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Is Contact a Process?

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Abstract. Both "optimists" and "sceptics" in regard to extraterrestrial intelligence tend to hold the view that we are entitled to an epistemically clear position: either there will be a signal, in the sufficiently general sense, proving the existence of extraterrestrial intelligence (ETI), or no such signal is forthcoming. The distinction, I wish to argue here, is not at all so clear-cut. On the contrary, there are arguments, intrinsic to the subject matter, to the effect that the detection of ETI will be a protracted affair characterized by uncertainty at every step. Such view of SETI discovery mandates different policies from those conventionally discussed in the literature. We should not gear our expectations and publicly promote the view that the Contact will be a clear-cut, Archimedean "Eureka!"-style discovery. In contrast, the tempo and mode of the process of discovery might significantly influence societal and political reactions to the discovery. We should be prepared for such a protracted unfolding of events.

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> I shall not today attempt further to define the kinds of material I understand to be embraced within that shorthand description [hard-core pornography]; and perhaps I could never succeed in intelligibly doing so. But *I know it when I see it*.
>
> US Supreme Justice Potter Stewart in *Jacobellis v. Ohio* (1964)

> We will know alien manifestations when we see them.
>
> An anonymous SETI enthusiast on the Web (2013)

1. Introduction

Detection of extraterrestrial intelligence (henceforth ETI) or the "first contact" or the Contact,[2] has been an accepted and acknowledged goal of SETI projects since their inauguration in 1960 (for

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historical overviews, see Dick 1996; Tarter 2001). Even opponents of SETI have acknowledged that much and actually indicated that the fact that SETI activities have not so far reached that goal confirms their sceptical position (e.g., Tipler 1980, 1981; Mayr 1993; Ulvestad 2002). In doing so, they have *tacitly assumed a particular model of Contact*. Usually, it is the same model used by the SETI proponents and investigators, which considers the Contact as an *event,* rather than a *process*. This somewhat subtle point has already generated a number of confusions and it continues to undermine the SETI discourse in various ways. Contact is usually used synonymously with "the discovery of extraterrestrial intelligence", without much considerations what such a discovery might look like, or even what exactly qualifies as a discovery in this context. In part, this is a relic of positivist strictures against delving into the "context of discovery", which are fortunately much less relevant these days than it was hitherto the case (especially in the times of the founding fathers of SETI). Nowadays, we are very much entitled to ask difficult questions about the nature of scientific discovery and its tempos and modes. These questions bear much relevance to SETI studies and it is quite irresponsible – both cognitively and policy-wise – to ignore them.

There has been much discussion in SETI circles concerning "protocol", "conduct", "post-detection activities", "contact procedures", etc., as well as possible risks for humanity following contact (e.g., Paprotny 1990; Vakoch and Lee 2000; Tarter 2001; McConnell 2001; Michaud 2007; Shostak 2010; Almár and Tarter 2011; Baum, Haqq-Misra, and Domagal-Goldman 2011; Haqq-Misra et al. 2013; Neal 2014; Gartrelle 2015). Most of these works presuppose a particular model or a scenario of discovery and consequently lack sufficient generality (partial exceptions to this trend are studies of Haqq-Misra et al. 2013 and Gartrelle 2015). In contrast to dogmatic views often present in the media and popular science discourses, any critical departures in this respect should be welcomed, as decreasing the risk of groupthink and systematic policy errors.

There are several reasons why reconsidering these issues is highly desirable. We are witnessing renaissance of the *extragalactic* SETI searches, most notably the Ĝ infrared search for Type 2.x/Type 3 civilizations (Wright et al. 2014a, b; Griffith et al. 2015) and the search for stellar-powered Type 3 civilizations by using the Tully-Fisher relation (pioneered by Annis 1999; for new attempts see Zackrisson et al. 2015). Both these original and dynamical approaches share the grounding directly inspired by Kardashev's (1964) classification and the Dysonian SETI (Dyson 1960, 2007; Bradbury, Ćirković, and Dvorsky 2011; Ćirković 2015). There is reason to expect, therefore, that the extent of SETI activities will increase and diversify in the near future, so the present topic will become more and more relevant in the years ahead.

