Can We Even Hope To Do Planetary Protection Effectively? P. J. Boston[1], [1] Earth & Environmental Science Dept., New Mexico Institute of Mining and Technology, 801 Leroy Place, Socorro, New Mexico 87801. pboston@nmt.edu

Introduction: The AIDS virus, the Ebola virus, the fungus that causes White Nose Syndrome in bats, the Chytrid disease in frogs and other emerging microscopically caused diseases have struck us at intervals in modern times and been greeted with a variety of responses. Our track record so far, in containing disease agents in nature and in human populations seems to be pretty poor [1, 2]. However, in highly controlled laboratory settings, we do seem to have a better track record in working with such agents in BSL4 (Biological Safety Level 4) containment settings [3]. Models for Planetary Protection protocols could conceivably be modeled after either or both of these very different situations. Are planetary missions more akin to what we see in nature and in medical events with emerging diseases, or are they more akin to the tightly controlled conditions in containment facilities? We argue that missions can be found along a spectrum that encompasses both those endpoints and can be analyzed on a case by case basis in that context. The product of such an analysis for any given mission scenario can help to guide the development of most-likely-to-succeed practices for specific cases.

Matrix of Analysis: A relatively simple multiphase matrix scheme can be constructed that encompasses the key features of a mission and can guide the mixture of techniques to be applied on behalf of Planetary Protection. It has been pointed out [3] that to assess the relative degree of effectiveness of various containment protocols, one must consider the level being discussed, namely 1) individual items and components in the area of concern which corresponds to individual spacecraft components 2) laboratory level which could correspond for our consideration to the whole spacecraft level, and 3) at the clinical-epidemiological level which would correspond to the natural free environment of extraterrestrial missions. Even on Earth, our assessment of such effectiveness has been found lacking [3]. However, we do know some important things that can be done as a matter of course and that have been identified long ago. These include relative risk analysis of different types of potential microbial contaminants and application of so-called "universal precautions" [4]. In the Earth-based laboratory framework, the containment protocol focuses on universal practices for a given risk level, and should not be dependent upon the nature of any given microbial agent but are designed to contain all organisms of a given risk category. This is precisely analogous to what we are attempting to accomplish with Planetary Protection. On the other hand, the ability to implement such stringency to high stakes situations in the real world like Ebola virus outbreaks has been very difficult and of minimal effectiveness, at least at first presentation of a crisis. In a life detection situation on planetary missions, we may not have second chances for on-the-job training and eventually "doing things right". A contamination event may well not be reversible on certain planets, although some claim that it may be [5], at least in the case of Mars. This is a highly debatable point which currently seems to be more an article of faith than a well-supported stance.

One can counter the points made above about similarities of the Planetary Protection concern to outbreaks of highly destructive diseases. Obviously, in a planetary mission setting, we are not dealing with ill, frightened, and possibly poorly educated populations of unpredictable human beings. This is true. However, anyone who is a field scientist or exposed to the elements in another occupation can attest that Nature herself is an often unpredictable and unruly mistress and presents us constantly with surprises on our own planet. Perhaps this will be even more so on other planets that we know much less well than we know our own home world.

Summary: We must find workable analogies in our own experiences of practice here on Earth that can be applied in a rigorous, yet flexible way to find solutions to the technical and operational challenges of implementing Planetary Protection practices in widely different planetary settings. We can look to our own planet to see how well we currently deal with the analogous cases of emerging diseases, ecological disease epidemics in other species, and closely controlled laboratory facilities to combine these very different arenas into a more workable and sane approach to Planetary Protection needs.

References: [1] E. M. Prescott (2007) *Global Health Governance* 1(1):http://www.ghgi.org. [2] E. Vaughan (2011) *Int J Behav Med* 18:83–87. DOI 10.1007/s12529-011-9160-y. [3] T.G. Kimman et al (2008) *Clin Microbiol Rev* 21(3):403-425. [4] W.J. Buesching et al (1989) *Clin Lab Med* 9**:**351-361. [5] C.P. McKay (2009) Science 323(5915):718.

Earth as a Microbe