Searching for SETI: The Social Construction of Aliens and the Quest for a Technological Mythos

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ABSTRACT

This dissertation uses Actor Network Theory (ANT) and Stark and Bainbridge's rational choice theory of religion to analyze an established but controversial branch of science and technology, the Search for Extraterrestrial Intelligence (SETI). Of particular interest are the cultural, and sometimes religious, assumptions that its creators have built into it. The purpose of this analysis is not to discredit SETI, but instead to show how SETI, along with other avant-garde scientific projects, is founded, motivated, and propelled by many of the same types of values and visions for the future that motivate the founders of religious groups. I further argue that the utopian zeal found in SETI and similar movements is not aberrant, but instead common, and perhaps necessary, in many early-stage projects, whether technical or spiritual, which lack a clear near-term commercial or social benefit.

DEDICATION

In memory of my parents, James E. and Ann Bozeman, who taught me to appreciate that which may not be quickly understood.

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TABLE OF CONTENTS

LIST OF FIGURES

"Where there is no vision, the people perish."
– Proverbs. 29:18a KJV

INTRODUCTION

Some two decades ago I attended a scholarly conference on the sociology of religion where I had the privilege of seeing a paper delivered by Susan J. Palmer, a scholar of new religious movements. In her analysis of a new age group called the Institute for Applied Metaphysics, she noted that the leader of the group, an older woman, had a partner some two decades younger. Over time a trend developed within the community in which such pairings were seen as being a sign of spiritual advancement within the group, even though this practice was not initially directly related to the core beliefs of the group. Palmer observed that founders of new religious movements not only imprinted upon the group, but could also use their movements as avenues through which to explore both personal concerns and also to experiment with possible solutions to social concerns shared with the broader society (Palmer 1994:105-32 and 209-64).

Later, when I moved into the field of Science and Technology Studies (STS) I was struck how parallels exist between persons founding new religious groups and persons starting new scientific and technological enterprises. In each case a founder or group of founders see a need that is not being met by society; strategies and techniques are then formulated to garner the resources required to address this perceived need. My intention in this project has thus been to choose an established but still controversial branch of science and technology—the Search for Extraterrestrial Intelligence (SETI)--and examine the reasons that SETI was seen as a worthy and important venture by its organizers and participants for a period lasting more than a century. In particular I wish to

examine the underlying cultural, and sometimes religious, assumptions that its creators have built into it.

My purpose in doing this is not to discredit SETI or any of the other avant-garde technologies discussed in this dissertation. Generally speaking, the researchers and technologists discussed in this dissertation took pains to ensure that their work did, and does not, violate generally accepted scientific or technological principles of their respective eras, claims which I for the most part accept.[1] Rather, I am concerned more

[1] I do not mean to say that I necessarily agree with the aims and goals of their research; I am asserting that researchers and technologists conformed to the dictates of scientific and technological material rationality of their time periods and should thus be deemed "scientific." In contrast, many of the more spiritually-oriented groups mentioned later in this dissertation (Swedenborgians, Raelians, UFO-centric religions, etc.) generally hold that such constraints and limitations are overly limiting, and are thus willing to operate outside of such boundaries. While some scientists and philosophers of science would call the latter group "pseudoscience," I am reluctant to do so because the term is invariably used in a hostile and disparaging manner (Gordin 2012:206-12); rather, I feel that that term "extrascientific" ("beyond the bounds of accepted science") more useful.

Another concern with the scientific and technological groups with I discuss here is not that they are not "real" scientists, but rather that they are involved in "pathological science" (science undertaken by a scientist of pure intent, but betrayed by self-delusion) or "junk science" (science undertaken by a scientist of pure intent, and which does not contradict accepted science, but which is under-supported by hard data, or which is simply unimportant and thus a waste of money) (Park 2000:9, 69). Individual self-delusion is readily recognized as being a threat in all ventures, both scientific or not; however, collective broad-scale self-delusion, I would argue, is more complex, and appears to be much more readily detectible after the fact, than at the time. The breadth of the applicability of the term "junk science," on the other hand, suggests that is in effect a subjective and invariably negative evaluation that states more about the emotional state of the speaker than about the thing described, as it does not seem to be possible to define junk science through a list of key core characteristics. Park, for example, holds that ESP research is junk science because it attempts to extract a tiny, and perhaps non-existent, signal out of background noise, often with contradictory results between research groups; however, he views research on global climate change, which similarly seeks to extract a tiny, and perhaps non-existent signal out of background noise, often with contradictory results between research groups, with forbearance. In a different realm, physicist C. Everitt (1992) writes with obvious satisfaction about his work on Gravity Probe B, a satellite designed to test certain aspects of theory of general relativity using gyroscopes. Everitt wrote with obvious pleasure about the "elegance" of the solutions to a variety of technological challenges; eventually the probe was launched after some fifty years of planning and construction, the expenditure of $750,000,000.00, and seven near-cancellations. By many measures this probe is technical and scientific marvel. At the same time, it could be viewed as a perfect example of "junk science" in that it merely confirmed an expected a result about which there was little doubt; indeed, as one anonymous critic cogently observed, if the probe had produced differing results from those expected, the probe would have been deemed defective and the data simply

about scientists and technologists select problems to pursue. In particular, I wish to show how new scientific and technological enterprises, of which SETI is one example, may be founded, motivated, and propelled by values and visions for the future that are remarkably similar to those that motivate the founders of religious groups, even though the scientific and technological means which they employ are based in a conventional functional-utilitarian understanding of the world.[2] What I argue is that the zeal and vision found within SETI are not aberrant, but are instead characteristics of most start-up projects, whether technical or spiritual, which lack obvious near-term commercial or social benefit; rather, they are attempting to use technology to answer questions about humanity's meaning and purpose in the universe. Further, SETI's success at finding an audience (both positive and negative) demonstrates that these concerns are shared both within the science and technology community, and within the broader society.

Science and Technology as Social Forces

Science and technology are profoundly ambiguous. On the one hand, they are conservative, using accumulated empirical knowledge to address pressing wants and needs for society and thus supporting the established social order; the development of

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discarded (Blackstar 2011), especially since expected approximate values for the data had already been calculated using several other experimental means. I thus conclude that an attempt to define non-obvious cases of "good" vs. "junk" science on the basis of either objective merit or social utility will likely founder due to the subjective and socially constructed nature of what counts as "sufficient evidence" or as "useful." Indeed, this harkens back to a decades-long debate within the philosophy of science to define a single coherent scientific methodology, an effort that failed as it became clear that different disciplines of science have different means and criteria by which certified knowledge is produced (Laudan 1987; Bloor [1976] 1991; Kuhn [1962] 2012).

[2] More specifically, SETI researchers, as well as most of the other groups described later in this dissertation (cryonicists, eugenicists, space colonization advocates, etc.) confine their tools and techniques to those accepted within conventional scientific practice; they thus repudiate "alternative" sciences and technology such as psychic phenomena and UFO-ology (Fricke 2004).

vaccines, and even of atomic weapons, are examples of such endeavors. However, science and technology may also be surprising as well, acting to disrupt society. Darwinism and relativity each elicited tremendous cultural responses, even before practical applications of the theories were imagined; in the technical world, personal computing began among obsessive hobbyists, with little regard for utilitarian application.

Puzzlement about the nature of technological and scientific progress has not been confined to non-specialists outside of the field. A number of philosophers, scientists, historians, and sociologists have tried to produce generalized definitions of science, technology, and progress, generally with unsatisfactory results. Early efforts tended to view mathematical physics as a Platonic ideal, with other sciences and technologies being viewed as secondary derivations. Social interactions were similarly idealized around the "Mertonian norms" of communalism, universalism, disinterestedness, originality, and skepticism (Merton [1942] 1973). Later work, however, revealed that such models of science and technology did not resemble anything like what was actually found in laboratories and research organizations (Mulkay 1976, Latour and Woolgar [1979] 1986). Mitroff's work in particular found that among leading Apollo lunar scientists, "counter-norms" such as emotional commitment, particularism, and secrecy were present at levels approaching the comical (Mitroff 1974).

Recent investigations have thus placed much more emphasis on empirical observations of the social, political, and historical contexts of scientific and technological work. While works of this type have certainly led to a less idealized understanding of the history and process of technoscientific development, the stories that emerge are also incomplete; earlier appeals to an abstract and progressive scientific method have been

replaced by atomized stories of careerism, local and national politics, and individual idiosyncrasy (cf Shapin and Shafer 1985; Latour 1987; Biagioli 1993; Pickering 1995).

My work here attempts to bridge this divide. Specifically, I seek to demonstrate and describe the way in which researchers ally broadly shared extra-scientific tropes[3]—social, religious, literary, etc.--and personal interests and concerns with utilitarian scientific and technological knowledge, skills, and abilities to create a variety of new enterprises, both scientific and not, which address the aspirations and desires of both the researchers themselves and of socially influential groups within the broader society. Researchers and technologists are thus motivated by both material and spiritual, emotional, and aesthetic desires, and the ventures that they create are designed to support both as well, even as they strive to abide by the constraints dictated by the material world. This inclusion of extra-scientific visions should not be viewed as idiosyncratic adulterants to some "pure" technological or scientific process but instead as integral to the development of an enterprise. Indeed, elements of zealotry—both individual and collective—are often required for a new idea or project to survive in the face of competition, or even apathy, from the surrounding professional and social world.

To this end I have chosen in this dissertation project to examine a contentious area of scientific and technological inquiry: the Search for Extraterrestrial Intelligence (SETI).

[3] I use the term "extra-scientific" to denote something which are not materially essential to the physical existence of a particular artifact or technology. However, I wish to avoid traditional terms, such as "non-scientific" or, worse, "pseudoscientific," because the latter terms imply a hierarchy of value in which what really "counts" is the material, and the rest is either interference or decoration. Instead I would argue that the personal and social meanings of artifacts and technologies are, on the whole, equally as significant as the functional utilitarian nature of the artifact or technology itself. As Pinch and Bijker (1987) show in their foundational work on the development of bicycles, the perceived social role and purpose of a bicycle determined what constituted a "good" design at least as much as did questions of physics and materials science.

