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On a morphology of contact scenario space

Joseph Voros

Faculty of Business and Law, Swinburne University of Technology, John Street, Hawthorn, VIC 3122, Australia

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ABSTRACT

The purpose of this paper is to explore the possibility space of scenarios of 'contact'—the discovery of extra-terrestrial life, whether intelligent or not—using a morphological approach utilising seven principal parameters, chosen both for their descriptiveness of the scope of possibilities, as well as for their relevance in examining potential societal impacts arising from different scenarios, including, for example, the proximity of the discovery. Several classes of contact scenario are examined, and existing approaches to the search for extra-terrestrial life and intelligence are situated within the range of possible search strategies and targets illuminated by this particular choice of parameters, as are some examples of contact scenarios from popular culture. The resulting possibility space can also suggest new search strategies and potential targets, one of which is highlighted—that of 'galaxy-scale macro-engineering'. It is hypothesised that an example of this might already be known to us, namely the intriguing galaxy 'Hoag's Object' (PGC54559), and some specific empirical observations are suggested in order to test this hypothesis. Some possible extensions to the parameters used, as well as some preliminary observations about modelling the range and extent of human societal *responses* to contact, are also made.

1. Introduction, motivation and background

This paper continues a train of thought outlined in an earlier paper a decade ago, where the idea was raised of conducting a detailed analysis of the parametric space of the possibilities for the discovery or detection of extra-terrestrial life—whether intelligent or not—in order to examine and prepare for the implications of such an event (Voros, 2007). The method employed is based upon the 'morphological approach' to problem definition and research developed by the legendary astrophysicist Fritz Zwicky during the first half of the 20th century (Zwicky, 1969), as is described extensively elsewhere in this Special Issue. In brief, since the morphological method is founded upon the systematic enumeration and examination of all conceivable possibilities within a 'possibility space', it is very well-suited as a basis for thinking systematically about the myriad possibilities inherent in the search for extra-terrestrial life or intelligence. A detailed introduction to morphological methods in the context of Futures Studies and thinking about the future possibilities and evolution of social systems, was given in (Voros, 2009), although the reader will not be assumed to be familiar with that work; instead, aspects of the discussion there will be briefly re-iterated here where they are pertinent for our present purposes. In addition, as detailed discussions of the morphological approach can also be found elsewhere in this Issue, we will here mainly focus only on any notable differences from the usual approaches.

Historically, the modern search for extra-terrestrial intelligence (SETI) was conceived, designed and executed from the technological base which our civilisation possessed in the mid-to-latter part of the 20th century CE. It is usually taken as dating from the 1959 "landmark paper" (see, e.g., Dick, 2006) of physicists Giuseppe Cocconi and Philip Morrison (Cocconi and Morrison, 1959) which proposed searching for interstellar (radio) communications, and was a product of our knowledge and understanding of the possibilities of life and intelligence from that era (for reviews of SETI, see, e.g., Morrison et al., 1979; Tarter, 2001; Tarter et al., 2010). Thus, the initial assumption-base and focus of SETI was understandably on biological beings with radio telescopes who might be broadcasting deliberately, or whose domestic electromagnetic radiation broadcasts might be 'leaking' into interstellar space, such as are our own.

Much has occurred in the intervening time, including the arising of the related field of 'astrobiology'—the broad multi-disciplinary study of the possibilities for life (not necessarily intelligent) in the universe (see, e.g., Chyba and Hand, 2005; Domagal-Goldman et al., 2016; Mix et al., 2006; Plaxco and Gross, 2006; Tarter, 2004), of which SETI could reasonably be considered a specialised sub-activity that is specifically concerned with looking for signs of *intelligence*. There has in recent years been a growing feeling in the SETI community that the search parameters initially laid out historically since the inception of SETI might need widening beyond the default view of searching for forms of electromagnetic radiation possessing certain characteristics emanating from the vicinity of certain types of stars (see, e.g., Davies and Wagner,

E-mail address: jvoros@swin.edu.au.

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2013; Shostak, 2010; Ćirković, 2006; Dick, 2009, and many references found therein, among numerous others). More recent work in SETI has even argued that *biologically*-based intelligence itself may be a relatively short-lived stage of development for truly long-lived intelligent species (Dick, 2003). The concept of 'The Singularity' (Broderick, 1997; Eden et al., 2012; Kurzweil, 2006; Vinge, 1993)—well-known to futurists since the early 1990s, which posits accelerating bio-info-nano-technological progress leading to human development advancing to a 'post-human' stage within several decades—has been extended to the idea of *post-biological* intelligence in the universe more generally (Dick, 2009; Shostak, 2010). Thus, it is suggested, conventional or "orthodox" SETI (Bradbury et al., 2011), in looking for radio signals from 'suitable' stars that may host 'suitable' planets, may in fact be hunting what might be a very short-lived prey (Shostak, 2010). Hence, it is argued, the SETI enterprise may need complementing with newer concepts and search strategies to widen the possibility of a successful detection. Indeed, SETI pioneer Frank Drake himself has said that the thinking of *futurists* may be needed to help expand our conceptions of what to search for, and where to search, for truly long-lived civilisations (Drake, 2009).

The approaches currently in use in the search for extra-terrestrial life (SETL)—i.e., not necessarily intelligent and so part of the broader astrobiological enterprise, rather than of SETI *per se*—are generally aimed at detecting traces of life either in our own Solar System (e.g., Mars, or the satellites of Jupiter and Saturn) or in the atmospheres of the ever-increasing number of known extra-solar planets ('exoplanets'). SETI scientist Seth Shostak has suggested (Shostak, 2009b) that these three types of search—the two SETL approaches for what he calls "stupid life", and SETI for *intelligence*—are each likely to yield a positive result within a couple of decades. If so, we had better start preparing ourselves for the consequences of such a detection—what is generically referred to as 'contact' (Harrison, 1997; Harrison and Dick, 2000)—especially if it turns out to involve intelligent entities (Tough, 2000). This paper is intended to be a contribution to that process.

