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Q. & A.

A Planetary Problem

Elizabeth Kolbert discusses her three-part series on climate change with Amy Davidson.

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Elizabeth Kolbert travelled from Alaska to Greenland, and visited top scientists, to get to the heart of the debate over global warming. In this week's magazine, she publishes the second of a three-part series on climate change; the first part is posted . Below, she discusses the series with Amy Davidson.

AMY DAVIDSON: What is global warming? Is it real, or theoretical?

ELIZABETH KOLBERT: I guess you could say that that depends on what the meaning of the word "is" is. The principles of global warming are as well established as any in physics. Nearly a hundred and fifty years ago, a British physicist named John Tyndall discovered that certain gases in the atmosphere—we now refer to these as "greenhouse gases"—trap heat on earth by absorbing infrared radiation. There are several naturally occurring greenhouse gases, including carbon dioxide and water vapor, and together they produce the so-called "natural greenhouse effect." Without the natural greenhouse effect, the planet would essentially be frozen. Any basic earth-science textbook talks about the natural greenhouse effect; it's a phenomenon that is not in any way debated. All that the theory of global warming says is that if you increase the concentration of greenhouse gases in the atmosphere, you will also increase the earth's average temperature. It's indisputable that we have increased greenhouse-gas concentrations in the air as a result of human activity, and it's also indisputable that over the last few decades average global temperatures have gone up. As best as can be determined, the world is now warmer than it has been at any point in the last two millennia, and, if current trends continue, by the end of the century it will likely be hotter than at any point in the last two million years.

How would warming the world change the world—that is, the world for human beings?

There are countless ways in which we humans are dependent on the climate: it determines what crops we can grow, what pests and diseases we have to worry about, how we get water, and on and on. Warming the world is likely to change the climate patterns that we rely on; some areas, for example, are apt to become drier while others will become wetter. Sea levels will probably rise, possibly quite dramatically, and that will affect coastal areas where hundreds of millions of people now live. No one knows exactly how higher average temperatures will translate into, say, changes in precipitation, but, considering that there are more than six billion people on the planet, it wouldn't take a very large alteration to create very significant problems.

Climate does vary naturally. How is what we're talking about here different?

It's true that the climate varies naturally, and some of the recent rise in global temperatures may well be part of a natural cycle. The point that's important to keep in mind is that the greenhouse gases we are adding to the atmosphere are overwhelming the natural forces that cause climate variability. In effect, we humans are becoming the drivers of the climate system, and we are doing so without knowing where we are going.

Your reporting for the article took you to Alaska. What did you find?

Alaska is being very dramatically affected by climate change; the state is warming up just about as fast as any place on earth. This is producing a lot of problems in Native communities; several Native villages may have to be moved owing to erosion that is being caused, or at least hastened, by climate change. It's also affecting daily life in places like Fairbanks, parts of which are built on permafrost. As the permafrost degrades, people's houses are starting to split apart. The roads need to be repaired more often; sometimes they just cave in. Ironically, it's also affecting the oil industry. The kind of heavy equipment used in oil exploration is allowed out on the tundra only when the ground is frozen to a depth of twelve inches. Since 1970 the number of days that meet that condition has been reduced by half. Early on, computer models developed by scientists working on climate change predicted that global warming would have a disproportionate effect in the Arctic.

You also spent some time sleeping in a tent out on the ice in Greenland. What brought you there?

Outside of Antarctica's, Greenland's ice sheet is the largest in the world. It contains enough water to raise global sea levels by twenty-three feet. There is a very real possibility that global warming will set in motion the destruction of the Greenland ice sheet. No one really knows how warm the world would have to get before that happens, but the signs are not encouraging. Scientists are already seeing changes to the ice sheet that suggest that it could occur at temperatures not much higher than today's. And although the process could take centuries, or even millennia, to fully play out, once the ice sheet started to melt it would become self-reinforcing and therefore impossible to stop.

I was very struck by your description of the work being done by Donald Perovich, a government scientist, who measures something called albedo. What is its significance?

Albedo is a measure of reflectivity. The ice in the Arctic, and also in the Antarctic, reflects a tremendous amount of sunlight back into space. This is a very significant factor in shaping the earth's climate. In the Arctic, the ice, and particularly the sea ice, is melting, and this is changing the earth's reflectivity. More heat is being absorbed, which is causing more sea ice to melt, and so on. This is a good example of positive feedback. It's taking a relatively small change to the system and amplifying it into a much larger one. There are several positive feedbacks in the climate system that are known, and quite possibly others that haven't yet been identified, and all are cause for concern.