We can even go some steps further and consider epistemological and even ethical consequences following from the discovery of possible extraterrestrial *artefacts*, with all implications of a long-term planning, stable society. Recent controversy over the lack of flux during transits of KIC 8462852 (Boyajian et al. 2016; Marengo, Hulsebus, and Willis 2015; Wright et al. 2015) is just one instance of the possible formulation of explanatory hypotheses directly motivated by Kardashev's scale and its ramifications. It is the prediction following from the overall framework of detectability, Dysonian SETI and the logic of Kardashev's scale that the number of such hard cases in which purely "natural" (i.e., non-intentional) explanations are progressively harder and harder to find will increase with the

[2] I shall use capitalized version ("Contact") for the avowed goal of all SETI projects and activities, the discovery of an extraterrestrial intelligence (i.e., as synonymous with "the first contact").

number and sensitivity of our detectors, in both intragalactic and extragalactic domain. This might have an interesting consequence for the concept of "success" or "discovery" in the domain of SETI studies. In contrast to the conventional image of the "first contact" powerfully suggested by the pop-cultural discourse (e.g., Sagan 1985, and the subsequent movie of Robert Zemeckis) and supported by the orthodox SETI circles, especially radioastronomers (Tarter 2001), and encoded in the famous "Wow!" signal (e.g., Gray and Marvel 2001), we might not have any particular decisive moment of discovery. Rather, we might face slow accruement of "inexplicable" cases without natural or non-artificial explanation, leading gradually to mainstream acceptance of astroengineering as not only legitimate, but even the best explanation.

Therefore, the attempts made recently of classifying and codifying the response to ETI detection or contact (e.g., Michaud 2007; Almár and Tarter 2011) might be incomplete in that they address only a particular mode of discovery, which is not very likely anyway. This, unfortunately, applies to the *Declaration of Principles Concerning Activities Following the Detection of Extraterrestrial Intelligence*, the most frequently cited international document on the topic.[3] In order to achieve better coverage of the complexity of the real issue, and avoid misunderstandings, mispresentations, and confusions which have anyway cost SETI the great deal in terms of respectability, authority, and funding, we need to put the discussion about responses to a broader level. In the rest of this paper, I shall argue that there are reasons to expect that detection and acknowledgement of ETI will be a protracted affair, without any "crucial", "defining", "epochal", "seminal", etc. moments. At least such moments will be visible only much later, on careful and complex historical analysis, not obvious to all contemporaries. Such scenarios are in sharp contrast to those implied, as a characteristic example, by Michaud (2003):

> ***Release of the news that ETI has been detected would provoke a burst of intense public and media interest. Reporters and others would ask officials and politicians not only what they know, but what they plan to do.***

But what if there are no "news" in this sensationalist sense, and yet the discovery of extraterrestrial intelligence is no less real and relevant? Obviously, the debate is *not* about semantics of "discovery" or "detection". There are deeper and more serious philosophical issues involved to which we now turn.

2. Two simplified models

Here I contrast two very rough models of discovery, distinct along the temporal dimension of emergence and acceptance. For more detailed philosophical accounts of this topic see Popper (2002); Kordig (1978); Simon, Langley, and Bradshaw (1981); Lugg (1985); Schaffer (1986); Magnani (2000).

2.1. Eureka! model

Archimedes' legendary *Eureka!* moment is a prototype of the first category. The discovery happens suddenly, "in a flash" or in a very brief interval of time and is obvious, first to the discoverers, and

[3] E.g., http://www.seti.org/post-detection.html (last accessed July 7, 2016).

subsequently to anyone else. Acceptance is usually also quick, since empirical evidence is close at hand, and interpersonal consensus is easy to establish. The discovery is quick, clear-cut, immediately recognizable, manifestly repeatable, illuminating of other problems in its home field and related fields of study. It is a form of *eucatastrophe* ("good catastrophe" in a memorable neologism of J. R. R. Tolkien[4]) or a *positive black swan* (Taleb 2007).

In contrast to a popular view of science, moments like these are exceptions, rather than a rule. It is only a selection effect – it is memorable to evoke naked Archimedes running through Syracuse, or an apple falling on Newton's head – which puts too big an emphasis on the "origin myths" and the role of great personalities, key moments, events, and circumstances in any historical process. These are opportunities for biographers, novelists, movie directors, and other artists, as well as media sound-bytes, but their role should not be overrated. One of the reasons while the distinction between the contexts of discovery and the context of justification remains salient to this day, in spite of almost everything else from the epoch of logical positivism being overturned or changed, is the realization that such tremendous moments of discovery are very few and give an incomplete and highly distorted image of the context of discovery.