SETI is contentious in part because it involves looking for something—intelligent alien life emitting detectable signals—for which there is presently no direct evidence beyond a common-sense intuition that "if intelligent life evolved on earth, it probably also evolved elsewhere." At the present time, it is widely held that elementary life forms could exist on other worlds (Dick 1996). However it is currently difficult to estimate how often intelligent, and especially intelligent and technologically proficient life, might emerge. It is thus an excellent example of what philosopher of science Karl Popper might call a "bold conjecture": searching for alien signals does not violate any fundamental tenets of accepted science, while confirmation of a signal would have a profound impact on multiple scientific fields (Popper [1963] 1989: 215-50). However, there is technical disagreement over the best way to search for an answer, disagreement as to what quantity of resources should be devoted to the search, and, most profoundly, disagreement as to whether the rewards of searching outweigh the risks. Yet in spite of a lack clear scientific or social consensus on these points, several elaborate research programs—some lasting for years--have emerged to search for alien signals.

SETI holds particular appeal for examination through a Science and Technology Studies (STS) lens in that it is clearly a nexus for a variety of sociological and technological issues and assumptions. Specifically, I will examine how groups of researchers have been able to convince both themselves and others that formally hypothetical aliens and their technologies are socially real enough to deserve concerted human social and technological responses, some spanning decades. I will also show how a significant fraction of supposedly "objective" science and technology is in fact a projection of individual and collective values upon ambiguous material and social worlds.

I will then broaden my approach to demonstrate how the SETI effort is not an isolated or aberrant phenomenon, but rather one example among many in which science and technology have been mobilized to provide means and legitimization for individual and collective self-transcendence, up to and including providing a guiding purpose for society, and for humanity in general—domains traditionally reserved for spiritual or religious means and institutions.

The first paper of this work, "The Social Construction of Aliens and Their Technologies: An Actor Network Theory Analysis in Two Movements," discusses the emergence of belief in Martian extraterrestrial intelligence (ETI) during the late 19th and early 20th centuries and the influence that this work had upon modern (1959 and later) SETI research. It demonstrates, using Actor-Network Theory (ANT), how SETI, sometimes viewed as a fringe activity, in fact has a long social and intellectual history, both within traditional institutional science and within popular culture. I also uncover narrative and organizational strategies used by researchers to secure resources and support from the broader society. In addition, the paper shows how institutional changes in science (particularly the growth of large-scale capital-intensive and economically rational "big science") helped to simultaneously promote and obscure research goals and assumptions, and also social agendas, rooted in earlier eras; I contend that this strategic selective amnesia allow modern SETI practitioners to present themselves as being "scientific" while leaving intact longstanding assumptions and cultural values regarding the existence and nature of extraterrestrial intelligence (ETI) . This determined lack of historical awareness on the part of modern SETI researchers aided the researchers in maintaining intellectual and institutional control of their movement for over fifty years,

but also may also have also contributed to an unreflective rigidity in SETI's conception of the "correct" way to conduct searches that discouraged alternative strategies from being pursued. [4]

In the second paper of my dissertation, "Transhumanism vs. Xenosalvation: Two Varieties of the Technological Millenarian Experience," I investigate how participation in SETI and other speculative technological projects offer participants an avenue to achieve a form of technologically-mediated self-transcendence. I have coined the term "xenosalvation" to denote the belief that humans will achieve their ultimate destiny through alien inspiration and intervention.[5] By comparing SETI adherents and other xenosalvationists with human-focused transhumanist groups, I show that such spiritual aspirations are not confined to the dreams of a few highly idiosyncratic, or even deviant, individuals, but are rather part of a broader cultural dialogue which I have dubbed "technological millenarianism" (Bozeman 1997). In particular, I examine how anticipated scientific and technological advancements of the future often serve as a blank canvas upon which both individuals and groups can project their tacit values, as well as their explicit dreams and goals.

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[4] In spite of consistently negative findings, the dominant search paradigm—searching for narrow-band continuous-wave radio transmissions in the 1420 MHz region of the radio spectrum--was established around 1960 and remained dominant until the early 1990s. It continues to be highly influential to the present day.

[5] The term is meant to include both persons believing that benevolent aliens commonly visit the earth (a group which includes "contactees" reporting benevolent aliens conveying messages of goodwill and benevolent guidance toward the human race), and SETI followers who generally hold that the earth is not routinely visited by aliens, but who attempt to detect signals from intelligent aliens which are either intentionally or unintentionally beamed toward the earth. The two groups generally do not get along; contactees feel that SETI workers are wasting their time because contact has already been established, while SETI participants dismiss contactees as being mistaken, deluded, and/or pseudoscientific kooks. However both groups use aliens as the ultimate standard against which human morality and technology are compared and found lacking.

In the process of my analysis, I suggest a needed extension to ANT as a framework. ANT, especially as envisioned by Bruno Latour and the "French School" of the social construction of science and technology, is particularly good at showing how networks of people, institutions, elements from the environment, and even abstract concepts are manipulated to form complex scientific and technological enterprises. However, ANT is less adept at showing the motivations driving the principle actors in the enterprise; these motivations are generally left unexamined, but are usually assumed to be economic—the researchers are engaged in a cycle in which they pursue economic and intellectual capital in order to produce further economic and intellectual capital.[6] I show instead that the motivations inspiring researchers are not confined to formal material rationality; instead non-economic social values and ideals may be also be incorporated, as per the work of the "myth and meaning" school of American studies of Leo Marx (1964), John Kasson (2001), and especially David Nye (1994; 1997; 2003). These scholars show how intellectual and aesthetic tropes have interactively influenced technological development in the United States. To this I have added insights gleaned from Stark and Bainbridge's (1985; [1987] 1993) rational choice compensator-based sociological theory of religion. Stark and Bainbridge suggest that religions bootstrap and expand through issuing fictive "compensators" as a form of IOU or scrip, in which the earthly investments and inconveniences of followers in the present world will be bountifully repaid in a heavenly future. I suggest that SETI and other avant-garde technologies operate in the same way, except for promising followers a utopian material, rather than heavenly, reward.

[6] See for example Latour's diagram on p. 160 in *Science in Action* (Latour 1987). Robert Merton detects somewhat similar patterns in "The Matthew Effect in Science" (Merton [1968]1973).

Taken together, these papers offer both an "inside out" and an "outside in" exploration of SETI and, more importantly, the assumptions standing behind SETI and similar endeavors. While science and technology are often portrayed as being value-neutral purveyors of objective truth, examining the history of SETI is helpful in demonstrating how the research programs of scientists and technologists influence, and are influenced by, non-empirical social values, ideologies, and aspirations at a foundational level. In particular, SETI and other alien-oriented endeavors can act as a religion analog and/or foundational moral referent within the movement, and especially among the movement's founders.

For transhumanists, current and anticipated future technologies offer a path to achievement of goals which for earlier eras were generally reserved for the domain of religion: individual and/or collective immortality in a blissful state, constrained only by the desires and imagination of the individual, achieved exclusively through human will and effort. "Xenosalvationists" have similar hopes, though the source of the technology, and perhaps the moral guidance necessary to reach this state, will be conveyed though the intervention, or at the very least the inspiration, of advanced extraterrestrial beings. An important assumption among those holding a xenosalvific belief system is that alien technological advancement is correlated with benevolent moral advancement as well. Yet in spite of these vast differences of modality (human vs. alien technological and moral agency), in both cases the visions of the future utopian states are similar, generally incorporating superficially-conflicting elements of limitless expansion and adventure, boundless knowledge, personal safety, and good interpersonal and sexual relationships.

Both papers in this study demonstrate how aliens have been socially constructed through the SETI movement, but each paper approaches the topic from a different direction. The first paper will demonstrate how aliens have been constructed as a part of "nature" worthy of scientific study and the commitment of resources. The second will show how SETI and other groups utilize concepts and values drawn from the broader culture to construct aliens as moral agents capable of ushering in a glorious human future and destiny achieved through radical use of science and technology.

Research Questions for Paper 1

A. *What factors led scientists and technologists to perceive the possibility of intelligent life existing on other planets as a promising intellectual pursuit, as well as a personally and socially meaningful area for inquiry?*

B. *How were the scientists involved then able to marshal resources and generate and maintain a research program over long periods of time in spite of the absence of clear evidence for the existence of aliens?*

In order to answer these questions, I reconstruct the historical development of SETI science. For the early period, I ask what scientific and cultural understandings made the ETI-oriented work of Lowell, Tesla, and Marconi compelling. For the later period I analyze the relationship and tensions between "Lowellian SETI" and the "modern SETI" research of 1959 and later. I look for broad patterns within the development of SETI science that reveal successful organizational and rhetorical strategies for legitimating SETI as a worthwhile scientific endeavor.

Research Questions for Paper 2

A. *What cultural factors, social trends, and assumptions contribute to the plausibility of aliens and motivate scientists and technologists to expend significant amounts of time and resources on SETI and other speculative topics?*

B. *How do SETI and its adherents operate in relation to other socio-scientific movements that are driven by many of the same forces?*

To contrast the similarities and difference between SETI and other social movements, I provide a comparative case study of transhumanist and xenosalvific movements. I propose the term "technological millenarianism" to describe sociotechnical movements like SETI, transhumanism, and Raelianism which link emerging technologies to normative ethical and/or political visions of human self-transcendence through the use of science and technology. In contrast to Paper 1, which focuses more narrowly on researchers harnessing scientific and cultural currents to generate plausibility for a specific research program, this second paper will show how a variety of movements harness the prestige and cultural capital of material science and technology to promise spectacular, if distant, future payoffs (immortality, ultimate personal and collective destiny and purpose, etc.) traditionally viewed as the domain of religion and spirituality.

Literature Review and Theoretical Frameworks

Paper 1: The first paper in my study discusses the history of SETI, particularly in relation to the earlier attempts by Lowell, Marconi, and Tesla to detect extraterrestrial intelligence on Mars and how this research paradigm has influenced more recent interstellar SETI work.

A number of scholarly works have been produced about theological and philosophical speculation regarding the possible existence of intelligent life on other planets. However Steven Dick's *Plurality of Worlds: The Origins of the Extraterrestrial Life Debate from Democritus to Kant* (1982) and Michael Crowe's *The Extraterrestrial Life Debate 1750-1900* (1986) are of particular interest because they examine the

transition between earlier arguments based on theology and speculative philosophy, and later arguments made on more materialist grounds. Steven Dick extends this work to the contemporary era with *The Biological Universe* (1996), to which I will refer more extensively below; however both Crowe and Dick examine Lowellian era research primarily in terms of the technical details of the debate within the theological and then scientific communities, rather than the debate's meaning and impact within broader society. Crowe in particular seems more interested in seeing Lowell as a defective scientist, rather than recognizing both Lowell and his more conventional scientific brethren as cultural entrepreneurs.

