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Limits to Nature

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Abstract

We like to think that we live in a world without limits. In practice though, everything is defined by the limits it imposes on the environment in which it exists. Our societies too, are defined, and made possible, by their limits, by the rules and values we impose. Throughout history, humanity has sought to understand and modify the limits that surround it, to cross boundaries and achieve ever more. As man-made limits are changeable, and as we have learnt more about the workings of nature, we have become conceited. We have begun to believe that we can change the limits of nature too. This is an illusion. We cannot manage the limits of nature and it is probably dangerous for us even to reach them. The amount of carbon we have pushed into the atmosphere in the last century shows that we should not test the limits of nature. We have started a process and the consequences will last for centuries to come. It is essential that we stop worsening this process and prepare ourselves for the changes ahead.

1. We cannot manage the limits of nature, even if we think we can

It is easy to want to live in a world without limits. We don't want to be constrained by anything, to be held back. Like long distance runners and formula one racing car drivers, humankind is always trying to push the limits, to achieve ever more. As technology allows us to breach ever more barriers, it is easy to think that we already live in such a world.

Yet everything has limits and it is unrealistic to wish otherwise. There is a maximum speed human beings can run, even drug enhanced. There is a maximum speed that racing cars can achieve, before they take flight. We don't understand where these limits are, simply because we haven't reached them yet. One day we will reach them though, and we will understand then that these limits are hard, that they cannot be overcome.

When we talk about boundless oceans, endless horizons and infinite possibilities this is just poetic. The oceans and the horizon are not limitless at all. They are bound by the planet. While possibilities may be many, they are never infinite. Even our universe has limits. What is in our head has limits too. Our imagination is limited by everything we currently understand. It is impossible to conceive anything more.

When we reach natural limits, even the cleverest technology cannot overcome them. They are not limits that can be breached, despite what we all like to believe. We only think that

they can be overcome because we have not encountered many of them so far, and because the limits we have breached until now were man-made.

Some of the natural limits are known. Light cannot travel faster than 300,000 km per second in space. Nothing can be colder than -273.15˚C. Water ice cannot be heated above 0˚C under normal pressure. That is the limit of its existence as ice.

Life is, thanks to limits. Cells are limited from their environment by membranes. Plants are limited in their rate of growth by nutrients, gases, water and light. The climate is limited by the heat of the sun, the activities of the oceans and the atmosphere.

The ability of living creatures to multiply has limits too. They are limited by the availability of resources, particularly energy, and by competing with other living beings. These limits are tightly woven into food chains.

Practically, as well as philosophically, everything is defined by limits, even things that are man-made. A house is bound by walls and a roof, the limits of its physical presence. It also imposes limits on the environment around it. It limits the amount of the rain that gets in. The bricks from which it is built are limited too, defined by their dimensions. A pile of bricks is chaos. When they are built into a wall, there is structure. Bottles, gas tanks and even the hulls of ships are designed to limits too. They are made to keep one substance in and others out. Their function is to limit the influence of what lies outside.

These are not natural limits but artificial ones.

In society too, we are defined by limits. The size of our society, from prehistoric times until now, has been limited by the rules we have imposed on it, to encourage a group of people to live together in an orderly way. At first, those limits were defined by rituals and taboos. Later, they became laws.

The difference between man-made limits and natural ones is that they are changeable. They can be overcome. We can knock down walls and smash the bottles we have made. We can change the laws. But we cannot change the laws of nature.

2. We do not know what nature permits us to be

Man-made limits have made our development possible. But they have also made us think that all limits are changeable. Our technological advances over decades support this idea, that we can master and then manipulate what is around us. We can take energy from the wind, modify cells and split atoms into their tiniest components. But this understanding of the world and our ability to manipulate it have also made us foolish.

Foolish, because the discoveries we have made are really rather modest. When we take energy from the wind, we simply change what was already there. When we change the contents of cells, we copy what nature could do. We do not create new life. And when we split atoms into their tiniest parts, all we are doing is looking inside.

There is so much that we do not understand, especially when it comes to the natural world and its limits. We do not know the limits of consciousness, or even what it is. We have not explored most of the oceans or understood their importance, though they are the largest part

of the planet. We cannot predict the weather more than seven days ahead. We do not even know what substance or force makes up more than 80% of the universe − and only discovered this very recently.

We also keep changing our ideas. Our theories about the origins of life and the birth of the universe have changed completely in the last 150 years. Many of them have changed in the last 50. Despite this, we are now certain that we have the right answers, or at least most of them. Like small children who have taken a few tentative steps, we think we are able to run.

