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Running in Fog

FINDING A SAFE OPERATING SPACE FOR HUMANITY

ON A BRIGHT SUMMER DAY IN 1979, four people started a hike from the southern coast of Iceland near Skógar into Thórsmörk. The day before, a strong storm had hit the island and cleared the air. By noon, the group had reached the height of the pass between two glaciers. Fog started to form and soon it became very dense. They were descending over a smoothly declining snowfield. After some time, the slope increased to a challenging level.

I was one of the group of four. The fog was one of the densest fogs I have ever experienced, with almost no visibility. Rather suddenly, I felt very uncomfortable, with a sense of danger starting to develop in my body, and I argued with the group that it was too dangerous to continue. Finally we decided to hold and prepare for a long night on the snowfield. This avoided disaster: The next morning we realized that we were only a few meters away from a sharp edge at the top of a 800-meter near-vertical drop into the magnificent valley of Thórsmörk. Hiking in the dense fog on the previous day, we had little idea what we were heading towards. The spectacular landscape carved by ice and water out of the sequence of hard lava and soft ash layers would challenge any hiker with sharp edges and deep drops. Adhering to a diffuse sense of danger had saved our lives.

Nick Mabey[1] and others suggest that our home planet is "on the edge." True, our planet is on a trajectory of great changes. As James Syvitski explains,[2] global change research has shown that we are in "an epoch of our making," the Anthropocene, in which we humans have risen to be the dominating force in the surface dynamics processes impacting ocean and atmospheric composition, biodiversity, and, eventually, climate. The notion that we are pushing the planet on the edge is thus not too far-fetched. However, the fact that we have moved from the passenger seats in the back of the bus to the driver seat is a game changer. We have to learn to drive, or we as humanity, not the planet, will fall into one of the abysses on both sides of the safe road.

The planet has gone through many transitions and phases in its history. Many of the stationary epochs would not have been accommodating for humanity and our civilizations. This brings us to the concept of a "safe operating space for humanity," introduced by Johan Rockström and others:[3] within the space of all possible states of our planet, there is a subspace that is safe for us. We better make sure that we do not push the planet outside of this subspace.

As far as we know, there are a few global boundaries that define this space, and Rockström and his colleagues identified nine: climate change, ocean acidification, stratospheric ozone depletion, nitrogen and phosphorus cycles, global freshwater use, change in land use, biodiversity loss, atmospheric aerosol loading, and chemical pollution. These boundaries may turn out to be like the edge we met on our hike in Iceland—an edge that separated life from death.

Editor's Note:
A related story about the Sustainability of Space Systems appears on page 30.

With this boundary concept, we see that it is not the planet but rather humanity that is on the edge. Another similarity with our hike on Iceland is the fact that not all of the nine boundaries are quantified and we are in a fog keeping us from seeing the edge. In Iceland, we did the right thing when we halted during our hike, but humanity's addiction to growth, including economic growth and profit at any cost, keeps us driving on without sufficient sight of the road and the edges.

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Our re-engineering of Earth's surface processes and climate system could well push the planet on a run-away trajectory to a completely new homeostasis far off from the state that allowed humanity's global civilization to emerge. James Lovelock stated that many feedbacks in the Earth's climate system are currently positive, leading to increasing speed of changes.[4] This is not unlike a run-away truck on a steep downward slope. Where the run-away system will end up depends on where the feedbacks turn negative. Lovelock thinks that this could be at a stage with global temperatures being 5 degrees Celsius warmer.

What are the consequences of being on a run-away planet? One consequence will be an impact on the carrying capacity of the planet. Lovelock estimates a capacity of one billion people for the 5-degree-plus planet.[4]

As of October 2011, there are seven billion people on the planet, and currently, we live a lifestyle with a footprint of 1.5-2 planets. The lack of sufficient resources in large geographical regions and the greedy hunger for resources in other regions are already fueling wars, migration and terrorism. With a decrease in carrying capacity and a continuous growth of our numbers, this can only worsen. Soon, our lifestyle may have a footprint of 5-10 planets. There is little that could prevent this from resulting in a period of global social unrest and unprecedented wars. Our children are facing a global nightmare.