The purpose of this paper, then, is to examine the parameter space of scenarios of 'contact'—the discovery or detection of extra-terrestrial life, whether intelligent or not—so as to expand our thinking around the possibilities that may exist for this event as well as forming a basis to consider the implications (broadly conceived) which these possibilities might hold for our civilisation. In the following section (for the sake of completeness and the unity of this paper), some of the properties of the morphological approach as they are relevant to the discussion here will be briefly sketched. Following this, a number of parameters which may be used to characterise the possibility space of contact are discussed and outlined, and an initial set is chosen to demonstrate the method and undertake the preliminary analysis. These are then examined to locate past and current approaches to SETL and SETI within the parametric space, and we also briefly consider contact scenarios as they have been depicted in popular culture. The use of a morphological perspective is able to bring into view other potential search strategies and new directions or targets to pursue, and a particular configuration sub-space of the parametric possibility space is highlighted in this regard. This configuration sub-space is identified with characterising 'galaxy-scale macro-engineering' (Voros, 2014). It is hypothesised that the beautiful ring galaxy known as 'Hoag's Object' (PGC54559) might perhaps be an example of such galaxy-scale engineering, and some suggestions for more detailed observations of this object for any signs of engineering activities are given. We very briefly consider the next logical follow-up to the analysis of contact scenario space, namely the range of possible scenarios of the human societal *response* to any actual contact, and we conclude with an invitation to interested others to expand and adapt the preliminary schema shown here in order to deepen the conversation around thinking about the implications for human society that 'contact' would have, as well as to, hopefully, take a closer look at Hoag's Object, 'just in case'….

2. Outline of method

As expounded elsewhere in this Special Issue, the 'morphological approach' was developed by Fritz Zwicky beginning in the 1930s (Zwicky, 1947, 1948, 1967, 1969). At its heart, the morphological approach attempts to systematically examine the entire range of possible combinations of the various attributes or dimensions of the area/topic of interest. In practice, this means attempting to exhaustively list all of the independent dimensions or attributes that may be used to characterise the situation or focus of interest. These dimension/attributes Zwicky called 'parameters', and there could in principle be any number of parameters, each of which could have any number of discrete 'values', which need not necessarily be numerical—so, in this view, the possible range of parameters and their possible values has no *a priori* limit. In essence, *every* aspect of the focus of inquiry could be considered as 'contingent' rather than 'fixed' and therefore open to consideration as a possible parameter with multiple possible values (Zwicky, 1947). This sort of 'contingency thinking' immediately primes the mind to open up to a much wider range of possibilities to consider, and when applied to the basic 'shape' or 'morphology' of the 'space of possibility' can lead to novel combinations and potentially new ideas for exploration (Zwicky, 1969).

In more precise language: Let there be n parameters which taken together characterise an exhaustive description of the area or focus of inquiry. Each individual parameter p_j in the full set of parameters $p_1 \ldots p_n$ has a positive integer k_j of specific values that thereby define it. Both the parameters and the parameter values should be as independent and mutually-exclusive as possible (what we might intuitively characterise as being 'as "orthogonal" to each other as possible'). These n parameters p_j thereby generate an n-dimensional combinatorial 'morphological space' or 'field' that consists of every possible combination of every value of every parameter, sometimes also known as a 'Zwicky box' (Ritchey, 2006). If one specific value is chosen for each parameter in the full set, this is known as a 'configuration' within the morphological space/field, which is therefore also sometimes known as a 'configuration space'. The total numerical value of distinct possible formal configurations so generated can be found from the product of all the values k_j, so that, therefore, even a relatively small number of parameters with relatively few values can nonetheless lead to a very large number of combinatorial possibilities. In practice, there are techniques that make the process of examining the large number of possibilities much more tractable than might first appear to be the case given these large numbers (see, e.g., Coyle, 2009; Rhyne, 1995a; Ritchey, 2006). More details about the formal properties of morphological combinatorial spaces can be found in (Ritchey, 2010, 2012), while a slightly-expanded version of the discussion in this section can be found in (Voros, 2009), upon which it is based.

One useful way to represent the morphological space is as a tabular array, with each column representing one parameter, and with each entry within a column representing one of the parameter values. As each parameter may in general have a different number of values from the others, the columns are not generally of the same length. Most recent work on morphological methods has used this form of representation (e.g., Rhyne, 1974, 1981, 1995a; Rhyne and Duczynski, 2008; Coyle, 2004, 2009; Coyle et al., 1994; Ritchey, 2006, 2009b, 2010), and this convention is also used here. (Zwicky usually rendered the parameters as rows of varying lengths set out underneath each other (Zwicky, 1947, 1948); in this regard, also see Godet (2006); Godet et al., 2003).)

In the variant of morphological analysis known as 'Field Anomaly Relaxation' (FAR) developed by Rhyne (Rhyne, 1974, 1981, 1994, 1995a,b), and subsequently used by Coyle and co-workers (Coyle, 2003, 2004, 2009; Coyle and McGlone, 1995; Coyle and Yong, 1996; Coyle et al., 1994), the different parameters (there called Sectors) are each represented by a unique letter, and a limit is imposed of six or seven parameters/Sectors in total, while the specific actual values taken