Indeed, Percival Lowell almost single-handedly made Mars a topic of popular interest in the United States. Wealthy, energetic, and charismatic, Lowell popularized and extended the work of Italian astronomer Giovanni Schiaparelli and French astronomer Camille Flammarion; Lowell eventually built and staffed his own observatory and also published three widely-read semi-popular scientific books about Mars and its possible inhabitants.[7] Several excellent works examine Lowell's work and influence in planetary science and the observation of Mars; one pioneering effort is William Grave Hoyt's *Lowell and Mars* (1976). Hoyt, a journalist with training in anthropology and history, presents Lowell and his scientific work in the context of his era, noting Lowell's place in popularizing the ideas of Martians and canals, and also his sometimes tempestuous relationship with the more traditionally-trained professional astronomical community.

[7] Schiaparelli first detected the existence of lines on Mars, which he called "canali." In Italian this can denote either a natural channel or an artificially constructed canal; while Schiaparelli generally leaned toward the former interpretation, at times he entertained the latter possibility as well. Flammarion was something of a prodigy, eventually building a career through publishing popular works on astronomy in France.

Hoyt's work has been extended by astronomer and historian William Sheehan. Sheehan's *Planets and Perception* (1988), examines how the work of several important astronomers, including that of Italian Giovanni Schiaparelli and American Percival Lowell, were influenced by their social and scientific expectations, by the telescopes available to them, and also by optical artifacts and illusions (some recognized by the astronomers and some not) introduced by these telescopes. In a later work, *The Planet Mars: A History of Observation and Discovery* (1996) Sheehan provides a fuller history of Mars, discussing the work of Schiaparelli and the popular and influential French Mars observer Camille Flammarion, and their eventual influence on the young Lowell. While Sheehan's description and documentation of the relationships between Schiaparelli, Flammarion, and Lowell are invaluable, his interest is confined to that of optical astronomy only; he makes no mention, for example, of Tesla's or Marconi's Mars work, and concludes (I think incorrectly) that the Martian canal controversy lost most of its momentum around the time of the first world war; this may have been true within academic optical astronomy, but it was not true for either the lay public or for persons such as Marconi and Tesla who suspected that Martians might be signaling earth through radio waves.

Most histories of modern (1959 and after) SETI efforts are generally presented as chronologies that address earlier interest in intelligent extraterrestrial life on Mars in a perfunctory and patronizing way, treating significant SETI research as only beginning with the work of Drake, Morrison, and Cocconi in 1959. The primary exception to this is the work of former NASA historian Steven J. Dick, particularly his masterful 1996 work *The Biological Universe: The Twentieth-century Extraterrestrial Life Debate and the*

Limits of Science. Dick provides a longitudinal survey of speculation about the existence of life on other planets from the time of Democritus to the 1990s. Dick acknowledges two frameworks informing his work: C.P. Snow's "cultures of science" approach, which claims that science is not monolithic but rather a conglomeration of cultures broadly categorized as "science"; he also voices an affinity for Andrew Pickering's "science as practice and culture" approach, which focuses on the interplay between human intentionality, the performative aspects of scientific research, and the material agency of the non-human world (Dick 1996:7-8). Dick thus takes very seriously the social and scientific contexts in which Lowell and his contemporaries were conducting their observations of Mars. He does a similarly commendable job in placing SETI in the broader context of the development of radio and radio astronomical technology, and suggests that the key to the relative success of Drake, Morrison, Sagan, and others was to form a sturdy network of personal connections between researchers.

While Dick in *The Biological Universe* displays a nuanced understanding of the social and technical environments in which the search for intelligent extraterrestrial life has been undertaken, he is primary concerned with demonstrating the growth of intellectual belief within scientific circles of universal biological laws, paralleling the growth in earlier centuries of belief in uniform physical laws. He thus tends to present a rich history but one in which time and scientific progress smoothly move forward hand-in-hand. On the one hand Dick concedes that "scientists [prefer] observation over theory, but do not hesitate to use theory in the absence of observation to further their argument" (Dick 1996:548). Nevertheless, in spite of his clear mastery of the primary and archival literature and acknowledgement of the desire on the part of some prominent SETI

researchers to make sweeping ethical and metaphysical claims, Dick does not appear comfortable in acknowledging the entrepreneurial or sometimes hegemonic aspirations of these scientific practitioners or their institutions. He also does not really look under the hood at the events, contingencies, and conflicts involved in the construction of either the Lowellian or modern SETI paradigms. Similarly, he also does not examine the relationship, if any, between the two research efforts.

Another work of note is Sierra Smith's 2012 master's thesis in history, "'A Cosmic Rorschach Test': The Origins and Development of the Search for Extraterrestrial Intelligence, 1959-1971." Smith, too, finds much that is admirable about Dick's *Biological Universe,* but contends that he does not go far enough in understanding the meaning of SETI within the SETI community, or in an international political context; she thus examines the Cold War political context in which SETI science emerged. Smith argues convincingly that the 1961 Green Bank conference, where Drake, Morrison, Sagan, and other early SETI researchers came together for the first time for the sole purpose of discussing SETI, provided the opportunity for the group to reflect collectively upon the question of the longevity of alien technologically-based civilizations; the participants realized that what initially seemed to be an abstract question about aliens in fact could be seen as vitally important to predicting the fate of a humanity menaced with self-destruction through pollution, overpopulation, and especially nuclear conflagration. SETI was thus not simply a scientific endeavor; it was a covert way to advocate for nuclear disarmament and to promote a spirit of international cooperation among both scientists and the public when confronted with the awe of the alien unknown. Smith continues on to discuss that the SETI effort toward international cooperation in some

ways paid off; in 1971 an international conference took place in Soviet Armenia which allowed a number of top American and Soviet scientists the opportunity to discuss SETI science and SETI projects, in terms not only of science but also of collective human cultural significance. Smith also cogently notes that scientists on both sides of the East/West political divide were enthusiastic about science being the defining characteristic of a progressive technical civilization (Smith 65).

Also significant is Daniel Romesberg's Ph.D, dissertation, "The Scientific Search for Extraterrestrial Intelligence: A Sociological Analysis" (1992). Romesberg's analysis draws heavily upon STS scholarship, namely Merton, Collins, Pinch, Latour and Woolgar. Most significantly he recognizes Lowell as legitimately inhabiting the same thoughtspace as modern SETI research. While his work deserves careful study, it is different from mine in at least three ways. First, his careful content analysis is flawed: for the Lowellian period, he declares, based on content surveys in the *Readers Guide to Periodical Literature,* that popular interest in the Mars debate fell off precipitously after 1916, an event which he attributes in part to the death of Lowell. However, as I will demonstrate, the discussion did not terminate; rather, it shifted from discussing the existence of Martians, to methods of communicating with them. This shift, which Romesberg does not appear to detect, causes him to miss a crucial part of the Martian debate within the popular press. Second, his discussion of modern SETI treats only the efforts of the NASA/SETI Institute research group, ignoring the existence of other SETI researchers. Finally, while he uses a somewhat similar methodology to my own, he focuses on how modern SETI was made formally intellectually plausible to elite

scientists, rather than examining the interplay between broadly-held cultural values and the generation of networks of social and financial support.

Of particular note is Arthur C. Fricke's 2004 dissertation, "SETI Science: Managing Alien Narratives." Fricke is interested in how various SETI efforts have navigated changing political and cultural environments over the course of several decades in order to maintain cultural relevance and plausibility. He also conducted ethnographic observations and interviews with a number of SETI researchers during the 2000-2002 time period, thereby updating the oral histories collected by Swift (1990; see "information sources" below) during the early 1980s; Fricke is thus able to examine critical changes within the American SETI effort after SETI's defunding by NASA in 1993, regarded by many as a turning point in SETI's organizational history.

Theoretical placement of Paper 1: In contrast to Dick, Smith, Romesberg, and Fricke, I use Actor-Network Theory (ANT), an interpretive framework drawn from anthropology, for my examination and analysis of both the Lowellian and modern SETI research. One focus of ANT, particularly as expressed by Bruno Latour in *Science in Action* (1987) and also in Callon's "Sociology of Translation" work (1986), is to show how researchers engage in a form of intellectual entrepreneurialism in order to build heterogeneous networks to support their research programs. "Heterogeneous" in this context means that the researchers are working with a variety of materials which may include fellow researchers, social expectations and values, scientific apparatus, and social institutions; they then use these resources to convince both colleagues and the broader society of the importance of their research, and also of their own particular competence for pursuing the research. ANT is also apropos for this study given the hypothetical

nature of intelligent alien life; even though direct evidence for the existence of the aliens is lacking, researchers have been able to garner some degree of interest and support for their research for over a hundred years, and even to establish themselves as experts in the field of alien detection and communication. ANT thus provides a model for how social capital can be translated into credibility, and vice versa, for the construction and stabilization of scientific facts, thus explaining the unlikely-seeming success of SETI in achieving recognition as a worthy research endeavor. My study also sheds light on the under-acknowledged relationship between Lowellian and modern SETI in terms of both organizational and historical structures and intellectual paradigms.

Paper 2: The second paper of my study examines modern SETI in a broader social context. Within the United States are thousands of religious groups providing frameworks of shared ethical meaning, as well as means to individual and collective self-transcendence. Less well recognized, however, is the existence of groups offering the same services but through explicitly technological, rather than spiritual, means. I examine SETI in this context to understand the extent to which SETI and similar movements act as religion analogs in a technological age.

Steven Dick shows some awareness of this aspect of SETI in his *Biological Universe;* this work contains a section (Dick 1996:514-536) on "astrotheology." Dick limits his discussion, however, to intellectual efforts by Christian theologians and their scientific counterparts to reach some sort of consensus on this issue. Instead, I would prefer to examine the topic from a different direction, drawing somewhat from the work David Noble, but especially from David Nye and Arthur C. Fricke.

Noble's *The Religion of Technology: The Divinity of Man and the Spirit of Invention* ([1997]1999), particularly the sections dealing with the modern era, presents cogent evidence that many of the researchers working in nuclear, biological, artificial intelligence, and space research have been driven by religious and religiously-derived visions. While there is much that is admirable in Noble's historical research, his conclusion—that all such efforts are motivated by delusional escapist religious fantasies, with little regard to the malign uses of their products by their capitalist and militarist backers (Noble [1997] 1999:206-8)--does not, in my opinion, do full justice to his own case; it concentrates agency in the hands of a small cadre of delusional scientists and their exploitive backers. Instead scientists are often motivated by the same desires and values as the general public. Science and technology thus reflect social values at least as much as creating them.

