

# Xenobiology and environment

*Synthetic biology* and *xenobiology* could be great tools for improving the environment, but there must be a balance in which the pursuit of benefits for humans is combined with respect for nature and its laws.

On 15th May 2015, Pope Francis published his encyclical *Laudato si*, in which he gave his views on the problem of environmental pollution that is devastating our planet, and how it affects not only nature, but ourselves, especially the most disadvantaged.

The problem of pollution, over-exploitation of resources and the global warming caused by these is being studied from different perspectives. One of these is the drive for research into new methods that can help us to obtain clean energy that will allow us to continue our development, obtain more resources for food and industry without depleting the planet, and methods for decontamination and repair of damaged ecosystems. Xenobiology could have a huge impact on all these projects in the future.

Xenobiology is a young discipline within synthetic biology that is at the forefront of some of the proposed projects. Xenobiology aims to add letters to the natural genetic alphabet to be able to obtain new words, and to write a story different the one told to us by nature. In the words of Floyd E. Romesberg, one of the principal investigators in the expansion of the genetic alphabet: "If you're given more letters, you can invent new words, you can find new ways to use those words and you can probably tell more interesting stories" (Callaway, 2014).

A transformation of biology such as that envisaged by *xenobiology still presents risks and certain ethical questions*, but at the same time, it represents a new way to overcome our environmental problems.

## **Risks of xenobiology for the environment:**

- Conservation of biodiversity

A very important question that arises from *the possibility of generating a biology that is orthologous (different) to natural biology*, with characteristics designed by ourselves, i.e. with what we consider advantages for our benefit, is the possibility of displacing natural species from their habitat or roles.

The conservation of ecosystems is based on an intricate system of relationships between the different species that compose them; generating changes in these relationships usually has devastating consequences for the ecosystems.

If the advance of xenobiology eventually creates artificial beings with properties not seen in nature, will we be able to predict — now or in the future — how this introduction will affect the ecosystem as a whole?

"We must be aware that the different species contain genes which could be key resources in years ahead for meeting human needs and regulating environmental problems" (Francis, 2015). Therefore, we cannot afford to risk losing species by introducing new species that

benefit us in the short term, believing that we will be able to get everything we need from these new uses of technology.

Furthermore, the conservation of ecosystems and species, although often disguised as defence of the planet, is conditioned by the economic factor, i.e. because it produces a benefit for the more advanced societies. If these benefits are obtained by xenobiological organisms, cheaper and more efficient, will these societies stop investing to continue protecting the most vulnerable ecosystems and species?

In the words of Pope Francis to the European Parliament (Francis, 2014), we are the "stewards, but not masters" of nature and the world.

Therefore, as stewards, and considering the ethical principle of "the protection of ecosystems and the environment" formulated by E. Sgreccia (Sgreccia, 2009), obtaining new species or life forms cannot distract us from the protection that we must provide to natural species and ecosystems. It is not enough to think of other species only as eventual exploitable "resources", forgetting that they have a value in themselves (Francis, 2015a).

"The establishment of a legal framework which can set clear boundaries and ensure the protection of ecosystems has become indispensable; otherwise, the new power structures based on the techno-economic paradigm may overwhelm not only our politics but also freedom and justice" (Francis, 2015a).

As Pope Francis tells us, we must be very vigilant so that the laws protect the environment and do not give free rein to a runaway technology, without measuring the damage that we could cause to all mankind.

#### - Biosecurity (Biosafety)

According to the World Health Organization, biosafety is the prevention of unintentional exposure to pathogens and toxins or their accidental release into the environment. (WHO, 2006)

Environmental biosecurity can be compromised by unexpected reactions of the organisms generated by synthetic biology with natural organisms, creating risks for both the environment and for humans themselves.

These biosecurity risks arise from research, in both genetic engineering and in certain disciplines of synthetic biology. They use the manipulation of DNA from different organisms, generating other new ones, but with the same genetic base. In a manner of speaking, they maintain the same programming language, so they can give rise to mutations, cross-linking or horizontal transfer of genes between artificial and natural organisms, with the subsequent risk that this would have for nature and for man.

Unlike other forms of synthetic biology, xenobiology uses information coding systems different to those of the natural species. i.e. the XNA and DNA of the different organisms are not compatible with each other. To continue the aforementioned simile of computer programming, they use different programming languages. Therefore, cross-linking of genetic information between natural and xenobiological organisms is not possible, a priori.

These properties of xenobiology therefore make it a firewall to protect nature, living organisms and the genetic integrity of man (Schmidt, 2010). It therefore fits the ethical principle of "protection of ecosystems and environment" (Sgreccia, 2009) perfectly, as man must preserve the natural setting from the damaging interactions that organisms created with extended genetic codes could cause. Establishing an orthologous biology is much safer form of control than all the control measures that can be taken in organisms that are genetically modified based on their natural composition.

## **Justice, dignity and interests**

Previously, we described the multiple advantages for the planet that we can obtain if, thanks to synthetic biology and xenobiology, we have new biofuels, improvements in agriculture, products that we now take from nature with the consequent damage to ecosystems, etc.

At the XXI Convention on Climate Change held in Paris in December 2015, Pope Francis warned of the need to "achieve global and 'transformational' agreement based on the principles of solidarity, justice, equality and participation; an agreement which targets three complex and interdependent goals: lessening the impact of climate change, fighting poverty and ensuring respect for human dignity" (Francis, 2015).

Therefore, if the research and benefits that are obtained with the products of synthetic biology are not managed justly, i.e. if the countries with most technological advances and wealth do not include other countries, inequality between humans on the planet will increase exponentially.

Many people currently earn their livelihood from the exploitation of natural resources, which supply the wealthiest countries. ETC Group, in their report to the Convention on Biological Diversity, warns of the appearance of certain substances, such as vanilla or palm oil, obtained by organisms modified by synthetic biology, which aim to replace products that are obtained today by farming, and are the livelihood of millions of people in less developed countries. The case of palm oil alone, it is estimated to negatively impact 25 million people from countries like the Philippines, Malaysia and India. (ETC Group, 2013)

For the sake of the good of the planet, we cannot look favourably at the increasing distance between countries with greater and lesser technological power. The dignity of persons — each and every one of them — is above the common good.

At this point, it is very important to highlight the difference between two concepts that tend to be confused and mixed up, namely the interest and dignity of the person. In society, when we talk about the common good, we think of the interests of the population as a whole, and we can often abuse the individual interests of certain people, as is the case of construction of a road, for example. In this case, there is no doubt that interest for the common good wins over individual interests.

However, in the case of biomedical research, the difference is often not as clear, and these two concepts tend to be confused. There is a tendency to lessen the dignity of the weakest or ignore it in the interest of the strongest. For example, when there is the possibility of using embryos in order to cure diseases, the interest of the investigators or the patients themselves,

who press for these human beings to be used as research material, destroy the dignity possessed by the embryo as the human being that it is.

Something similar occurs in the case of synthetic biology. We have to weigh up whether the interests of the more developed countries collide not only with the interests of less developed countries, but mainly with the dignity of the people who live in these places.

International organisations must deeply consider the direct and indirect consequences that may arise from the use of these new technologies in countries with a lower degree of technological development and more based on manufacture, and especially the negative impact that it will have on people from these regions.

In summary, synthetic biology and xenobiology could be great tools for improving the environment, but there must be a balance in which the pursuit of benefits for humans is combined with respect for nature and its laws and the other beings that share the world with them and which, we must not forget, has been left by God in our care. We must remember that we are "stewards, but not masters" of Creation (Francis, 2014).

More of biotechnology and the ecosystem read [HERE](#)

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