the
WINNOWER

SCIENCE AND SOCIETY

Interview with biologist Mickey von Dassow on collaboration, citizen science and ctenophores

ALEXANDER LANCASTER[1 2 3]

1. Biosystems Analytics
2. Ronin Institute
3. Amber Biology

CORRESPONDENCE:
alex.lancaster@roninInstitute.org

DATE RECEIVED:
January 20, 2016

KEYWORDS:
biology, citizen science, independent scholarship, open science, organismal biology

Mickey von Dassow is a biologist who is interested in exploring how physics contributes to environmental effects on development. He created the website **Independent Generation of Research** to provide a platform to allow professional scientists, other scientists, non-scientists or anyone to collaborate and pursue any scientific project that they are curious about. I talked to him recently about his new site, citizen science and the future of scientific research and scholarship.

Can you describe your background?
My background is in biomechanics and developmental biology. My Ph.D. asked how feedback between form and function shapes marine invertebrate colonies. During my postdoc I worked on the physics of morphogenesis in vertebrate embryos, specifically focusing on trying to understand how the embryo tolerates inherent and environmentally driven mechanical variability. Since then I have been independently investigating interactions among ecology, biomechanics, and development of marine invertebrate embryos, as well as teaching courses.

What is IGoR?
IGoR is a wiki for sharing research ideas, skills, and resources among novice, amateur, and professional scientists. The goal is to make it easier for everyone to do scientific research, regardless of how they make a living.

Tell us a bit about how you came to start IGoR?
One of the main motivations was that I often need devices that are just beyond my own skills to make, but which hobbyists with other skills could easily help me make. This got me thinking that I could do more and better science if there was an easy way for me to build collaborations with amateurs who have different skill sets. I also realized I would have much more fun doing science if I had a way to keep doing it whether or not I get the next grant or research job. Amateurs, such as Benjamin Franklin, Charles Darwin, or Grote Reber (the inventor of the radio telescope), used to be major contributors to scientific research. Today's technologies should make it much easier for people to do science outside of a career, but we need ways to pool people's talent and experience.

How do people contribute to IGoR?
Just like on Wikipedia, people can start new pages or edit existing pages. People can also comment on pages. The heart of the site is the 'project' pages in which people develop research projects. The goal is that one person can post an idea, and interested people can coalesce to develop that idea into a

collaborative research project.

Do you need to be professionally trained in science to contribute?
Anyone can contribute, including by starting their own projects. The idea is that community feedback would help novices learn to do their own science, but at the same time, amateurs and professionals might find people who could help them by sharing their skills.

What are the biggest motivating factors you see towards people contributing?
I think the citizen science shows that there are many non-scientists (or non-professional scientists), who are excited about science and want to participate in it, and the Maker movement shows that there are a lot of people who want to exercise their creativity and skills. So, for non-professionals a big motivation would be having a way to participate in the creative and intellectual side of science. For professionally trained scientists, a major motivation would be to find ways to do research on a limited budget with limited time. It would also provide a way for scientists to communicate their science in a deeper way.

What are the biggest barriers?
I think the biggest barrier is the Catch-22 of needing people actively using the site to make it desirable to join and use the site. Until people see a community that demonstrates how it can work for people like them, few people will invest the time to try using the site, and thereby create that community.

Where do you see "citizen science" going in the next 5 or 10 years?
I should say that IGoR is inspired by "citizen science," but is a bit different from most citizen science. At the moment, most (but not all) citizen science seems to follow a model in which a few experts design a way to obtain a lot of data by getting many volunteers to do some low-skilled, repetitive task. However, there is a lot of interest in community-generated approaches (such as Public Lab, iNaturalist, OpenROV, and others), and approaches where there is real feedback between professionals and citizen scientists, involving creative and intellectual input from citizen scientists.

How does citizen science relate to the "open-science" movement?
As far as I can tell, the open-science movement seems to be focused mostly on open data and open publication models, but there are a lot of other strands to it. One strand that IGoR is definitely a part of is trying to move away from a status quo in which research is almost all done by people employed as researchers by big institutions. Open science, open source generally, citizen science, and the Maker/Hacker movement, all seem to be pushing against the divide between the professional and everyone else....

We are in an era where science, especially basic, fundamental science, has struggled for funding, how can projects like IGoR help?
Projects like IGoR could make it much cheaper to do research. For example, consider my own research. Right now I spend a depressing amount of time seeking funding to pay for my time doing research, and to buy equipment. However, much of that equipment would not be especially difficult to make with the right expertise. If I could collaborate with hobbyists with a variety of skills and tools, we could build all the specialty equipment I'd need.

Are there particular kinds of research areas or projects that tend to fall through the cracks of traditional funding agencies (NSF, NIH etc.)?
Yes. Funding agencies and universities like high-tech science. If you use a big machine that goes ping to do it, you have a much higher chance of success than if you just need to watch something with your own eyeballs, even if the intellectual merit is the same or better. Funding agencies are also driven by fashion, so in biology anything "omics" is in, and organisms seem to be pretty much out for the moment. Finally, they are not good at funding brand new projects, or new or unknown researchers. For example, researchers often say you need to do the project before you can get funding for it, and then use the funding for the next step. This makes perfect sense: your best bet with limited money is the big lab, with lots of toys, piles of preliminary data, and oodles of publications to prove they can do the job.

However, that makes it hard for new researchers, small labs, or people trying new directions. Cutting those researchers out reduces the diversity of research questions and perspectives.