This may be natural of course. We are ambitious and, for the majority of the structures we deal with day to day, because we made them or have studied them for centuries; we mostly understand their limits. We understand the tolerances we need to work within. We know, at least generally, how far we can heat a piece of glass before it melts. We made the glass. We know too, more or less, how hard we can hit it, before it breaks. We have tested it.

The difference, between knowing precisely and knowing generally what will happen, are the tolerances. These are the boundaries to the limits. Tolerances can be big or small and they depend on a wide range of factors. They depend on how thick the glass is, for example, or what additional chemicals it contains.

When we, as humans, create complex physical systems that could cause problems if something goes wrong, we take time to understand these tolerances very carefully. This allows us to improve the design. So, we limit the chances of human error in factories by controlling them with computers. We build walls around nuclear power stations, to limit the consequences of very large waves. We limit the effects of a tear in the hull of a ship by giving it a second skin. And we limit the result of a failure in aircraft control mechanisms, by installing backup systems.

Similarly, there are tolerances in our complex social systems too, though not always by our design. These may be linguistic, religious or cultural. They may stem from our values or our political structures. In such cases, the tolerances act as buffers and warnings, to limit the consequences of a rupture. They allow wars or revolutions to be avoided, or permit them to be embraced, so that a new system is established.

In man-made systems, the tolerances are usually broad and flexible. In nature however, the tolerances are often poorly understood. As Rousseau said, “we do not know what nature permits us to be”. Nor do we know what nature permits us to do. This is particularly important when we consider very complex and interlinked natural systems, such as those that control our climate.

In nature, because tolerances are often extremely small, signals only appear when change is unavoidable. When a hurricane forms, there is nothing that anyone can do to stop its development or change its path. A process has begun. We can only watch the damage it unleashes. Similarly, melting Arctic icecaps and rising sea levels are not nature’s warning signals; they are signs that we need to change. They are the start of a transformation that we will have to witness.

In nature, the concept of time is different. For us, the impact of new political philosophy or a declining empire might last for many generations. This is a long time to us. In nature, tens of millions of years are but a moment.

We are used to simple, flexible systems that we designed and understand. Eager to gain the most for ourselves in the shortest possible time, and failing to understand the hard limits of natural system however, carries the risk that we can enter forbidden territory. If the environment wakes up and begins to defend itself, with its own peculiar means, and we continue thinking about how we can profit from the change, the consequences could be grave.

"We need to classify the environment as a global security issue, to place it above every other concern."

The changes humankind has unleashed on the planet are already unstoppable, certainly within any timeframe that we really understand. The effects of our pumping large amounts of carbon into the atmosphere have become visible within a century, a flash of earthly time. It will take many hundreds of years before the effects have passed.

3. It is tempting to reach a limit, unsafe to go beyond

It is human to want to breach limits. It is what fuels the fires of passion in explorers and pioneers. But it has also brought us a conceit. We think that we are the masters of everything around us. Our curiosity for the brink, and our willingness for conflict, adds to our belief that every battle can be won.

Nature is easily the most complicated system we know. We are part of it and cannot survive without it. It provides us with our food, energy and somewhere to live. It does this by working within limits. The acidity of the oceans and the gases in the atmosphere are *exactly* as most living creatures require. We know of no other place where this happens, or has ever happened. We know too, that an average temperature rise of even a few degrees will change all this.

We have set a process in motion that will force us to confront the limits of nature. Unlike the limits we make, these cannot be overcome, no matter how clever we are.

It is therefore essential that we stop everything we do that is bringing about this change.

4. Change is in all things sweet

How do we do that? The steps we need to take are much clearer than many of us imagine. We are making them happen, and the consequences are hard. First, we need to classify the environment as a global security issue, to place it above every other concern. We need to adopt a war-footing, in effect.

Future generations also need to be given representation in governance structures, to have a voice in all the decisions we take. Clear international targets for the reduction of greenhouse gas emissions need to be identified, and quickly, with a detailed plan and timetable for it to be achieved.

As well as reducing fossil fuel use progressively to zero, we need to stop deforestation and begin a programme of reforestation. Countries with large forested areas need to be compensated for doing this, or economically debilitating sanctions need to be applied if they refuse. We need to capture man-made methane and cut emissions from livestock.

We also need to prepare for what is to come. Many parts of the world will suffer badly from climatic extremes in the decades ahead. Everyone will need to pay more for food, water and energy. Without a response, this will bring instability. We also need to protect ecosystems, build flood defences in vulnerable areas, and develop the capacity to cope with more pests and droughts.

How much will it cost to reduce our carbon emissions and build defences against the climate change we have already unleashed, that will be with us for centuries to come? It really does not matter.

If we can print money to solve a financial crisis, we can pay whatever it takes to protect our future. Destroying our economies is better than destroying our world.

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