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An Interview with Adam Frank

Ethan Owens
SUNY Geneseo

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Adam Frank, PhD, was the keynote speaker for GREAT Day in 2020 and the Helen F. and Fred G. Gowen Professor at the University of Rochester's Department of Physics and Astronomy. His speech was titled "Light of the Stars: Seeing Climate Change and the Human Future in Our Universe Awash in Worlds."

Could you tell me about astrobiology?

Astrobiology is the new version of an old idea and it's the idea that to really understand life you need to consider it in its true astronomical context, which means a planetary context. But you can go even to broader scales like with the Galaxy and certainly the solar system. You may want to know how the host star for a planet changes things or you may want to know about the whole solar system environment like asteroid impacts. Even in the galaxy, there are places in the galaxy that may be better for life so astrobiology tries to look at life and its conditions for formation and evolution in this sort of broader context. But, there wasn't much to do in the field until the late or the mid-1990s. That was when they discovered two major things happening. One was the discovery of other planets orbiting other stars, what we call exoplanets. The other was that there was a meteorite that was found in the Antarctic which was actually a chunk of Mars that had been blown off of Mars. That meteorite, in the analysis, had hints of possible life of microfossils and chemicals that were interesting. It turns out that that meteorite probably didn't have evidence for life, but it made NASA really interested. NASA then created a part of funding astrobiology as opposed to exobiology.

Could you tell me about your research specifically? And what you will talk about in your keynote speech for GREAT Day?

I'm interested in a wide variety of questions and astrobiology, but the things I'm really talking about is the part of astrobiology that has to do with intelligent life, the possibilities of EXO civilizations. What I'm interested in is what I call the astrobiology of the Anthropocene, the Anthropocene is this era that we have entered where human activity is dominating the functioning of the Earth. We consider earth to be a bunch of coupled systems: there's the atmosphere, the hydrosphere, the cryosphere, the lithosphere, and then the biosphere, which is the sum total of all life. Each of those systems are tightly coupled with all the other systems, and the Anthropocene is this era where we were finding that human activity is basically pushing on all of them. It's now human beings that move more mass around the planet than anything else. The Anthropocene has been proposed as a new geologic epoch, and what I'm interested in is the astrobiological aspect of of a planetary transition. If we're not the only time that an intelligent species and a

technological species has arisen, then it may be generic. This may be the kind of thing that any civilization that arises on a world, and becomes successful enough is going to hit this point. In the talk, I'm really going to be focusing on that question: can we look at climate change and the Anthropocene through that lens and it doesn't have anything useful to teach us about what we're going through right now?

Can you tell me how important you think this research is at the undergraduate level to further these fields?

There's a huge amount to be done and especially for undergraduates. I asked the question, does any technological civilization drive some version of climate change or Anthropocene? How do you want to answer that question? From a research perspective, what we could do is we could take a model of a planet like the Earth and we could move it around and say "imagine that you have another version of the earth that is 20% farther from the Sun than our Earth is." If a civilization evolved on that world would it trigger a climate change? How about a third version of a planet like the Earth that's a little bit closer to the sun? An example of this kind of research is finished a paper which was led by an undergraduate Ethan Savage that just got accepted. And Ethan did the work; Myself and my collaborators put together the model, but then Ethan ran the model and design. He was amazing. He designed to the research program, sort of, "how to set up the variables," "which which conditions to use," and we wrote that paper and set it up so there's really a lot of work to be done answering this question from a theoretical perspective, where we have models and simulations that can be done that's really quite good for an undergraduate.

Do you think that GREAT Day is a good opportunity to share this undergraduate research?

If it's about undergraduate research, absolutely. This is a great place for undergraduates to show that they can be involved in cutting edge research. The sooner you can get involved in research, the better off you are. Because scientific training is interesting, you start off just reading books and taking tests. That's not what science is about at all; soon after you get to graduate school, you find that you've run out of answers in the back of the book. And what's almost more important than finding answers is asking questions. What's the right question to ask? You can spend a long time and get nowhere because you haven't figured out how to match your question to the tools you have to answer the question.

So can you see any other benefits to GREAT Day in regards to research that isn't just putting in the initiative to start research?

I think what's important is to also communicate research, you have to go out and communicate your research results to other people and that means standing in front of your poster. You're writing it up, creating the poster in a way that people can understand thinking about how to best communicate this standing in front of it, giving talks. The

more practice you have an understanding that science is a human process and requires communicating with other human beings, the better. That's an essential skill for researchers and some people are very comfortable doing that and some people aren't comfortable doing that, but it's so important that if you're not comfortable about it, you have got to practice and challenge yourself to do it as often as you can.

Could you give some examples of how, in your own research, you communicated your research to heighten the project?

One thing I do is a lot of science communication: I do writing, I give talks, I do TV shows. But, even as a scientist, I go to conferences. If I have a new result that my group has done that I'm really excited about I will look to go to conferences, get in front of people, and explain to people why this research is important. You have to let people know there's a lot of scientific research out there, you have to let interested parties know that you've done something that you think can contribute to the conversation.

For communicating to the public, how would you go about doing that in an effective manner?

You should, first of all, start your own blog and get used to writing. Write, write, write, write, write, Hemingway said the most important thing about writing is getting your butt in the chair. You can start there, just doing your own thing. You can also make a video, if you're more interested in Visual Communications, or create a podcast for auditory communictions. However, if you would like a more established platform, you can reach out to a science magazine. There are a lot of online science magazines that you can use. You should find someone to contact, find out who is the editors of these publications. Contact the writer and say "hey, I'd like to write for this magazine, how do I do it." They may not be helpful and they may not get back to you; however, you do that enough times and somebody is going to get back to you and then you pitch an idea. Hopefully, as time goes on, you'll build a portfolio of material that you've done. The next time you go to another publisher, they'll be more inclined to take your research and maybe even pay you for it.