Also significant is George Basalla's relatively recent technological history of SETI, *Civilized Life in the Universe: Scientists on Extraterrestrials* (2006). Basalla's work is somewhat unusual in that he does see Lowell, Sagan, Drake, and others as being cut from the same cloth, arguing that both Lowellian and modern forms of SETI are inspired by 1) a secularized and technologized projection of traditional religious longing onto alien, rather than spiritual, astral beings, and by 2) extremely anthropomorphic projections of human values and motivations upon aliens who, if they exist at all, are probably nothing at all like us in terms of either science or motivations. While Basalla's history is very clearly written and is in many ways persuasive, I find that it has several shortcomings. First, Basalla may have an overly-schematic view of the cycles of human history, viewing SETI (and other non-explicitly utilitarian forms of technology) as some

sort of exception that needs to be explained away because it does not fit into Basalla's cyclic model of human technological history; similarly, he faults SETI scientists for their overly-simplistic views of inevitable scientific, technological, and cultural convergence between human and alien ways, while not recognizing the unknowability of his own foundational axiom--that alien culture and technology will be totally and permanently incomprehensible due to lack of common cultural referents. The latter problem points to the most serious problem with Basalla's otherwise excellent work: he tends not explore Drake, Sagan, and others as embodiments of broader cultural trends.[8]

Instead I follow more in the tradition of David Nye. Nye's classic work, *American Technological Sublime* (1994), operates within the American intellectual historical tradition of Perry Miller, Leo Marx, and John Kasson. While Miller and Marx tend to focus on literary responses of the elite to the increasing role of technology in society, Nye examines the way in which first the natural, and then the technological world have inspired feelings of the sublime – defined as a mixture of awe and wonder, tinged with terror – within broad sectors of American society. In particular, he notes various periods in which a new technology – railroads, factory mass production, electrification, nuclear detonations, and the space program, particularly the launches – produced a culture-wide sense of the sublime, and visions of a utopian future, before being displaced by a new wonderment. Nye's subsequent works, *Narratives and Spaces: Technology and the*

[8] I find Basalla's work troubling in part because it appears to violate Bloor's principle of reflexivity (Bloor [1976] 1991): social scientists should use intellectual tools that can tolerate analysis by the very same tools of inquiry. Basalla's "SETI is nothing but the forced anthropomorphism of the unknown into culturally familiar terms" argument can be rendered moot with the mirror assertion "Basalla's critique is nothing but the forced anthropomorphism of the unknown into culturally unfamiliar terms." For example, Basalla complains (Basalla 2006:176-8) that SETI researchers are unjustified in assuming that aliens would have mathematics like our own, or math at all; while his statement is formally true, it does not in anyway demonstrate why aliens would not develop such concepts.

Construction of American Culture (1997) and *America as Second Creation: Technology and Narratives of New Beginnings* (2003) analyze how narratives were imposed upon both nature and new technologies, gradually domesticating them in a succession of narratives in which humanity is called upon to utilize and order the plentiful but unruly, and sometimes dangerous, bounty of nature (Nye 2003:18).

Arthur C. Fricke also explores some of these themes in his dissertation, discussed above, "SETI Science: Managing Alien Narratives" (2004). Fricke examines how SETI, NASA, and the American UFO-ology movement have evolved over the course of some fifty years in changing scientific and political environments. In particular, he notes how both SETI and the UFO-ologists have changed as science and culture have moved from a Cold War-era model of research which honored, and was supported by, government agencies with structured procedures and expectations, to a more entrepreneurial model in which support is generated through appeals to private donors and the general public.

Theoretical placement of Paper 2: I extend Nye and Fricke's arguments and apply them more broadly. Regarding Nye's discussion of the American Technological Sublime, I argue that SETI, along with a variety of other scientific movements, such as eugenics, cryonics, and space colonization, draw upon a form of the technological sublime as well; the difference between my groups and Nye's groups is that Nye's groups focus on the experience of the technological sublime of the present, while mine stand in awe of a vividly imagined future.

Further, I argue that the movements that I explore not only stand in awe of the future technological sublime; they also claim to own it and shape it, per Latour and ANT. This claim serves two overlapping purposes: first, it allows adherents to understand the

future as a somewhat familiar and thus domesticated source of hope, instead of an unknowable source of fear. Second, by supporting a particular vision of the future, the adherents attempt to turn their movement into a Latourian mandatory passage point through which the broader culture may also enter this future; if successful, this will gain the movement status both in the present and in the future to come. Whereas Nye used the technological sublime to show how American culture acknowledges, owns, and glorifies, the present, I show that technological millenarianism – the notion that humanity (especially "American humanity") will achieve its ultimate cultural and spiritual destiny through technological means—is used to own and glorify a particular vision of the future. Per Latour's insight, this strategy allows technological millenarian groups to lay claim to owning the future, while simultaneously asking for resources from the broader culture to make the future—usually portrayed in glorious terms □□ happen. However, I also argue that this is made possible by the issuance of "compensators," or promises made now that serve as IOUs or tokens that can only be redeemed in the future, when a powerful anticipated (but currently non-existent) technology is successfully implemented (Stark and Bainbridge (1985; [1987] 1993).

***Conclusions*:** In the "Conclusions" section of the project I further elaborate upon the Stark and Bainbridge model. As mentioned above, Stark and Bainbridge's model of motivation is based around the notion of "compensators." Compensators act as IOUs; when a person contributes to a long-range goal with no immediate payoff, they usually are given a compensator in exchange for their present-day inconvenience, which can then be used to lay claim a future reward. To use a prosaic example, one contributes to a retirement account in the present day in exchange for the promise (compensator) of a

future pleasant retirement; the subjective worth of the compensator is balanced against the knowledge that there is some chance that the holder of the promise might die prematurely, or that some other issue, such as economic trends, could cause the promise to increase or decrease in value, or even become undesirable, as in the case of the comfortable retirement turns out to be so boring that the person prefers to return to work. Education may also act as a compensator as well: the labor, expense, and opportunity costs of the present are exchanged for the promise of a greater deferred reward in the future.

For Stark and Bainbridge the key difference between these examples and the case of religion is this: the future rewards of retirement and education are known to exist, while in the case of religion the rewards (say, a more pleasant life either in a future lifetime or on a non-earthly plane) cannot be empirically demonstrated. However, I argue that technological millenarians, whether SETI/alien-focused or transhumanist, are similarly investing in the present in order to reap a future reward which cannot be empirically verified. The entities in question (technologically advanced and benevolent aliens) cannot be proven to exist, and the proposed technologies (eugenics, cryonics, mind-files) cannot be proven to work in any meaningful way; each thus requires extensive faith on the part of the adherent, given current and foreseeable near- and intermediate-term technological developments. Such movements are thus technologically-based answers to Pascal's religious wager.

Significant attention is also given to SETI@home, a branch of SETI research that is largely independent of Drake's SETI Institute. SETI@home uses many of the same core research concepts as that of "traditional" SETI, using radio telescopes to search for

microwave-region radio signals that are then analyzed via computers using fast Fourier transforms (FFT) for signal detection. However, the SETI@home searches differ from the SETI Institute (and most other searchers) in two ways. First, signals are not gathered using expensive targeted searches, in which radio telescope time is rented to study specific target stars. Instead, an auxiliary antenna is mounted on the radio telescope and signals are randomly gleaned from wherever the telescope happens to be pointed while doing its primary research, thus dramatically reducing data acquisition costs. Second, and more importantly, the recorded data is then packaged into so-called "work units" and sent via internet to persons volunteering to let their personal computers search for possible alien signals.

The SETI@home project is interesting for two reasons: first, it demonstrates a case in which the original compensators (the prospect of alien contact) and economically worthless rewards (certificates of appreciation) have taken on a life and culture their own as participants began to compete over who could process the most work units. Second, the computer technology used for SETI@home was then adapted to a number of other purposes, such as vaccine, epidemiological, and code-breaking research, as concrete uses were subsequently developed for the inexpensive, immensely powerful, massively parallel, and relatively slow computer created through SETI@home's distributed processing. We thus find both a culture and an economy of sorts developing around a SETI technology, though in ways largely unanticipated by its human creators.

Information Sources for Both Papers

It is fortunate that Lowellian and modern SETI activity are fairly well documented; there is a significant amount of primary literature and documentation available in scholarly, semi-scholarly, and popular publications.

The Lowellian Era: Comments and activities by Lowell, Tesla, Marconi, and other researchers were widely reported in the press in newspapers, magazines, and journals such as *Popular Science* and the *New York Times.* These are the main sources of information that I utilize for this era.

The Modern Era (1959 and after): A significant amount of modern era SETI documentation and discussion exists in publications such as *Nature* and in published proceedings of SETI conferences. Semi-scholarly works are also significant and include early publications by Drake and others in journals such as *Physics Today* and *Sky and Telescope* (Drake 1962; Drake 1961; Drake 1960). In some cases the researchers have published their own reflections on their SETI work; for example, John Kraus published *Big Ear Two* (1995), a memoir that includes coverage of his construction of the Big Ear radio observatory[9]; similarly, Frank Drake has published his own autobiography, tellingly named *Is Anyone Out There?* (Drake and Sobel 1992). For several years (ca. 1978-82) Kraus also published a magazine, *Cosmic Search*, dedicated to SETI; these are available online and also at the NRAO archives (see below); this correspondence includes some brief letters between Kraus and Bernard Oliver.

Another invaluable source is *SETI Pioneers,* by David Swift (1990). Swift, a sociologist at the University of Hawaii, conducted a series of structured interviews with a number of the early SETI researchers, mostly during the 1981-1983 time period. Swift

[9] *Big Ear Two* appears to be a revised and expanded version of an earlier 1976 work, *The Big Ear.*

added introductory comments and a concluding chapter and published these interviews. These interviews are an excellent snapshot of the views of the original scientists reflecting upon SETI science roughly twenty years into the search. Interviewees include key SETI researchers Drake, Morrison, Cocconi, Sagan, Oliver, and Tartar. I discussed the project informally with Dr. Kenneth Kellermann of UVA, who conducted a SETI search in 1966, the second known SETI search (Kellermann 1966). I have also been in contact with Arthur Fricke; for personal reasons, Fricke has now discontinued his work on SETI but has provided significant insight into both the SETI and UFO studies communities.[10]

Archival sources, including online archives, have also been consulted. One source of information was the archives of the National Radio Astronomy Observatory (NRAO). While the main radio telescopes are located in Green Bank, West Virginia, their archive is located in Charlottesville, Virginia. Included in the archives are the papers of Robert Bracewell and especially Kraus. A trip was made there to view the holdings (unfortunately somewhat scant) from the 1961 Green Bank conference; I also reviewed the Kraus holdings and physical copies of *Cosmic Search* magazine, plus the correspondence that Kraus received about the publication. The archive also holds the papers of radio astronomer and historian Woodruff ("Woody") Sullivan, which includes a recording of Frank Drake presenting and answering questions about his SETI work in April of 1960, prior to the formative Green Bank conference.