2.2. Atomic-theory model

While ideas about atomism originate with Leucippus and Democritus in 5th century BC, the acceptance of the atomic structure of matter was controversial until early 20th century. Prominent atomists of previous centuries, including luminaries such as Descartes, Boyle, Boscovich, Lavoisier, Dalton, and others were not able to decisively persuade natural-philosophical/scientific circles – not to mention wider public – of their times of the veracity of their main thesis (for a historical review see, for instance, Pullman 1998). The turn of the century saw the famous debate between Ludwig Boltzmann and Ernst Mach on the reality of atoms. Einstein's celebrated 1905 work on the Brownian motion was only the penultimate step stone toward realization that only atomic hypothesis can successfully explain the results of our macroscopic experiments.

The scientific community gradually adopted the discovery and engaged in investigating its ramifications. The opponents were not vanquished in a flash – some of them, like Mach or the great physical chemist Wilhelm Ostwald, continued to oppose it well into the 20th century. The most decisive evidence came with the experiments of Jean Perrin, performed about 1908, which left no reasonable doubt in the reality of atoms (Perrin 1913). So, even if we discount ancient and early-modern atomistic speculations, and take as a landmark moment Dalton's lecture of 1803, it took about 105 years for the scientific community to accept the reality of atoms as basic structural blocks of all matter. For those who find this example too extreme, there are many other instances of protracted discoveries. In the long term, perhaps the most significant contemporary discovery in physics, the one of Higgs boson (Dittmaier and Schumacher 2013; Dawid 2015) was such an example, where although a landmark moment occurred in 2012, it was discussed for at least 48 years prior to the announcement, and the period of cautious rechecking the data and confirmation of the discovery is still continuing. A similar case was the discovery of oxygen, which was accompanied by the rejection of the old paradigm of phlogiston and adopting Lavoisier's new chemistry (e.g., Schaffer 1986). Even a seemingly clear-cut case like the discovery of new planet, Uranus, took more than a year (March 13, 1781-late April 1782) to be understood and publicized as such. In all these cases and

[4] Tolkien (1983).

many others, there is a period of years to decades in which the novelty diffuses and more or less vigorous debate on merits and demerits of new explanatory hypothesis goes on. The diffusion process is slow, uneven, uncertain, and risky. Even more, at each step it could be influenced by extrascientific factors – and this can lead to favouring some research strategies over others in a manner not entirely supported by rational analysis (Perovic 2011).

3. Arguments for slow, atomic-theory model in the case of ETI

Why would one expect gradual, incremental, atomic-theory model to be applicable to ETI? In contrast to expectations fuelled by science-fictional drama, probability of direct contact between Galactic civilizations is most likely vanishingly low. Probability of receiving a message specifically directed to us is also quite low, as is the probability that we shall be able to both intercept *and* decipher internal messages of advanced technological communities (e.g., Bates 1978; Ulvestad 2002). This does not mean that SETI targets are truly absent: it just means that our choice of strategies is perhaps poorly appropriate for the job. Hence many recent calls for an overhaul of the orthodox SETI methodology (e.g., Dick 2003; Davies 2010; Bradbury et al. 2011; Ćirković 2012).[5]

Perhaps the most important astrophysical datum of relevance for SETI so far is the age distribution of Earthlike planets in the Galaxy (Lineweaver 2001; see also Lineweaver et al. 2004). As we had intuitively expected, precise calculations showed that the median age of potentially habitable planets is almost 2 billion years greater than the age of the Earth. This has tremendous implications for our SETI thinking, although they have never been entirely elaborated so far (see the critical discussion in Ćirković 2012). If most potential SETI targets are much older than ourselves, chances of receiving an intentional message or intercepting their communications are slim indeed. What we could do, in principle, is to detect their impact upon astrophysical environment, notably in the form of astroengineering traces, manifestations, and artefacts. This applies to the hypothetical extragalactic civilizations as well (cf. Armstrong and Sandberg 2013).

If we are talking about recognizing traces, manifestations, and artefacts, it is crucial to realize that such activities have always been *slow*. Even for cases in human history, we have had trouble recognizing the importance of artefacts of other human cultures. The Rosetta Stone took 23 years for its crucial importance for deciphering ancient Egyptian hieroglyphics to be understood. Michaud (2003) cites the example of the Dead Sea Scrolls which were published more than half a century after being discovered in a similar context (although there were some additional complications in that case). For alien manifestations or artefacts, with no common evolutionary background or species-wide constants, the period of detection, recognition, and interpretation could easily last centuries.

