this ying/yang aspect to biological systems; conflict and collaboration. I find this a very useful way to look at the world.

Q: The research ecosystem is undergoing rapid change mainly due to factors such as advances in technology used to conduct science and lack of funding. What are your predictions for your field and research in general in the near future under these trends?

A: Clearly there is a lot of interest in systems biology and networks and how they function and evolve. That's a big topic area going forward. From my own perspective, genomics will continue to be a huge tool, so it's a resource for us to be able to answer questions we couldn't answer before. As an evolutionary biologist I believe that we're in the golden age now when there are questions that have been around for hundreds of years that we couldn't answer until very recently. This whole gene transfer thing was basically unknown until very recently when we have the genomes to be able to go and look, and discover, Wow, this stretch of DNA comes from a totally different organism. I think genomics combined with computational approaches with ecology and genetics, but that in a sense we talked of my career choice.

Q: And what about epigenetics?

A: Epigenetics has become a buzz word, it can mean different things to different people. So, oftentimes when people ask me this kind of question. I say ok, what kind of epigenetics are you thinking of? In one broad sense, epigenetics is variation in gene expression within an organism. In other instances, it refers to phenotypic plasticity. And in others to heritable features that do not involve changes in the underlying DNA sequence. All those things are interesting, but in order to explore the topic, we need to be more precise on what kind of epigenetics is being discussed.

Q: Let's focus on changes that are inherited without being coded in the DNA sequence.

A: Right! A long time ago and before my switch to biology, I was trained as an anthropologist in my undergraduate time, and I started to switch field. I've always been interested in cultural evolution, how transmission of information through culture is semiautonomous from the genetic process. This is one form of heritable epigenetics. In my undergrad degree I jumped between fields, and put together a degree called "Biocultural Evolution". I think how biology and culture interact is a fascinating topic. Nowadays people are talking a lot about epigenetic inheritance meaning that circumstances can result in "non-genetic" changes (e.g. DNA methylation or histone modifications) that can be passed from parents to offspring. Fascinating research is underway in this field. However, I think that some people lose sight of the fact that those are often evolved systems. Selection has shaped the DNA for epigenetic changes that are generally adaptive. In other words, phenotypic plasticity is often adaptive. When it is maladaptive, then selection on DNA will likely lead to reduction in that particular plasticity. The organism can respond adaptively to changes in temperature in its lifetime, and even pass on some of these traits epigenetically to offspring. However, if the responses were maladaptive, they would soon be eliminated by natural selection at the DNA level. So, I think it is important to keep this in mind, and not conclude that epigenetics is some revolutionary concept that overturns Darwin, as some have argued. I think is important to realize that anytime anything like this comes along people like to make it something more "revolutionary" than maybe they should. So, does epigenetics mean that Darwinian theory is now old fashion and that epigenetics processes are supplanting Darwinian process? I think that is an exaggeration. Epigenetics is important, but not fundamentally an abolition of basic Darwinian processes. That is my view on it.

Q: Now to a different kind of questions, what are you most proud of in your career so far? A finding? A paper?

A: This is the kind of question I should have prepared answers to it. I am very proud that I got back into science because it wasn't clear at all that I was going to after serving in the US Military. I am proud of my contribution to the *Wolbachia* field. I am proud of my contributions to the topic of genetic conflict and parasitic DNA. I would say those are the main things. I am hoping that *Nasonia* will continue to grow as a genetic model because I think it's a really a fantastic experimental system.

Q: If you were to choose a different career, what would you choose to do?

A: Archeology!

Q: If you were to choose a disguise for Halloween, what would you choose?

A: I would probably be doing it with my granddaughter, so she would end up telling me what I was going to be.

Q: If you were to choose a song, what would you choose to listen to?

A: My favorite song of all-time is O*ver the Rainbow* from the Wizard of Oz, sung by Judy Garland

Q: If you were to choose a paper from yours, which one is a must read?

A: They're all must reads (cheerful)! I would probably choose my *PNAS* review on the role of selfish genetic elements in evolutionary innovation.