A significant amount of primary material was reviewed that is housed in digital archives; indeed, portions of the NRAO archives are now digitized, and in some cases

[10] I have also discussed with Fricke the possibility of the eventual donation of his materials to the NRAO archives in Charlottesville.

search and retrieval is easier online than in person. Also available online is the oral history archive of the American Institute of Physics (AIP); this source contains interviews with both Morrison and Drake, as well as several other radio astronomers and physicists voicing opinions about SETI. The Library of Congress is also currently processing and digitizing the Carl Sagan papers; at the time of my research the archive was still being processed and only a small portion had been posted. Little of the available material currently available addresses SETI. (More information can be found in the "Archival Sources" section of the "references" section below.)

Several of the technological millenarian groups examined have significant web presences. These include the Raelian Movement, the Terrasem Faith, the Mars Society, Alcor Life Extension Institute, and others. In the case of the American eugenics movement, I have photocopies of a significant amount of archival material from a prior research project. The online Eugenics Archive, sponsored by the Cold Spring Harbor Laboratory, contains additional information and archival photographs.

Other archives are available as well; the Philip Morrison papers are housed at the MIT library; I hope to access these in a future project.

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Library of Congress: Finding Our Place in the Cosmos: From Galileo to Sagan and Beyond Collection – This collection provides a nice survey of popular understandings of western cosmology. The materials on Lowell and Mars are of particular interest, as the collection contains at long letter from Alexander Graham Bell to his wife on the topic of Lowell and his Martian hypotheses. Material is available at http://www.loc.gov/collection/finding-our-place-in-the-cosmos-with-carl-sagan/about-this-collection/ (accessed 4 October 2013).

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Woodruff T. Sullivan III Papers, archived at the National Radio Astronomy Observatory Archive, Charlottesville, VA. This source includes transcripts of Sullivan's interviews with F. Drake (in 1978 and 1979) P. Morrison (in 1976), and S. Von Hoerner (in 1977 and 1979). Much of this material can be accessed at http://www.nrao.edu/archives/Sullivan/sullivan_list_transcripts.shtml.

Ah, but a man's reach should exceed his grasp,
Or what's a heaven for? -- Robert Browning

The Social Construction of Aliens and Their Technologies: An Actor Network Theory Analysis in Two Movements

ABSTRACT: The scientific quest to contact extraterrestrial intelligence (ETI) is promising area for examination because the subject matter – technologically advanced space aliens – is as yet completely hypothetical. Over the past 150 years there have been two efforts to communicate with ETI: one focusing on Mars (ca. 1860 to 1924), and one focusing on communication at interstellar distances (1959 – present). An Actor-Network Theory (ANT) historical analysis is used to show that the two efforts are in fact two cycles within a broader cultural system, and to suggest that a new cycle may be emerging.

SETI, or the Search for Extraterrestrial Intelligence, is usually regarded as having begun in 1959 with two events: the publication of Cocconi and Morrison's paper "Searching for Interstellar Communications" in *Nature,* and the Project Ozma study conducted during the same year at the National Radio Astronomy Observatory (NRAO) in Green Bank, West Virginia, by Frank Drake. A subsequent follow-up conference in 1961, under the auspices of the National Academies, was held in Green Bank which brought together a number of the future leaders of the field, including Morrison, Drake, Carl Sagan, and Barnard Oliver. A research paradigm rapidly developed within the group that remained influential for the following fifty years. Less attention, however, has been devoted to examining the parallels between SETI and an earlier effort during the late 19th and early 20th century to detect and establish radio contact with extraterrestrial intelligence, namely the intelligent beings then believed to inhabit the planet Mars. While this earlier effort was focused on interplanetary rather than interstellar communication, in both cases

researchers used the scientific knowledge and cutting-edge technology of their day to generate social and economic support for building the science of the future.

This paper will employ Actor-Network Theory (ANT) to examine each search cycle, and also to suggest that a third cycle may be emerging. ANT is an anthropological mode of analysis that posits that researchers and technologists build research and development efforts through the development of heterogeneous networks. "Heterogeneous" in this context means that the various parts of the network are not necessarily composed to the same sorts of materials; they may consist of combinations of researchers, public observers, institutions, and artifacts. The researcher, in this picture, acts as an entrepreneur, working to convince colleagues and the broader society of the merit and achievability of his or her research project. To this end, the researcher may employ his or her own personal credibility and past achievements, technical data, equipment, and techniques from both his or her own lab or from other credible authorities, appeals to the values of the scientific community, potential donors, and/or the values of the broader society, and so on. The goal of the researcher here is 1) to build a sturdy network of associations (publications, facilities and staff, institutional support, collegial support, reliable donors, etc.) that allows the researcher access to resources, and 2) to make him- or herself a mandatory passage point (or "go-to" person) in the field of endeavor, thereby becoming a recognized authority in the field. The latter position provides the researcher with access to yet greater resources with which his or her credibility may be further enhanced (Latour 1987; Latour 1983; Callon 1986; Law 1987; Fricke 1993).[11]

[11]This process is not one-dimensional; the researcher may establish setbacks through failed projects, loss of a donor, personal scandal, changing social priorities, or research by a competing researcher that jeopardizes

One of the strengths of ANT is that it models network-building activity as a dynamic process in which the research must continually adapt to changing circumstances in order to maintain the network; failure to do so may result in the network falling apart, with potentially interested parties deciding that the project is not worthy of support, or that the goals in question may be better achieved through different methods or personnel. The researcher thus must maintain awareness of possible threats to the network, which may occur in the form of experimental failure, the emergence of credible competitors, or through shifting trends within the broader society.[12] As we will see, researchers in the search for ETI -- for both interplanetary and interstellar varieties -- have followed similar upward and downward trajectories, to the point that they might be viewed as two cycles of the same overall process.

Searching for ETI on Neighboring Planets

Philosophical and theological speculation about the existence of intelligent life on other worlds has been going on for centuries, loosely divided into particularists who feel that the earth is in some way unique, and pluralists subscribing to a "plurality of worlds" notion that other astral bodies are likely inhabited as well (Dick 1982; Crowe 1986). By the 1800s, however, the question was beginning to be seen as addressable through empirical scientific and technological inquiry. Astronomers, using rapidly improving optical telescope technology, noted occasional flashes of light

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the first researcher's credibility. Faced with such a challenge, the first researcher may then pursue any of a variety of options: attempt to disprove the claims of the competitor, reinterpret the challenge in a favorable manner, make common cause with the competitor and thus turn them into an ally, reinterpret the challenge, or perhaps even cede defeat and retire from the field (Latour and Woolgar [1979] 1986.

[12]Note that competition is normally constrained in certain ways; the researcher may question or attempt to undercut a competitor's claims, but only in ways which do not jeopardize the credibility of the researcher's own efforts.

on the surface of the Moon and Mars, leading some to suspect that the flashes could be signaling attempts by intelligent aliens and that a signal should be made in reply (Young 1896). Often the means suggested for accomplishing this would use recent technological developments and/or knowledge immediately at hand. In 1821, for example, Carl Friedrich Gauss invented the heliotrope, a device using mirrors and the sun's rays for signaling, to accomplish a large-scale land surveying project; the following year he wrote about using a giant heliotrope to signal beings living on the moon. Similarly, French inventor and polymath Charles Cros suggested in 1869 that Mars or Venus might be signaled by means of flashing large electric lights, focused with parabolic mirrors, in the direction of these planets, perhaps encoding data in a pattern similar to Morse Code—a code which had only recently been adopted as an international standard for telecommunication.

However, the plausibility of intelligent life on Mars was greatly enhanced by Italian Giovanni Schiaparelli's 1877 discovery of lines on surface of Mars. Schiaparelli called the features *canali*, denoting either natural channels or artificial canals. Of particular interest, however, was that sometimes a line appeared to undergo "gemination," or doubling, whereby one line would develop a parallel canal next to itself. Schiaparelli, who had studied hydraulics and civil engineering prior to becoming an astronomer, felt that an earthbound observer could interpret this phenomenon as Martian engineers opening and closing locks in a canal system (Sheehan 1996: 98-113, 131; Sheehan 1988:193).[13]

[13] Schiaparelli exasperated his fellow astronomers by sending mixed signals as to the nature of the *canali*; while he generally maintained that the features might be natural, artificial, or even optical illusions, he

The respected French astronomer Camille Flammarion also believed in the existence of intelligent life on other planets; a gifted and voluminous writer, his best-selling books on astronomy brought him significant fame and wealth. In a widely-reported essay in 1892 he opened the field of alien communication to broader participation by announcing the *Prix Guzman*, a bequest offering 100,000 francs to anyone able to communicate with another celestial body within ten years (Flammarion 1892a).[14] His book of the same year, *La planète Mars et ses conditions d'habitabilité* (1892b) provided detailed and sober summaries of all Mars observations, including his own, up to that time. Toward the end of the book, however, Flammarion gave increased attention to the mysterious canals. While allowing the possibility that the canals were natural phenomena, Flammarion argued that an inhabited Mars should be considered as a leading, if as yet unproven, explanation for the apparent geometric precision, as well as the rapid appearance, disappearance, and doubling behaviors observed. To this he added

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at one point wrote a paper supportive of the canal lock hypothesis. On the copy he sent to Flammarion he wrote "Twice a year it is permissible to say things that are insane."