It's interesting that you mention "omics". I've worked in both kinds of biology: evolution and ecology as well as large-scale genomics. I believe we need both, but not one at the expense of the other. To my more molecular and biomedical colleagues I always point out that evolution has found some ingenious solutions to problems, that would take be almost impossible to find through traditional engineering or model system approaches: the search space is just so large. This includes both macroscopic phenomena (e.g., the sticky pads found on the bottom of geckos feet that enable it to walk up walls or high performance biomaterials from spider dragline silk) as well as microscopic and subcellular phenomena (e.g., medicinal compounds found in natural products such as non-model plants, or mating types in Volvox algae). I wonder if this might be a way to get those folks more excited about organisms, especially non-model ones? Or is just that agencies aren't willing to risk funding projects that might not pan out in the traditional timescale for reporting of results?

My hypothesis for why "omics" and traditional model organisms dominate (even when there are better ones for particular problems) is positive feedback. If approach or field X is fashionable it will garner higher profile publications and more funding, so people doing X will have more opportunities, and other people will pay more attention to X, hence X seems even more exciting and an even better bet for funding or new hires. But, attention and funding are limited, so the more those go to X, the less they go to everything else. As I write this, it suggests that the answer is to make funding, and also publication visibility, a non-zero sum game. That gets back to finding new ways to support science, and to tell people about it, which encourage diversification of questions and approaches.

What kinds of changes in the institutional structures of science (e.g., peer review, publications, promotions etc.) would encourage more citizen science, open science or independent scholarship?

For brevity, I'm focusing on independent scholarship.

I think one of the biggest things that academic institutions could do is to teach students that independent scholarship is possible. There will never be enough funding for everyone who wants to do research (and is skilled at it) to make a living doing it. However, we all know that some of the deepest conceptual advances, notably Darwin and Wallace's theory of evolution, came from people who were not employed as scientists. There are still many of important questions that can be addressed by an individual investigator on a shoestring budget.

So, if we value science (or scholarship generally), we need to create an environment in which research can be an avocation rather than a career. The most important parts of that are to make that choice socially acceptable within the scientific community, and to teach people - starting in undergrad and going through all career stages - how to make it work. There are many resources describing how to succeed in academia (or whatever other career one might choose); but, there are few, if any, guides to doing research successfully when one is not doing it for one's job.

There are lots of other things I could mention, but I think that's the most important one.

Are there other new models of doing research, outside of mainstream academic research institutions, that you have seen out there that inspire you?

Several.

Community labs are one that excites me a lot, and is an inspiration for IGoR. They could be great for getting novices, amateurs, and independent professionals working together to do substantive research; their main limitation is that they are few and far between.

There are also a couple of organizations I've seen, like the Ronin Institute, that aim to create a more flexible approach to being an independent scholar, so that more professional-level scholars can do research. Even simple things like providing an institutional affiliation for applying for grants could be very helpful. So far, these are small and few in number, but I think that is due to their novelty.

What is the most fun or rewarding project you have worked on either via IGoR or elsewhere?
Although it was also painfully frustrating to do, I'm most proud of mywork on the role of mechanical properties, such as force generation and stiffness of the embryo, in developmental responses to temperature. I think that project shows clearly that biomechanics can mediate development-environment interactions in important and unforeseen ways.

I know you've done some mathematical modeling in your work. There also seems to be increasing interest in modeling developmental processes (e.g. EmbryoMaker). What do you as see as the role of mathematical modeling and simulation in this kind of work in the future? Are there efforts to standardize aspects of modeling in developmental biology like the SBML (Systems Biology Markup Language) has attempted in the systems biology world, or do most people just "roll their own"?
I like modeling, but most of my theoretical work has amounted to shoehorning some phenomenon into the simplest analytical approximation I can come up with (serious theoreticians might not even consider it modeling). Part of the reason I have taken that approach was that it fit my questions and time constraints, but another part was philosophical. I like to have something simple enough that I can understand the predictions, rather than just seeing what a simulation spits out. Simple approximations are also much easier to generalize than highly realistic, but highly specific, computational models. Therefore, they make a nice bridge between vague mental concepts and detailed simulations. As to the substance of your question, people (including my brother and his collaborators) have come up with platforms for different types of models in developmental biology, but as far as I can tell most people still "roll their own" except for some special classes of problems. At least in biomechanics it is far from clear what the best way to represent the embryo is (there probably is no one best way), so I don't think it is ready for a *single* standard approach.

What's your favourite organism?
Do I have to choose just one?Ctenophores might be it right now. The way they glide through the water with waves of iridescence running down bands of beating cilia, is incredibly beautiful. I love the fact that they coordinate a lot of their motion and sensation using interactions among cilia: a very different approach than most animals. They also have some very cool developmental features. For example, some of them can regenerate half or more of their body as adults, despite the fact that (for the most part) each embryonic cell forms a particular part of the body, and cannot be replaced when lost. There is a point in their development where they gain the ability to regenerate. However, I love lots of invertebrates, and I can't look at ciliates without wondering why I don't study them.

Anything else to add?
One thing I would add about IGoR is that is designed to serve everyone from novices to professionals in order to build a community in which diverse skills, resources, and interests are represented. It may be disconcerting to have easy and difficult projects, or silly and serious projects, sitting right next to each other. However, this will benefit everyone: feedback from experienced researchers should help inexperienced researchers become better scientists, while inexperienced researchers can add their skills or time to help experienced researchers. Therefore, the goals of doing research, and educating people about how to do research, complement each other.

Thank you, Mickey!
This post was originally published on the Biosystems Analytics blog and reposted on The Winnower.