

ON THE ASYMMETRY BETWEEN PROVING THAT A WORLD IS INHABITED AND PROVING THAT IT IS NOT. E. Persson¹, ¹Lund University (The Pufendorf Institute of Advanced Studies, P.O. Box 117, 221 00 Lund Sweden, erik.persson@fil.lu.se).

Introduction: When looking for life on other worlds we are obviously most preoccupied with thinking about how to establish the positive results we hope for. The many faulty claims that have been made about extraterrestrial life through history, and even in very recent times, show us that the question of what it takes to establish that there is or have been life on another world is very important but also very difficult. The opposite question, that is, what it takes to show that there is no life on another world [1], does not seem as fun and has consequently received less attention. It is also as we shall see even more difficult than the positive question. Even so, it is nonetheless important, and it might be even more urgent than the positive question.

The negative question is important for both principal and practical reasons. In principle, it is important for our ability to say at some point that a world is uninhabited and thus add new knowledge to the corpus of scientific knowledge instead of just postponing the judgment indefinitely. Being able to establish that a world is uninhabited is also important for the purpose of resource allocation and to avoid causing havoc for existing life or danger for earth life in connection with future missions.

The asymmetry: Establishing that there is life on a planet, moon or other celestial body, and establishing that there is not, are in spite of being opposite sides of the same coin, two very different types of tasks. The former task can be achieved in the form of a single discovery, but how many “non-discoveries” does it take to achieve the latter? Strictly speaking, no number of failures to find life on a particular world, or in the universe outside our own planet in general, can prove that it does not exist in the same sense that one positive discovery can prove that it exists.

The asymmetry between proving a universal statement and proving an instance is not unique for questions regarding extraterrestrial life. This is a well known problem in the theory of science and it is dealt with in different ways depending on the subject, the methods and the purpose of the research [1-4]. The question for us will be: How is it best handled when looking for extraterrestrial life?

How to handle the asymmetry: That we cannot show that a world is uninhabited in the same way or with the same certainty as we can show that a world is inhabited does not mean that the former is a meaningless task. It still makes good sense to claim that the higher the number of failed attempts, and the better the

attempts, the more justified we are to claim that the world is lifeless.

We should look at the task of establishing that a world is uninhabited as a gradual process asymptotically approaching certainty rather than as a discovery in the traditional sense of the word.

This means that we can in principle assign a degree of certainty to whether a world is uninhabited based on our research. In practice we can at least tell if one set of unsuccessful missions will provide a higher degree of certainty than another set.

In our particular case, the degree of certainty has to be a function of (I) the number of observations, (II) the diversity of observations and (III) the quality of the observations.

We also need to decide which degree of certainty we need in order to be justified to declare a world lifeless. This decision depends on the circumstances. It will for instance take a very high degree of certainty to declare a planet lifeless before we start a geo-engineering project that will substantially alter the conditions for life on the planet. That we need a high degree of certainty does not mean that we can put up the decision for ever waiting for ever more and better results, however. In situations like these there are time constraints to consider. That is, we need an answer before the geoengineering starts, which means we need some upper limit for how long we can go on searching before reaching our decision.

If we want to make it a part of the scientific corpus (that is, claim it as a scientific “truth”) that a world is uninhabited, the situation is the opposite. We do not have to worry about life threatening consequences in the same way and could therefore afford to set the standard a bit lower. On the other hand, we will not be under the same time constraint.

References: [1] Persson, E. (2014) *Challenges* 5, 224-238. [2] Achinstein, P. (2003) *The Book of Evidence* Oxford University Press. [3] Chalmers, P. (1999) *What is This Thing Called Science?* Open University Press [4] Noble, C. E. (1975) *Amer. J. Psychol.* 88, 537-547. [5] Popper, K. (1959) *The Logic of Scientific Discovery* Basic Books.