[14] While "inter-astral communication" may suggest "interstellar" to us, during this time the term was used to mean communication between any heavenly body, including the Moon and nearby planets. A synopsis of Flammarion's article, minus mention of the Guzman Prize, appeared in the American version of *The Review of Reviews* (Anon. 1892a: 90). Notice of the Guzman Prize, along with a brief discussion of the technical difficulties in interplanetary communication, appeared in the *Popular Science Monthly* (Guillemin 1892) and in "Flashlight for Mars" in *Manufacturer and Builder* (Anon. 1892b). Flammarion also made a prescient suggestion: noting Edison's experiments with telephony and recent observations that solar eruptions could cause noise in telephone lines, Flammarion hinted that further observations might pick up interplanetary magnetic signals coming from somewhere other than the sun. Edison's strange signals, and also those of W.H. Preece, "engineer to the telegraph office of the British post office," were reported in 1894 (apparently based on an article from the *New York World*) in the *Marion Daily Star* of Marion, Ohio (Anon. 1894). Preese, who was experimenting with short-range wireless telephony, did not say that he was certain that signals were of Martian origin; however, he did say "If any of these planets be populated with beings like ourselves, having the gift of language and the knowledge to adapt the great forces of nature to their wants, then if they could oscillate immense stores of electrical energy to and fro in telegraphic order, it would be possible for us to hold commune by telephone with the people of Mars.

the notion that any such civilization will be more ancient and thus more advanced—both technologically and socially—than any found on earth:

> … [C]osmological theory gives [Mars] a much older age than our own planet. It is thus natural to conclude that … [Mars'] humanity, whatever it is, must be more advanced than ours. While drilling the Alps, the Suez Canal, the Isthmus of Panama, or an underwater tunnel between France and England all appear as colossal ventures to the science and industry of our time, it will be closer to children's games for the humanity of the future. Think of the progress made in our own 19th century: railways, telegraphic communications, applications of electricity, photography, telephone, etc. How might we be dazzled if we could see the material and social progress that the 20th and 21st centuries and beyond have in store for humanity's future. The least optimistic spirit holds that aviation will be the ordinary mode of movement; borders of nations will be erased forever; the hydra of war and unspeakable folly of standing armies, the ruin and stigma of ignorance, will all be annihilated before the glorious rise of enlightenment and freedom! Is it not logical to assume that those even older than us—the people of Mars—are also more sophisticated, and with the productive unity of its people, the work of peace has brought about great achievements? (Flammarion 1892b:586-7, my translation)

Flammarion thus began the process in earnest through which Martians developed from vague possibility to compelling hypothesis. Flammarion used his training in astronomy, along with his skill as an able and tireless writer, to develop a measure of scientific credibility; to this he added Schiaparelli's credibility, as well as Schiaparelli's cautious and sometimes conflicting views of the ambiguous *canali.* Flammarion added two additional components: first, the Kantian/Laplacian nebular theory that smaller planets, and planets further away from the sun, were older than the earth because they cooled more quickly during the formation of the solar system. Second was an axiomatic French Enlightenment assumption that the passage of time inevitably meant technical and social progress. This led them to conclude not only that the canals were artificial, but also to "discover" that the Martians possessed a technical and moral history that was both long and didactic: theirs was a civilization much older than any on earth, and thus must be

more socially and technologically advanced than our own. Given the best-selling nature of his books, it appears that his views resonated strongly with the French public. Flammarion's peaceful, technocratic, and enlightened Martians stood in silent moral judgment of bellicose 19th century Europe, but also acted as a symbol of hope for a more enlightened future. Flammarion's Martians and French social values were thus mutually reinforcing, even if one of the parties was hypothetical. Flammarion was quite willing to speak on behalf of both.

Through his book on Mars, Flammarion also gained an important American convert: Boston-bred and Harvard-educated Percival Lowell, a multi-talented, charismatic, and wealthy man who found in astronomy—particularly planetary astronomy—a cause worthy of both his time and his monetary support. In 1894 Lowell used his Harvard connections to borrow telescopes to set up a temporary observatory in Flagstaff, Arizona, in time to view an Earth-Mars conjunction. He borrowed two of their staff as well: William Henry Pickering, who had published about the canals of Mars, and Andrew Douglass, who became for a time the director of Lowell's observatory. In short order Lowell had constructed a facility with highly trained staff and state-of-the-art equipment under his direct supervision. By 1895 Lowell was lecturing and publishing about Mars, and especially its canals, of which he mapped some 183. These canals, he was convinced, were narrow and ran in perfectly straight geometric lines; too small to see directly, he hypothesized that vegetation bordered each bank, which in turn was what was actually being observed by Earth-based astronomers. Lowell promoted this hypothesis in three widely-read books, *Mars* (1895), *Mars as the Abode of Life* (1908), and *Mars and Its Canals* (1911).

The publications of the scientists, and especially the offer of prize money, generated a number of proposals for ways to respond to the alleged Martian signals. *Manufacturer and Builder*, for example, commented on a plan in which a large flat area would be covered in coal dust or similar dark material. Over this would be constructed a grid of some six million gas jets or arc lights, spaced three feet apart; these would be blinked on and off at regular intervals, with the intervals being changed from time to time. (The magazine's editor praised the ambition of the plan, but suggested that it would require too much effort and expense to be practical.)

We see here the beginning of the formation of an actor network. There is development of a credible premise that intelligent aliens exist on Mars, that they may be signaling earth, and they are technologically advanced, as demonstrated by their complex geometric canal system. The next step is "problematization" (Callon 1986): given that we suspect that aliens live on Mars, who can best tell us about them, and can we communicate back? The first question was monopolized in Europe by Schiaparelli and especially Flammarion, who could sustain their claims using their credibility as astronomers and their articulateness as communicators to enroll the public. Lowell, who lacked formal training in astronomy, manufactured his own credibility by befriending Schiaparelli and Flammarion, building an impressive facility in a location, Flagstaff, which he claimed offered unusually good seeing, purchasing a large and expensive telescope for it, and staffing it with astronomers from Harvard. Thus, through enrolling the leading European Mars scientists, a formidable telescope, the reputation and staff of Harvard's astronomy program, and the exceptionally clear air of Flagstaff, Lowell could then use his own prodigious communications skills and energy to establish himself as the

American expert on Mars and its canals through his lectures, and the publication of a series of three best-selling popular books, eventually garnering honorary doctorates from both Amherst in 1907, and Clark University in 1909 (*see figure 1)*. Indeed, through his writings Lowell was able to enroll the greatest English-speaking "expert" on Martians of the era, H.G. Wells; in a widely-read and richly illustrated 1908 article in *Cosmopolitan* magazine, Wells explicitly turned from his own imagined amoral and bloodthirsty Martians of *War of the Worlds,* re-imagining them instead along Lowellian lines: peaceful, orderly, and more concerned with maximizing agricultural output than in interplanetary conquest (Wells 1908). (*See figure 2.)*

This, however, only addressed the first problem, that of who could best tell us about Mars and its inhabitants; a second question, the best way to communicate with the Martians, remained open. Counterintuitively, this seeming weakness was in fact a great strength in that it opened the door for further enrollments to take place. The Guzman Prize generated interest on the part of those devising means and methods to communicate with the Martians, and most based their assumptions on a Lowellian foundation. The popular press was also enrolled as it appointed itself to be both publisher and critic of the various communications schemes. The inventors, and to a lesser extent the press, thus behaved as if the Martians and their advanced technologies existed as facts, rather than as hypothetical constructs. Schiaparelli, Flammarion, and Lowell thus continued to act as the "go-to" authorities speaking on behalf of the aliens, with the press evaluating the merits of the various proposed earthly technological responses. This activity also helped divert attention from the less tantalizing, and thus less-well-publicized, doubts among

many professional astronomers who felt that the canals might well be illusory; credible public questioning would have threatened the network.

Similarly, with Martians now credible entities worthy of discussion, other outsiders, apparently in an unsolicited fashion, began to enroll themselves into the network. In 1896 the British polymath Francis Galton of England published a lengthy essay examining the question of how to communicate with the Martians once contact had been established. Anticipating later thinking on this issue within the modern SETI community, Galton felt that establishing communication might be fairly easy, with each side initially transmitting simple numbers and elementary mathematical functions back and forth. Once these had been established, "conversation would shift to trading information about the planets' relative distances from the sun, planetary radii, and so on." This would be followed by descriptions of polygons and a coordinate system, which would allow transmission of simple pictures based on geometric coordinates. Eventually, complete photographic pictures might be transmitted using a polar coordinate system; chemistry could be discussed using "specific gravities and other physical properties," and even colors discussed using diagrams of prisms and rainbows. Most of these concepts Galton thought would be able to be conveyed to each side rather quickly. Clearly, Galton felt that physics, astronomy, number theory, pictographic information, and even color theory would be fairly similar between "advanced" cultures (Galton 1896).[15] This allowed the actor network to grow into a new area—how best to encode signals to Mars via optical flashes--while further entrenching Lowellian assumptions about the aliens.

[15] Galton, a relative of Charles Darwin, is best known today as the founder of the British eugenics movement. However, his scientific interests ranged widely.

The discussion was further expanded in June of 1900 when a new communications technology, radio, was brought to bear on the quest for alien contact. The brilliant, if eccentric, Nikola Tesla published what would become one of his most widely cited essays, “The Problem of Increasing Human Energy”; in it the inventor elliptically described his experiments in wireless energy transmission and their potential use for wireless telephony. He also noted that it would soon be possible to produce electrical signals “perceptible on some of our nearer planets, as Venus and Mars.” Later in the essay, Tesla confidently stated that “It is highly probable that if there are intelligent beings on Mars they have long ago realized [wireless electric power transmission], which would explain the changes on [Mars'] surface noted by astronomers” (Tesla 1900a).

Later that year, the American Red Cross asked Tesla for an inspirational message for publicity purposes. On Christmas day of 1900 he released the following brief handwritten message (Tesla 1900b):

> To the American Red Cross, New York City.
>
> The retrospect is glorious, the prospect inspiring: Much might be said of both. But one idea dominates my mind. This – my best, my dearest – is for your noble cause.
>
> I have observed electrical actions, which have appeared inexplicable. Faint and uncertain though they were, they have given me a deep conviction and foreknowledge that ere long all human beings on this globe, as one, will turn their eyes to the firmament above, with feelings of love and reverence, thrilled by the glad news: "Brethren! We have a message from another world, unknown and remote. It reads: one ... two ... three..."
>
> Christmas 1900 Nikola Tesla[16]

[16] The question as to what (if anything) Tesla heard is not clear, but an interesting and provocative argument is made by Corum and Corum (2003) who suggest that Tesla received radio signals from Jupiter and its moon, Io, which were in the same region of the sky as Mars when Tesla received his signals; they also claim that Tesla’s receivers were highly sensitive, but would only have registered mainly signal-like discreet “beep” tones, rather than static-like fluctuations that would have been detected by later amplitude modulated radio receivers. See also Carlson 2013:274-8.

While the announcement generated a bit of a stir in newspapers, response was more muted than might be expected for such a momentous announcement.[17] However, *Collier's Weekly* did interview the inventor about his discovery. During the interview Tesla showed awareness of the extreme environmental conditions on Mars and other planets, but also noted that sufficiently advanced creatures, given enough time to prepare, might be capable of moving underground or even of evolving into forms not requiring chemical energy to sustain life.