Further argument could be made from limitations of our astronomical knowledge. Astronomy is an observational science, whose insight in the physical nature of particular celestial bodies is often limited. While it has achieved tremendous results in the course of human history and was often at the forefront of great revolutions in human thinking, there has often been specific kind of uncertainty related to different interpretations of the observed phenomena (for some classic examples see Bondi 1955). So, if conclusions about controversial phenomena like the transits of KIC

[5] An early precursor in this respect from the pen of one of the SETI "founding fathers" is Kardashev (1985).

8462852 are ambiguous – as they are likely to be – it could take a long time and many expensive long-term follow-up projects to reach expert consensus.

Contact-optimists are fond – since the times of Sagan and Shklovsky – of emphasizing the tremendous advances made in observational astronomy, which are entirely uncontroversial. What is far less appreciated is the simple fact that the astronomical knowledge in and of itself is insufficient for Contact; at some point it may even be counter-productive, since the richness and complexity of discovered and explained *natural* phenomena may mislead the scientists into reflexively believing that *any* observed anomaly could be explained entirely in naturalistic, non-intentional terms.[6] As noted by Stanislaw Lem in his last great novel, *Fiasco*:[7]

> ***Astrophysics, besides, had advanced to the point where it possessed sufficient hypotheses to "explain" every kind of observed emission without resorting to the existence of other beings as the senders. A paradox arose: the greater the number of theories astrophysics had at its disposal, the more difficult it became to prove the authenticity of an intentional signal.***

In other words, in sharp opposition to obscenity (in the legal context, as described by Judge Stewart) and to hopes of many naïve SETI-optimists, we may *not* know alien manifestations when we see them. There is no simple, obvious way out of this difficulty, except to build better and more detailed quantitative models of each particular astroengineering project and their observable signatures. In contrast, conventional contact scenarios betray not only the usual anthropocentrism, but an appalling poverty of imagination as well. It is not surprising that SF authors went some steps ahead of the orthodox SETI science; I shall mention here just two distinguished examples, the already classical novel of Stanislaw Lem, *His Master's Voice*, and the world of Alastair Reynolds' *Revelation Space* trilogy (Lem [1968] 1999; Reynolds 2000, 2002, 2003). Lem's novel gives us setting as orthodox and inconspicuous as one might expect in a SETI-related novel: the alien message has been received, the government keeps a tight lid on everything related and forms a super-duper multidisciplinary team of scientists and engineers to decode its meaning. But then Lem proceeds to ironically undermine this most conventional of all classic SETI clichees: although decoding of some very minor parts of the message offers a host of new (and allegedly practical) insights, we still cannot be absolutely sure that the message itself is intentional and not the product of a weird, but entirely natural, cosmological process! A guest from another research team proposes this naturalistic interpretation, to visible disturbance of Lem's narrator and his colleagues from the original group. The dilemma stays *unresolved* in the novel, even when the veil of secrecy is removed and all documents become public. We clearly cannot treat this form of Contact as an event – rather, it is a continuous process. Lem also shrewdly points out how extrascientific factors (in this case the Cold-War paranoia) act to prolong the overall process and interfering with the evaluation of different explanatory hypotheses.

Reynolds' trilogy goes further still in undermining the conventional narrative of the sudden, momentous Contact. A major protagonist is Dan Sylveste, an archaeologist searching for artefacts of

[6] Here and elsewhere in this paper, I consider intentional to be opposite of natural *in the SETI context*, i.e., not in the general context of, say, metaphysics or theology. Extraterrestrial intelligence is taken to be a product of Darwinian evolution, so while strictly speaking all its artifacts are *eo ipso* natural as well and explainable (in principle) in naturalistic terms, the distinction between processes not involving intelligence and intentionality and those which do is sufficiently intuitively clear.

[7] Lem (1987), p. 88.

the long-gone Amarantin civilization, which apparently went extinct when their sun became nova many millennia before the advent of humanity. Within the context of the *Revelation Space*, humans have not encountered any other intelligent species in the classical SETI sense, but have discovered at least two manifestations of advanced intelligence, so-called Pattern Jugglers and the Shrouds. The latter are regions of extremely *artificially* warped spacetime, effectively impenetrable from the outside. No one in human space understands their true nature and all – or almost all – attempts at revealing their secrets and getting the alleged treasures within remain futile. After a series of convoluted events, one of the outcomes of Sylveste's adventures is the epochal realization that mysterious Shroud-builders are in fact the Amarantin – a splinter group which achieved space flight and inadvertently triggered the destruction of most of their species. Thus, the discovery in the usual sense of finding explanation for particular observations (here, the Shrouds) requires joining astronomical *and archaeological* data, as well as apparent *decades* of dilligent research.