How good is the science? We often hear it said, at least in this country, that there are conflicting views.

There is a very broad consensus in the scientific community that global warming is under way. To the extent that there are conflicting views, they are usually over how exactly the process will play out. This is understandable. The climate affects just about every natural system on earth, and these systems in turn affect the climate. So making predictions is very complicated. Meanwhile, we have only one planet, so it's impossible to run a controlled experiment. To focus on the degree of disagreement, rather than on the degree of consensus, is, I think, fundamentally misguided. If ten people told you your house was on fire, you would call the fire department. You wouldn't really care whether some of them thought that the place would be incinerated in an hour and some of them thought it would take a whole day.

In your second article in the series, you talk about climate modelling. How do scientists use computers to predict the future of the environment?

Scientists use very elaborate climate models, which are run on supercomputers, to try to predict the future. These models use equations to describe hundreds of different processes that affect the climate: the formation of clouds, the evaporation of water, heat transport in the oceans, and so on. The model I'm most familiar with, which was produced by nasa's Goddard Institute for Space Studies, here in New York, consists of a hundred and twenty-five thousand lines of computer code. Of course, even the most detailed climate models can only approximate reality very crudely, and it's hard to know in advance which will prove to be the most accurate. I think it's important to note, though, that all climate models—there are about fifteen major ones in operation—predict that global temperatures will increase in coming decades. They also all predict that if we double CO_2 concentrations in the atmosphere this increase will be quite substantial.

Some scientists look backward instead of forward. In the second piece, you discuss the Akkadian civilization. What about that story is especially relevant now?

Akkad is often referred to as the world's first empire. It was, for its time (around 2300 B.C.), a very sophisticated civilization, and it collapsed in a period of prolonged drought. As a result of global warming, it's predicted that some regions of the world will start to experience droughts, while others will receive more rain and be vulnerable to flooding. The question is, how will society deal with that? In this context, the history of Akkad, and of other civilizations whose demise has been linked to climate change, is not very encouraging.

One disturbing thing about your article is just how alarmed many seemingly sober-minded scientists are. What sort of a gap is there between expert and lay opinion on climate change?

That's a good question. I think there is a surprisingly large—you might even say frighteningly large—gap between the scientific community and the lay community's opinions on global warming. As you point out, I spoke to many very sober-minded, coolly analytical scientists who, in essence, warned of the end of the world as we know it. I think there are a few reasons why their message hasn't really got out. One is that scientists tend, as a group, to interact more with each other than with the general public. Another is that there has been a very well-financed

disinformation campaign designed to convince people that there is still scientific disagreement about the problem, when, as I mentioned before, there really is quite broad agreement. And third, the climate operates on its own timetable. It will take several decades for the warming that is already inevitable to be felt. People tend to focus on the here and now. The problem is that, once global warming is something that most people can feel in the course of their daily lives, it will be too late to prevent much larger, potentially catastrophic changes.

If human beings have caused climate change, can we also reverse it?

We cannot reverse climate change. This is because carbon dioxide is a long-lived gas. What we do have the power to do is to mitigate climate change by reducing emissions. The longer we wait to do this, the riskier the situation will become.

Human beings have responded to challenges for millennia. For most of that time, we have had far fewer technological tools at our disposal than we have now. Why shouldn't we be optimistic about our ability to face climate change and adapt?

I certainly hope that we can face climate change. My oldest son is ten years old and, for his sake, I would very much like to think that we will be able to cope with this challenge. It's hard for me to be optimistic, though. Scientists have been warning about the dangers of global warming for more than twenty-five years now, and in that time we have increased our energy usage—and, with it, our production of greenhouse gases—quite dramatically.

In terms of adaptation, it's a nice idea, and certainly it will be necessary; the amount of warming that is already inevitable is quite significant and may cause severe disruptions. At a certain point, though, the changes will become so great that adaptation will become extremely difficult; a five-foot rise in sea levels, for example, would put parts of the state of Florida underwater. If you imagine that sort of scenario being played out all around the globe, it gets pretty frightening. And, as one climatologist pointed out to me, while we are more technologically sophisticated than earlier societies, we are also more sophisticated when it comes to destruction. ✦