Now having addressed the Martian question on Lowellian terms, Tesla moved into his comfort zone, avant-garde radio technology. The inventor asserted that optical methods for signaling other planets would be too energy-intensive to be practical, requiring 100,000,000 horsepower of incandescent lamp energy to be seen from another planet. Conversely, Tesla stated that with only 2000 horsepower of energy he himself could transmit electrical signals "to a planet such as Mars with as much exactness and certitude as we now send messages by wire from New York to Philadelphia." Tesla concluded that a machine could be built to transmit to Mars and that inhabitants of the planet could signal back with reasonable ease, "if they be skilled electricians." Furthermore, once basic communication was established—say, by humans transmitting four clicks after receiving a series of one, then two, then three clicks from Mars--"progress toward more intelligible communication would be rapid (Tesla 1901).

If the press was restrained in its support of Tesla's views, some astronomers were openly skeptical. Robert Ball, a British astronomer of some note, apparently believed

[17] *Western Electrician* noted the announcement and had a short follow-up interview, but the entire piece covered only about 1/6 of one page (Anon. 1901b). A similar brief notice appeared in the *Atlanta Constitution* (Anon. 1901a).

that the canals were the product of extraterrestrial intelligence. However, Ball took issue with the notion that we could communicate with Mars' inhabitants, stating that an optical signaling flag would need to be the size of Ireland to be seen from Mars. In a comparison that surely galled Tesla, Ball noted that Marconi had only just been able to send a wireless message fifty miles to a ship at sea, and it was not yet certain that Marconi would even be able to transmit across the Atlantic. Ball therefore deemed it unlikely that Tesla could exchange messages with Mars, which was much farther away. Ball communicated these notions in popular articles and in a public lecture that was reviewed and summarized in the *New York Times* (Ball 1901; Anon. 1901b; Anon. 1901c; Anon. 1901d).

Discussion of communication with Mars then died down until another favorable conjunction in 1909. Again discussions, both pro and con, began to appear in the press about the possibility of signaling Mars in some way. *Collier's,* for example, published an article by William Brooks, director of the Smith Observatory at Hobart College, who proposed a now-familiar system of a vast array of slowly flashing electric lights (Brooks 1909; Anon. 1907; Fleming 1909). Tesla again added his voice, this time in a long *New York Times* letter to the editor (Tesla 1909). Here Tesla repeated his conviction of the existence of life on Mars based on both the canals and upon the signals that he had detected ten years prior, as well as the technical superiority and feasibility of wireless signals over optical methods. David Todd, a professor of astronomy at Amherst, was interviewed by the *Washington Post* about his expedition to the Andes in which he used a telescope-mounted camera to photograph the canals, which Todd believed were artificially constructed. Several letters to the editor also appeared in *Scientific American*,

with readers writing in to debate how large a mirror would need to be in order to flash visible signals to Mars (Fleming 1909; Griffin1909). The popular press in general, however, appears to have turned more skeptical of the likelihood of success. When Harvard astronomer (and former Lowell associate) William Pickering proposed the construction of a giant heliograph be built at a cost of several million dollars to signal Mars, the proposal was reported in both the *Independent* and *Scientific American*. Johns Hopkins' Robert W. Wood's suggestion of using huge strips of dark cloth set up on a roller system in the American Southwest was also reported,[18] as was Todd's plan to loft a balloon carrying an antenna in an effort to receive Martian signals. Both periodicals disparaged the efforts, however, with *Scientific American* going so far as to editorialize that "[i]n all probability, neither Prof. Wood nor Prof. Pickering seriously believes that Mars in inhabited," ultimately concluding that "so much of [Lowell's work] is based on unsound geological reasoning, and so much on sheer conjecture, that it seems almost futile to make any attempt at signaling in the hope of obtaining something like experimental evidence that Mars is really a living world inhabited by intelligent beings." The *Independent* took this one step further into sarcasm, suggesting that it might be more promising and less bothersome to contact Martians through psychic trance mediums (Anon. 1909c; Anon. 1909d).

The 1909 Mars conjunction represented a peak of sorts in the Mars communication debate; at this point the Lowellian network had enrolled most of its heavy hitters, but significant portions of the popular press were becoming openly skeptical of the Mars contact effort. Perhaps the editors felt that their reading public was growing

[18] The latter system would roll and unroll the cloth, creating a contrast with the white sand beneath and thus generating a visible signal. For more on Wood see Abrahams (N. d.).

permanently tired of reading inconclusive reports about the features of Mars and peculiar radio transmissions, particularly in light of newer astronomical research casting doubt on the existence of the canals. If so, they were mistaken; interest arose again when further favorable conjunctions took place in the 1920s, again prompting communications proposals. An early entry was published in 1917, when a prominent article appeared in *Illustrated World* suggesting that Earth might build its own set of canals to signal back to Mars. Citing earlier ideas about using large pictographs of the Pythagorean Theorem as a signal of earth-based intelligence, the author proposed the construction of three canals in the form of an isosceles right triangle, with two sizes being 700 miles and the hypotenuse 1000 miles in length. This system of canals would not only signal Mars, the author wrote, but also vastly increase the region's cultivable land (Thompston 1917).

Such a proposal would have been familiar for many readers. What was surprising, and may have shored up support for the Lowellian network, was Guglielmo Marconi's entry into the field; in a 1919 interview the respected inventor noted that wireless signals leaving the earth would continue on infinitely, leading him to express hope for "a very big thing in the future." When pressed by the interviewer to provide more details Marconi replied, "Communication with intelligence on other stars. . . . It may some day be possible, and as many of the planets are much older than ours the beings who live there ought to have information for us of enormous value." When asked about language barriers, Marconi responded, "Well, it is an obstacle, but I don't think it is insurmountable. You see, one might get through some such message as 2 plus 2 equals 4, and go on repeating it until an answer came back signifying "Yes," which would be one word. Mathematics must be the same throughout the physical universe."

However, the high point of the interview was at the very end:

> Mr. Marconi stopped speaking for a moment, and then, as if the matter was something so uncertain that he did not feel it worthy of more than a passing mention, said that he had often received strong signals out of the ether which seemed to come from some place outside the earth and which might conceivably have proceeded from the stars.

This interview made the front page of the *New York Times* of January 20, 1919 (Anon 1919a).

Not surprisingly, Tesla immediately weighed in with a statement in the New York *Evening Post* reminding everybody that he had reported similar signals earlier. He further suggested—probably in an attempt to one-up Marconi—that rather than being content with communicating through numbers, transmitting wireless pictures back and forth would be preferable: "When that step [i.e. picture transmission] is taken the whole riddle of interplanetary communication is solved" (Anon. 1919b; see also Tesla 1919).

Marconi was back in the papers again a year later with publication of another interview about mysterious radio signals. Marconi stated this time that the signals seemed to be similar to Morse code signals, but could not be deciphered. Furthermore, the signals seemed to arrive simultaneously, and with equal intensity, at stations in both London and New York, leading the inventor to conclude that they were not of Earthly origin. Upon being asked if they were from another planet, Marconi simply said that he did not know; it was possible, but they could also be a natural phenomenon (Anon. 1920c).

The next few days a great number of experts weighed in with opinions. Most were either skeptical or took the opportunity to air their own pet theories about life on other worlds. Marconi himself elaborated upon his announcement, saying that the mysterious signals appeared to occur at random time at wavelengths "of approximately 100

kilometers, which is three or four times the length used for commercial purposes" and that their cause was completely unknown. Sir Frank Dyson, the British Astronomer Royal, went on record saying that the signals might have come from Mars, while Professor Doolittle of the University of Pennsylvania was doubtful. Two American radio engineers consulted were also skeptical, one attributing the signal to atmospheric interference and the other saying that the wavelengths were "too indeterminate" to be of intelligent origin, while a Harvard physics professor felt that it was either interference or perhaps broadcasts from a high-powered experimental station in Japan or some other distant country. Noted mathematician and electrical engineer Charles Steinmetz stated that the cost of wirelessly telegraphing Mars might cost a billion dollars, while the Sperry Gyroscope Company suggested a better bet might be to signal back with 150 or 200 of their billion-candlepower searchlights used in the recent war effort. C. B. Abbot, the director of the Smithsonian Astrophysical Observatory, stated that if the signals were of interplanetary origin they were probably from Venus, not from Mars. The French wireless station located on top of the Eiffel Tower detected nothing at all, leading most French newspapers and radio specialists to treat Marconi's announcement either as a joke or as some sort of natural interference (Anon. 1920a; Anon. 1920e; Anon. 1920h; Anon. 1920f; Anon. 1920 b; Abbot 1920).

The editors of *Scientific American* were also skeptical; after surveying what was known about the signals, especially the fact that the signals only seemed to occur at Marconi stations, they concluded that the most likely explanation was sunspot activity (Anon. 1920i.).[19] However, their editorial skepticism did not prevent them from

[19] This editorial was later summarized in the *Literary Digest*, whose editors suggested that the Martians seemed to be special friends of Marconi (Anon. 1920g).

publishing a serious piece the following month entitled "What Shall We Say to Mars?" Drawing inspiration from Native American bead weaving, Nieman and Nieman (1920) explicitly addressed the question of how simple two-dimensional images might be encoded into a matrix, which could in turn be translated into a long string of dots and dashes suitable for transmitting to other planets via wireless or heliograph. (*See figure 3.)* The authors noted that progress would probably be quite slow at first, due to each side's lack of familiarity with the other's basic concepts. However, they felt that with time an "interplanetary language" analogous to Esperanto might be built up between the two planets.[20]

This was not the end of Marconi and his extraterrestrial signals. In April of 1920 the inventor went to sea in his laboratory-equipped yacht, publicly stating that he would work on wireless telegraphy, telephony, and direction-finding, not search for messages from Mars (Anon. 1920c). However, in September of 1921 Marconi again made the front page of the *New York Times* when his London manager publicly announced that the inventor was now certain that Mars was broadcasting signals—not only at the 24,000 meter wavelength, but also wavelengths around 150,000 meters (Anon. 1921a). Curiously, the only intelligible code seemed to be frequent repetitions of the international Morse code letter "V." The inventor—or at least his representative—was confident that Mars was home to an ancient civilization, and that through the use of picture transmission and code-breaking methods like those employed in the Great War, any language could be eventually decoded.[21]

[20] Vakoch notes that a similar method had actually been proposed in 1869 by Charles Cros (Vacoch 1998).

