Ways of Knowing: Field Science in the 21st Century

A Conversation with Noah Snyder,
Assistant Professor of Geology and Geophysics,
Boston College

INTERVIEW BY ERIK OWENS
BOISI CENTER FOR RELIGION AND AMERICAN PUBLIC LIFE
BOSTON COLLEGE, CHESTNUT HILL, MASSACHUSETTS
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ERIK OWENS: In your presentation, you gave a brief history of geology as a science and talked about how imaging and thinking about the world around us has changed. Could you say a bit about that again? In particular how geology as a scientific field developed from its origins?

NOAH SNYDER: As with anything, you can actually go back thousands of years. But what I call the modern science of geology, the modern discipline, really dates back to the 18th and 19th century, with European naturalists. They were broadly trained scientists who observed the flora, fauna, rocks, soils around them. They developed hypotheses to explain what they saw and explain how earth history was recorded in the rocks and everything else.

What is interesting about it is that they were just scientists then. They weren't as sub-specialized as we are now. So much of what I was talking about today harkened back to the sort of birth of the science. It was a field-based science to begin with. The primary observable has always been the field. That's what I wanted to talk about.

EO: Were the naturalists you were speaking of generalists in any real sense? When you speak of them being naturalists and not trained as geologists because the field hadn't existed until that point, were they also generalists? Did they apply their observations of the natural world to biology, to botany and other areas?

NS: Yes. Darwin is the perfect example, because Darwin is thought of as a biologist. But in many ways, he was a geologist. And it's interesting, because his work is all evolution, and it's just whether it's biological evolution or geological evolution. It works fine either way.

Geomorphologists, which is my field, my subspecialty, we're heavily influenced by Darwin. The evolution of landscapes was a very Darwinian concept and in some ways stays with us today.

EO: Is that sort of broad application across what are now scientific fields is gone now, or can you still be the kind of person who applies general observations across many disciplines?

NS: It's hard. I remember being at MIT, and my professors talking about that as their goal. Their goal was to train scientists in the tradition of Darwin and think about biology, chemistry and physics of earth processes. That is what geology is all about. It's applied biology, physics and chemistry to the earth's system.

But in practice, it's hard to have the sort of depth of knowledge you need in all those fields to be as broadly trained as you once could be, when the depth of knowledge that was out there wasn't as great.

EO: Are the quantitative sorts – the jocks in finance or the data-oriented people in political science or in your own field – in other words, the mathematicians, are the new generalists of the world today?

NS: That's a great question. A friend of mine in grad school was a math Ph.D. student at MIT, but he wound up in my earth science department somehow. And I saw that he's now a professor a math department.

And he's no longer looking at landscapes. I think he has published papers on landscapes, on biology, but now he's looking at the stock market and sociology and things like that. So in some ways, you're absolutely right. He's the perfect example of the generalist.

But I alluded to this in my talk, that those people, while making wonderful contributions to the science, without that field component, there is something missing.

And the perfect example is there was sort of a fad of fractal representation. I don't mean fad in a pejorative sense. But it was a fad of fractal representation of landscapes. The mathematicians just kind of ran wild with it for a while in the late 90s. But there was just a limit to how far it could go, because they weren't really understanding process. They just understood the numerical scaling of landscapes. And it was useful, and it was an important contribution. But, there was a limit to how far you could take that. And there's a limit to what you can do in the field, without fieldwork.

EO: Do you think that the numbers people would call that a romantic or a nostalgic view? Or do you think that they recognize that there's a yin and yang with field science and observation.

NS: My friend, the applied mathematician that I was talking about is the perfect example of realizing that there is this whole other world out there that is important too. He went out of his way to actually come along on field camps and try and really understand how we did science.

But there are people out there who just don't appreciate that side. And that's a constant tension in earth science and probably in other science, like social science. That tension between the very quantitative people and the people who acknowledge the importance of the qualitative, observational side.

EO: You presented in your talk some really striking imagery, and we spent some time talking about visualization. I'm curious what you see as the effect of these new sorts of visualization techniques, not necessarily on the scientific field of geology, but as a culture. For example, the way we experience the world around us. With Google Earth, we fly

through mountain valleys, and now we fly into museums and to the ocean floors and such. How do you think that changes the way we and future generations will look at the world?

NS: I love Google Earth. I think it's just an incredibly useful teaching tool and enhances my experience and ability. At this point, if I'm going to go to a new landscape, the first thing I do is go check it out on Google Earth and get a sense of the lay of the land, quite literally. So I guess the worry would be that it'll replace going to the place.

EO: I'm curious in part about the idea of perspective. When you stood at the base of a mountain and looked up, your way to see what it looks like from the top throughout history has been to climb it. Now, with the very different set of tools, your ability to see things from different perspectives is radically different.