What metric is supporting the notion of a run-away planet? In a recent *Science* publication, Shaun Marcott and colleagues showed that at the beginning of the last century, the global temperature was close to the minimum of the last 11,300 years, while today's value is almost the maximum in this time span.[5] Thus, the change during the last century was the largest century-scale change in more than 10,000 years, and it was on the order of the total range in this time window.

◀ FIGURE 1. Humanity, on the edge.

▲ FIGURE 2. Thórsmörk, Iceland, 1979. Image courtesy of Hans-Peter Plag.

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Together with a colleague, we estimated how much temperature normally changes within one century. We used temperature data for the last 800,000 years, and found that within a century, temperature changes were always less than +/– 0.4 degrees C.[6] Thus, the change of +0.7 degrees during the last century already exceeds the maximum century change observed in the past. The potential increase of 4-5 degrees during the 21st Century would exceed the maximum change of the past by a factor of 10.

Interestingly, the distribution of century-scale changes in global sea level is bounded by +/– 6 meters per century and changes of +/– 2 meters per century are very common. The last 7,000 years were very unusual with sea level changes limited to a few centimeters per century. The exceptional stability of sea level on a global scale and locally in many coastal areas allowed humanity to benefit from coastal settlements. Our experience of a stable sea level throughout the period of recorded civilization has fooled us into believing that sea level is basically stable. However, there is no rational basis to assume that sea level will remain stable in a time where the speed of temperature changes is larger than ever.

One great transition of humanity is the one from a rural to an urban species, and most of our rapidly growing urban centers are in the coastal zone. With this development continuing, a highly variable sea level will challenge our civilization to its core. At the same time, we have allowed our cities to sprawl into hazardous areas with the consequence of increasing human-made disaster triggered by natural hazards.

The planet is on its way to a state unfavorable for us as a global civilization. More importantly, the speed of the transition is most likely exceeding the adaptation capabilities of large parts of the biosphere. The combination of us vastly killing off species and climate change exceeding the adaptive capabilities of many ecosystems is rapidly reducing biodiversity. Yet many of us still believe that we will remain unscathed.

Our situation is like the one on the Titanic after

Bio:

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it hit the iceberg. The key issue in such a situation should be to find the lifeboats and get as many people as possible into them. But in all societal sectors, we are continuing business as usual with no sense of urgency. The scientific community is acting as if we have all the time in the world to create the knowledge that is needed to overcome humanity's sustainability crisis. The private sector loves its addiction to growth and admires those who get rich beyond limits. The public sector continues to put local and national interests above global responsibility.

We also continue to define global principles and goals. The sustainable development principle attracts great intellectual capacity and political power to global summits, but its operationalization lags behind. The Millennium Development Goals (MDGs) have a great ethical value but reaching them is unlikely, particularly in Africa. Nevertheless, we go on to define Sustainable Developments Goals (SDGs) for the next decade,[7] but reaching those is not more likely than reaching the MDGs.

The science community also comes up with programs that have the potential to produce the knowledge that policy and decision makers would need to make progress towards MDGs and SDGs, but then these programs turn out not to be focused on reaching these goals, and they lack urgency. The most recent example is the Future Earth Initiative[8] conceived by an alliance of international research organizations, which has the goal "to develop the knowledge required for societies worldwide to face challenges posed by global environmental change and to identify and implement solutions and opportunities for a transition to global sustainability."

Achieving this goal could turn out to be crucial for humanity and our civilization. Given the rate of change we can expect if my metaphors of a run-away truck and of the Titanic have any similarity to our situation, the Future Earth Initiative may be the last initiative we can start to get the knowledge that could help us stop the truck, find the lifeboats, and make a transition to a more resilient and adapted post-modern civilization. Unfortunately, at all the science conferences I attend, which is a considerable number, the sense of urgency that I have is not the norm. ∧○

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