This is a huge material for future studies of both literary critics and SETI students searching for ideas and inspiration. The fact that we may find such well-developed and well-reasoned scenarios in the realm of popular culture should neither surprise us nor discourage scientific approach to the same cluster of topics.

4. "It will happen this way…"

A plausible scenario might be that gradual accumulation of anomalous cases such as KIC 8462852 leads, on the timescale of years to decades, to the situation in which non-intentional hypotheses explaining such phenomena have been rejected one-by-one. The pool of such non-intentional hypotheses will be eventually exhausted, except for extremely contrived scenarios. During that entire time interval, the intentional hypothesis remains untested and there is no further confirmative or disconfirmative evidence as far as it is concerned. In such a situation, there will be a gradual pressure to acknowledge the intentional hypothesis as the best explanation, and the existence of ETI will be the major inference from this best explanation. There will be no particular moment, no ground-breaking event, no "Wow!" excitement connected with the momentous discovery – just routine research work, weeding of unsatisfactory hypotheses by gradually accumulated empirical data. Under such scenario, there might possibly be no big hurry to explicitly acknowledge likelihood of ETI being discovered, but in the same time there might be no big resistance to such an announcement. There would be several peer-reviewed technical papers, first focusing on the observational side of "anomalies" and the lack of capacity of accepted astrophysical theories to explain them. Issues such as level of confidence in conventional explanations, number of adjustable parameters in the models, uncertainties of empirical measurements (especially those like interstellar distances and ages of stars, which are often very difficult to pinpoint precisely) and any possibility of alternative *naturalistic* theoretical explanations will be highlighted at this stage. There will be no need for secrecy, special precautions, or following any specific protocol – just as there has been no such need in other scientific controversies in the past.[8] While some specialized scientific journalists may show interest at

[8] Even when such controversies involved, at least half-jocularly, explanations in terms of "little green men", as in the case of the discovery of pulsars in 1967 (e.g., Longair 2011).

this stage, it is by no means obvious that it will make screaming headlines, even in popular science journals, not to mention general media.

In the anomalies turn out to be non-negotiable within the accepted theory – and alternative naturalistic theories – stage will be set for the artefact hypothesis as the best explanation of observations. This may or may not be accompanied by strong resistance within the astronomical community (for the concept of interstellar archaeology, see e.g., Carrigan 2012; Davies 2012; Jones 2015). If the resistance is strong, we may justifiably talk about the *controversy* in science, similar to other well-known controversies, like the one in mid-20th century cosmology between the supporters of the Big Bang and the steady state theories of the expanding universe (e.g., Kragh 1996). The amount of resistance will be dependent on a host of social, cultural and political circumstances, which are of course not predictable. We may expect – as has been the case in several instances in the history of science – that such extra-scientific factors are more or less carefully *disguised* as internal, scientific arguments. This phase might be quite protracted and we may have to wait for years for the "critical mass" of support for the artefact/intentional origin hypothesis to be gathered. There will likely be powerful conservative forces which will demand ever more observing runs and empirical data, which will certainly take time. During this phase we may expect gradual increase in media and general social interest in the issues involved.

After the critical mass is reached, one may expect gradual normalization and acceptance of the intentionality hypothesis. Further observations will bring further corroboration, and it is in this phase that the eventual Contact proclamation will be made. This might be years and perhaps decades after the initial anomalies are detected and there will be more than enough time to carefully consider the ramifications of the existence of such-and-such extraterrestrial technological civilization. It might also be considered possible that the civilization itself went extinct some time ago and that the anomalies are consequences of old artefacts and activities undertaken thousands to millions to billions years ago. Reception of such a hypothesis is likely to be much different than in the case of an active or even dynamically expanding contemporary civilization; again, this case has not been covered (not to mention seriously modelled and analysed) in the SETI literature so far.

If anomalies turn out to be statistically significant not only in their individual properties, but in their number, we may reach the next stage of insight, namely how general are those parts of the overall astrobiological landscape (cf. Cirković 2012) containing artefacts and astroengineering feats postulated by the intentionality hypothesis. We can speculate that a serious and massive observational SETI effort will be mounted by that point, with wealth of new results which are likely to overturn many of our current prejudices and common places. Of course, this will be accompanied by much greater impact of society, culture, politics, and religion – which is exactly what SETI circles should be prepared for.