I wonder what that means. You spoke a bit about a new sense of awe, or whether it simply is a virtualization of our understanding of the world, that we can overlay digital and real together in a new fashion.

Or maybe another way of asking the question would be, what has it done to the concept of empirical observation? I mean what has the digitizing, the ladar and radar maps and things like that done to the concept of empirical observation?

NS: I just see it as a real enhancement of my ability both observe and experience the world. My whole life is centered around observing topography and understanding landscapes and observing landscapes. It's what I do for recreation and for work.

So the availability of visualizations, of virtual landscapes, just enhances that because I can see more areas. I look at them in different ways, especially that whole idea of basically stripping the trees off the landscape [with lidar data]. You can just see more.

So for me it's very much an enhancement of my ability as a scientist, but also in that sort of sense of awe. That rejuvenation I feel of being out in the world is enhanced by the fact that there are other ways I see them. It's no substitute for being there, but you can see different things when you're flying through a landscape on Google Earth than you can when you're walking around it.

I've had the opportunity to do helicopter flights and small, low-flying airplane flights, and you can't beat it, as far as being able to see things. But now, the fact that you have some of that ability to view things from that farther perspective at your desktop is awesome. It's great.

EO: One last question involves the datasets that are produced by these mapping technologies. What sorts of implications for ownership and use do you see from this information? What role these datasets should play in public education about the world around us? Should all this information be free? Who pays for it? What are the responsibilities?

NS: It's a tricky question, because it's expensive to collect the data and it's expensive to serve online. But it's also really useful, and people are willing to pay for it, both for research purposes and also for land use planning purposes and all kinds of purposes. Practically, I think it's wonderful that there's all this data available.

And every state now has its own office of geographic information systems. Massachusetts has incredible aerial photography available. They did the whole state in 2005 and 2001 and made it available, I think, at half-meter pixels. That's incredibly high-resolution data that's now available.

EO: Are these on Google Earth?

NS: Yes, those are the Google Earth imagery for Massachusetts. If you zoom out on Google Earth enough so you see all of Massachusetts, you can see that it's got a different set of imagery than all the surrounding states. And different states have prioritized different things.

It's one of those sort of common good-type things, because it's so useful for so many different fields for research. You have all different jurisdictions that are going to be able to use it – local government, counties, towns, private citizens. It's a great function of government to make those data available.

It's a very organic thing, in some ways. Different states have put different priorities. For some reason, I don't know that much about why, but Massachusetts has amazing aerial photography. But there hasn't been a lidar survey, whereas Connecticut has a lidar survey. It's expensive to do a lidar survey of this whole state, but North Carolina and Pennsylvania are pretty big states, and they have lidar surveys. So some states have just prioritized this, and when they do a big area, like a whole state, it's usually public sector stuff.

EO: This is the last follow-up. Is this in any way analogous to the location-awareness that's become so crucial to everyday life, with the GPS satellites, that is used real-time by tens of millions of people every day? And yet it's something that can be taken away with the flip of a switch by the U.S. government, by turning off the signal. So is the landscape data – once it's out, it's out? Or is this something that is manageable, in some sense?

NS: It's an interesting question, because it's a static dataset. Massachusetts hired some company to fly the whole state in April 2005 and collect aerial photography. That's a snapshot of what Massachusetts looked like in April 2005. Once it's out, it's out. I could just download the whole dataset, and I could serve it here. So it isn't something you could take away.

But Google Earth is a great example, because basically Google Earth is an active thing. They're basically always looking around for whenever somebody releases a higher resolution dataset, and they just bring in and add it right in. And because it's on-line, you don't download all the data into your computer. It's just connecting to Google Earth servers to get the data. So there, it's sort of this live thing.

EO: They make policy decisions about what's blurred and what's not?

NS: Well I'm sure that they have relationships with government agencies on this, but I suspect that mostly they just take whatever is out in the public domain, and that's what they blur.

EO: I know that Obama's house in Hyde Park, Illinois, in Chicago is now a blur, and multiple blocks around President Obama's home has been blurred recently. It wasn't if you flew over it a year ago on Google Earth. And now it's not available in the same way that the roof of the White House isn't visible.

NS: If you were to go to the Illinois state geographic information systems website, you could still get the non-blurred data. I could be wrong, but presumably it was released. Say John Kerry had been elected president. He's got a house in Beacon Hill and he's got a house on Nantucket. They would probably blur it in Google Earth, but they would not have taken down the original source. A lot of people have DVDs of that. I know that you can get a DVD of the whole one-meter pixels of Massachusetts. Once that's out, it's out.

EO: That's very interesting. Thanks so much for taking the time to talk with me.