

Tulips On The Moon

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Bernard Foing, Chief Scientist at the European Space Agency, is also Project Scientist for SMART-1, a spacecraft now orbiting the Moon. SMART-1 is currently mapping the lunar surface topography and mineralogy, and scientists hope this information will lead to new insights about the Moon's evolution.

In this essay, Bernard Foing ponders what steps will need to be taken to establish future human bases on the Moon. The Moon has one-sixth of Earth's gravity and no atmosphere, but the difficulties of living there could be eased by something as beautiful and delicate as a flower.

The Moon is a great laboratory to learn how to expand Earth life to another planet. That is because the Moon is a part of the Earth. 4.5 billion years ago, an asteroid collision with Earth caused expelled material to form the Moon.

We don't believe there is any indigenous life on the Moon. We have to eventually revisit that, because if there are some polar ice deposits, there may be organic contaminants coming from comets.

Short episodes during subsequent impacts might warm and process this ice and organic mixture. But besides that, most of the Moon is barren and dry, so it's a good place to try to turn a desert into an oasis.

Of course, we cannot globally terraform the Moon all at once. We would need to start with an artificial biosphere. It would be a little bit like Las Vegas; when you go into the hotel, you have an artificial domain. You

cannot stand it outside, it is too hot.

The Moon has no atmosphere, but the soil is rich in minerals. There's about 45 percent of oxygen in the soil, for instance. So we have to learn how to extract resources that we can use later for sustaining these areas. And there are also some resources that can be used for producing energy back on Earth.

I believe what is important, for the return of humans to the Moon, is to learn how to develop life on the Moon. It's a different environment, exposed to high levels of radiation, so we have to be careful. We could bring some bacterial colonies to the Moon to see how they would adapt or mutate.

We have developed a concept of a small life science prototype to learn how such life would adapt. We named our miniature life support demonstrator the First Extraterrestrial Man Made Ecosystem, or FEMME. That doesn't mean we want to send only women to the Moon, but we want a few! Hopefully we'll have the first woman on the Moon, it's about time.

Another step is to bring some plant life communities to the Moon. And what is more beautiful in terms of life communities than a flower?

A flower is not a single system. A flower is a host to a series of organisms. So it is just like a microorganism biosphere that you could bring to another planet. And also, symbolically, pictorially, a flower has a strong meaning.

We are collaborating with botanical groups in Ukraine and the Netherlands, looking at very resistant plant forms. We have to start with a plant that can survive the trip. Because I live in Holland, and I cross the tulip fields on my way to work, I thought tulips could be a nice example.

You can freeze a bulb. You can sterilize it. You can transfer it to the Moon and then, with sufficient water, some heat, and an artificial CO₂ atmosphere, you could see the flower grow.

I have some colleagues developing very miniature cameras. So I want to see, day after day, this flower grow. We could set up the camera to show Earth in the background, showing in three dimensions how we are bringing life from Earth to another planet.

We are thinking about other kinds of flowers or plants that could be brought to the Moon as a sophisticated life science experiment. For instance, we are looking at various ornamental plants, to help provide psychological comfort to the astronauts.

Seeing these plants grow could make them happy, because they would see life developing in the lunar desert.

We are also involved in activities to grow plants in a greenhouse - to grow salad and other foods for the diet - so astronauts could start living off the land. To do this, we need to learn how to recycle some of the water and nutrients.

The European Space Agency's MELISSA project (Micro-Ecological Life Support System Alternative) uses different compartments to recycle wastes from animals, and from this we can grow algae.

Another very interesting plant to grow on the Moon is called Arabidopsis, from the mustard family. It is very resistant, prolific with a short 6-week cycle, and can be cultivated in restricted space.

Its genome has been mostly sequenced, with a large number of mutant lines and genomic resources. Growing on the Moon mustard, algae, and salad would be the start of lunar gastronomy (maybe adding lunar garlic

for French and Italian cooks!).

So the first step to bring life to the Moon would be to grow bacterial colonies, with precursor experiments such as FEMME, followed by more advanced life science experiments on the upcoming lunar landers. We believe this could be done sometime between 2010 and 2015.

What we learn from that can teach us about the problems of growing plants, and developing greenhouses on the Moon. After that, we could consider the next steps to take for animal life and then human. This is how we are going to develop sustainable systems for future human bases on the Moon.

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