Finally, we may enter the period described humorously by Alastair Reynolds in his "essay" in *Nature* (Reynolds 2005), in which discovery of a new advanced technological civilization by a group of researchers is met with pedantic indifference – almost boredom – on the part of a fictional peer-reviewer. It is an old hat, he tells them, go and do *statistical* analysis of behaviour of *an ensemble* of advanced civilizations, don't waste our publication space by reporting *individual* cases! While obviously making a joke at the expense of those regarding SETI as an outlandish pseudoscience, never to be integrated into "normal" science, Reynolds makes a deeper philosophical point here:

history of science teaches us that everything is eventually normalized. Tycho Brahe observed the supernova of 1572 and the "Great Comet" of 1577 as sensational and completely unique events which defined the whole new classes of celestial occurrences with cosmological and metaphysical ramifications; nowadays, hardly anyone bothers (even among astronomers) when a discovery of a new comet or another supernova in a distant galaxy is reported by robotic telescopes.

5. Discussion

I have argued that slow, incremental progress toward the discovery of ETI is *at least as realistic* a prospect as a sudden, epochal discovery to be announced *urbi et orbi*. This should be put in context of huge difference in attention and research activity invested in favour of "sudden, epochal Contact" in contrast to the incremental, protracted process. The latter option has not been discussed much in the literature so far; for example, none of the five scenarios of the discovery of extraterrestrial life analysed in the recent study of Gartrelle (2015) correspond to the most probable outcome of the Dysonian SETI, although his #2 ("extraterrestrial artefact in the Solar System") has some relevant features as well. The present manuscript can be regarded as an attempt to rectify the imbalance at least a bit, but much more work needs to be done to prepare scientific, media, policy-making and other audiences for the protracted, process-like Contact (cf. Ćirković 2012 for an analogous point in the context of Fermi's paradox).

But it is not all about fully rational scientific realism. A few words are in place why this model of incremental discovery is not only realistic and probable, but also a *desirable* one as well. Since SETI is still in its infancy, there still exists a measure of liberty for intentionally and institutionally steering the course of events toward the most desirable outcome. So, to the degree to which such steering can succeed, it is our moral duty as well to investigate the whole question.

In many ways, the discovery of ETI under the atomic-theory model is likely to be more beneficial and even healthier for the human society on this planet. Not only will it demotivate most of the media nonsense and sensationalism, but it will of itself provide a set of concrete local strategies for dealing with next steps. The *process* of Contact will be seen clearly as the scientific process, thus helping achieve sharp delineation from the religious, political, or any other kind of takeover. Contact as a process is diametrally opposed to the picture of Contact as a revelation, which is exactly what SETI science needs to do. Unfortunately, in the course of SETI history thus far, its image has been severely tarnished by added or implied (quasi)religious elements (e.g., Drake 1976). Hostile criticism – not healthy scepticism – of SETI has played exactly the revelation card in order to disparage the whole enterprise as quasireligion or religious substitute (e.g., Tipler 1981; Basalla 2006). There would be no opening for that kind of nonsense in the model of gradual, process-like Contact. Irrational, visceral opposition to SETI should be denied the opportunity.

Adjustment to our not being alone is also something which needs time, if we are to derive maximal utility from it. Many human institutions are still based on rather crude anthropocentrism and human exceptionalism, which makes progress in field such as environmental protection or animal rights or even artificial intelligence slow and difficult, as it is. Therefore, when we realize that we are not alone, our cultural, social, legal, and political systems might need adjustment in light of the new

reality. This will be much more efficient and fruitful process in the limit of very gradual, atomic-theory-like model of discovery than under the eureka!-model. Adequate institutional and legal framework could be built, benefitting from careful and prolonged deliberation. Such deliberation could include more actors and proceed in a thoroughly democratic manner, unlike the case of a sudden Contact, requiring centralised and narrow decision-making by whichever executives are contingently employed at the moment.

Finally, while we cannot know what lies in the future of astrobiological and SETI research, we might wish to consider the reasons for being as prepared as possible for various scenarios, including those in which there is no particular moment of discovery. Not only for merely prudential reasons, but also as an antidote to sensationalism and unwarranted wishful thinking, so much present in discussion of SETI-related issues. Even if the very first Contact is indeed an *Eureka!* moment, this might not be the case with the second, third or any subsequent extraterrestrial intelligences we discover. Although the preceding arguments indicate that this is not very probable, even if it were the case, it would have been worthwhile to investigate procedures and policies for a prolonged contact model as well.

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