Death and life in the Moon: exploring the limits of exobiology and exoecology

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October 9, 2009

The question 'What if an astronaut dies on the Moon?' is scrutinized in the framework of exobiology. As it turns out, the answer prompts to yet another intriguing question.

On 20 July 2009 we celebrated 40 years of the descent of man on the Moon. The extraordinary enterprise was realized by the Americans with the Apollo 11 mission. They repeated it five times more, up to number 17. The exception in the row is Apollo 13. That mission did not succeed but was a great success of human persistence and creativity, to save the lives of its three astronauts, in risk after the explosion of an oxygen tank in the service module.

The Saturn rocket, used to propel the command, service and lunar modules, was gigantic. Its 120 m of height can be grossly compared to that of a 40 store building.

Fortunately, nobody died on the Moon soil. We might well ask ourselves: *what if that happened?*

The Moon is a tremendously inhospitable environment for humans. No sign of atmosphere, let alone oxygen. Regarding room temperatures, NASA's probe Lunar Reconnaissance Orbiter has recently informed us again: from +100 degrees centigrades in daytime to -180 degrees at night.

Incidentally, on Earth, there exist certain organisms — generally called "extremophiles" — that live under extreme environmental conditions, such as those prevailing on the depths of the oceans, in hot springs and ice caps.

Let us now imagine an astronaut that for some reason dies on the Moon surface. The astronaut is an organism consisting of about 10 trillion cells — much more than the number of stars in the Milky Way, around 100 billion. He is not alone, though. It is estimated that the average human body has about ten times as much as that number of microorganisms, sitting mainly in the gut, but also in the skin, in the mouth, and in almost every human organ. They live in our body in a symbiotic relationship, performing a number of useful functions for our health.

In other words, the astronaut dies but this may not immediately be true for his trillions of space-journey companions. We are faced, therefore, with a potentially extraordinary experience of exobiology — biology outside Earth — and of *exoecology.* Figures are astonishing: trillions and trillions of microorganisms — bacteria, fungi, etc — fighting for survival. The theory of evolution by natural selection of Charles Robert Darwin (1809-1882) rests especially on these two ingredients: the fight for survival and a large number of "fighters". Would there be a winner? Would there be then "life after death" in the Moon? Or, would there be an effective and full "pasteurization"?

Anyhow, it is comforting to know that no astronaut died in the Moon, and that the experience in exobiology put forth above happens only in our imagination.

I thank my wife Lu for helpful discussions.