[21] Note that the code letter "V" would have been quite significant to Marconi; apparently it was the test letter that he used in his early experiments sending wireless messages across the English Channel in

Others, however, were not so sure. Tesla stated that he thought that the signals Marconi was hearing were long-wave "undertones" accidentally being transmitted by high-powered wireless stations. Some radio operators concurred with this explanation, at least as far as agreeing that interference in this frequency range was in fact sometimes produced by experimental stations.[22] Marconi himself kept up the search at least through 1922, when he again spent time at sea—this time fruitlessly—searching for further long-wave signals (Anon. 1921b; Anon. 1922b).[23]

It does not appear that Marconi or Tesla made any significant new announcements about receiving interplanetary signals after this point. Perhaps the most noteworthy attempt at Martian contact was made by a former colleague of Lowell, David Peck Todd. While Todd did not have the funding or public flamboyance of Lowell, Tesla, or Marconi, and was in the final stages of his career, he appears to be the only one of the group who was professionally trained in both astronomy and radio technology. He was also well-connected enough to bring about one of the few public experiments in the search for intelligent Martian life: he requested that the U.S. State Department, the Army, the Navy, the Italian, Cuban, and Argentine embassies, and the Radio Corporation of America all observe periods of radio silence during the two days of Mars' closest

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1899, using a simple un-tuned spark-gap transmitter broadcasting across a large swath of the radio spectrum. Marconi may have concluded that extraterrestrials had received this early signal and were repeating it, along with other information, back in response. See as Douglas 1987:18-19 and Jackson and Hohmann 1962. The latter is a most curious paper that made use of Todd family material; however, its friendly treatment of the notion that Marconi and Todd may have received ETI signals makes it a favorite within fringe UFO groups. See also note 25 below.

[22] However, long wave signal range and whether or not the signal would have maintained its integrity were questions not addressed in any of the articles.

[23] A later report suggested that the mysterious signals were in fact of terrestrial origin, sent out by a Dr. Irving Langmuir of the General Electric labs in Schenectady, NY; see Anon. 1922a.

approach in 1924. While most commercial stations did not comply, it appears that the Army and Navy did; the Army even offered the services of its top code-breaker, William F. Friedman. Todd also arranged to have the sound signals received at his station recorded using a photographic film-based optical recorder. Though a variety of sounds and signals were recorded, most were ascribed to either normal radio interference or accidental broadcasts (Anon. 1924a; Anon.1924b; Sullivan 1993:147-8).[24]

As of the 1924 conjunction, the Lowellian network, which had been temporarily strengthened by Marconi's enrollment, was starting to break apart. Lowell himself died in 1916, and Flammarion in 1925. Tesla's career was by this time also in decline, and Marconi appears to have abandoned his efforts to contact aliens. In the professional astronomical community a rising generation of astronomers, using new instruments now superior to Lowell's, rarely saw canals, leading most to doubt their existence. At the same time remote sensing techniques, based on spectroscopy, infrared analysis, and other methods, also advanced. While the different methods often generated conflicting results, the overall trend seemed to point to a cold planet with an atmosphere low in oxygen, low in water vapor, and low in overall pressure (under 10% that of earth), though chlorophyll also appeared to be present. This suggested a planet with life on it, but probably nothing more complex than a moss or lichen (Dick 1996:46-8; Sheehan 1996:114-24). While notions of Martians and their technology continued, it was primarily in literary and folkloristic forms. The coherent and orderly scientific discussion that had existed within

[24] Apparently, the orders were issued by Major General Charles Saltzman of the Army, and by Admiral Edward W. Eberlin, Chief of Naval Operations. Friedman was the Chief of the Code Section of the Office of the Chief Signal Officer of the Army. See White (2000). In my opinion, further examination of the Todd historical materials may be warranted; helpful archival material may exist in the Yale University Library and/or other locations, perhaps also shedding additional light on the Jackson and Hohmann paper (mentioned in note 19 above).

the Lowellian network was now impossible; nobody could any longer make credible claims to speak on behalf of the aliens and thus impose structure on the debate. There the discussion rested until the 1960s and 1970s, when a series of American and Soviet space probes found Mars to be even more inhospitable than previously imagined. Mysterious cloud-covered Venus was an even greater disappointment; beneath the clouds lay a sulfurous inferno.

The "Modern Era" of SETI

By the time of the arrival of the first space probes to Mars, "modern" SETI research had begun. This new generation of researchers were radio astronomers, rather than planetary astronomers using optical equipment; long-range measurements of hostile Martian surface conditions had also led both optical and radio astronomers to take as a given that any intelligent extraterrestrial life would be found in other star systems, not our own. Furthermore, there were not social connections between the earlier group and the later one; Lowell, Tesla, and Marconi did not leave professional successors dedicated to the search of intelligent life within our solar system.[25] While notions of an inhabited Mars with canals persisted for decades in the popular and literary imagination, among professional astronomers Lowell's canal boosterism was viewed as an embarrassment.

Thus Frank Drake felt that he arrived at the idea of intelligent life on other worlds independently, arriving at the idea at eight years of age but not discussing it because of concerns about repercussions in a theologically conservative Baptist household. He remained silent on the topic through college, where he majored in physics as an undergraduate. He then entered the Navy and received training in electronics; after

[25] Marconi's intellectual ties to the US may have also been attenuated by his support of the Fascist government of Italy leading into World War II.

separation from the military he earned a Ph.D. in astronomy at Harvard, where he was encouraged to study radio astronomy due to his electronics expertise. During the course of his dissertation research he at one point thought that he had discovered a strong narrowband signal, apparently of intelligent origin, originating from the Pleiades star cluster; while he soon surmised that the signal was of earthly origin, the event prompted him to consider his interest in detecting ETI more seriously (Swift 1990:59).[26]

Such an opportunity soon arose upon his move to the National Radio Astronomy Laboratory at Green Bank, West Virginia. A sense of newness pervaded everything about the situation: it was Drake's first professional job in radio astronomy, the field of radio astronomy was regarded as new, the observatory was so new that no radio telescopes had yet been constructed at the observatory site, and there was a feeling that discoveries needed to be forthcoming soon to justify both the installation and the field of radio astronomy in general. Amidst his other duties Drake calculated that the first radio telescope slated for completion at the site, with a dish size of 85 feet, would probably be able to detect a signal from an identical unit out to a distance of about 12 light years. With trepidation Drake suggested a search project to his colleagues over lunch; while his immediate colleagues were cool to the idea, the acting director of the observatory, Lloyd Berkner, was enthusiastic and authorized the venture. Otto Struve, who succeeded

[26] In a 1979 interview with W. Sullivan, Drake said that he could not remember thinking about ETI during his time in the Navy (Drake 1979). It is surprising that the topic had not come up during Drake's graduate work; the Harvard astronomy program was supervised by Barton Bok, who was in turn a student of Harlow Shapley; Shapley had himself voiced the notion of extraterrestrial life in works such as *Of Stars and Men* (1958). Struve, who was the director of the NRAO when Ozma was conducted, was an optical astronomer who had built his own career though demonstrating that planets were likely to form around sun-like stars; prior to his work it was widely believed that planets were formed through near-miss encounters between drifting stars, and thus quite rare. However it is clear that Drake perceived himself as isolated in regard to his interest in ETI.

Berkner as director, also supported the project; he was pessimistic about the long-term prospects of radio astronomy in general and he felt that the project, which Drake whimsically called "Ozma," could be a way to garner support for the new field. Drake desired to keep the project out of public view "to avoid publicity and interference from the press" (Drake and Sobel 1992:31; see also Swift 1990:62-3). It appears that the plan was to announce the project publicly only in the event that something was detected; otherwise it would be quietly dropped. Ozma preparations thus proceeded at a leisurely pace using minimal resources.

Up to this point Drake had been self-consciously acting as a loner, at least in regard to his interest in detecting ETI; his work in the field was private and he was unaware of anyone with a professional interest in the field. This situation underwent a dramatic change, however, with the publication by Guiseppe Cocconi and Philip Morrison of a paper, "Searching for Interstellar Communications," in the September 19, 1959, issue of *Nature*. Cocconi and Morrison were physicists at Cornell; a colleague had recently begun work using a new synchrotron to produce powerful gamma rays, and it occurred to Cocconi that these might be used for purposes of interstellar communication. He suggested this to Morrison, a former Manhattan Project physicist who had moved into the field of astrophysics and cosmic ray research. Further discussions led them to realize that radio would be easier to use for signaling, and that new radio telescope technologies, particularly Cornell's new 1000-foot Arecibo dish, had recently been developed that could realistically transmit and receive across interstellar distances. They suggested that the microwave hydrogen line frequency of 1420 MHz (21 cm wavelength) "must be known to every observer in the universe" due to its radio astronomical significance. It

was also the *only* naturally occurring microwave spectral line known at that time (Swift 1990:60; Cocconi and Morrison 1959; Drake 1976).

When Cocconi and Morrison's paper appeared, Struve was livid. He felt that the project had somehow been "scooped" by the Cornell researchers, especially given that the NRAO project had been underway for several months prior. Struve thus announced Ozma in dramatic fashion during a series of public lectures delivered the following month at MIT. As reported by the *Saturday Review,* Struve claimed that three great revolutions had taken place in astronomy: that of Copernicus, who showed that the sun did not revolve around the earth, that of Trumpler, who showed that the earth was located at the periphery of the galaxy rather than at the center as previously supposed, and a present revolution asking, "Are we alone in the universe?" Struve hailed Cocconi and Morrison for asking the question; however, Drake of the NRAO was portrayed as the person trying to answer it (Lear 1960:39-43).[27]

While Drake did not initially enjoy the public attention generated, Struve's precipitous outing of Ozma turned out to be a brilliant strategic move; it allowed the struggling observatory to capitalize upon—and even promote—interest generated by the audacious proposal of the established Cornell physicists, while also minimizing the risk of ridicule should no signal be detected. It also forced the publicity-shy Drake to discuss Ozma before a variety of audiences both in print and in public. In the popular press Drake published a long article in the January 1960 issue of *Sky and Telescope* about Ozma before observations had even begun; he followed this up with a popular book, *Intelligent*

[27] These were the 1959 Karl Taylor Compton Lectures, a prestigious series of annual lectures held at MIT. The *Saturday Review* article covering Struve's statement, Cocconi and Morrison's paper, and Drake's Project Ozma was the cover story for that issue of the magazine. See also Swift (1990: 60-3).

Life in Space (1962). In the scholarly arena he presented an unscheduled paper, "Project Ozma," at a radio astronomy symposium held during the April 1960 meeting of the New York State section of the American Physical Society; the text was then published a year later in *Physics Today* (Drake 1961). Drake dedicated most of his articles to describing the problem and the equipment used, and only briefly mentioning the negative results of the experiment.

The announcement of Ozma had unanticipated benefits as well, resulting in the donation of a state-of-the-art prototype amplifier from Dana Atchely of Microwave Associates, along with the services of the company's head technician for installation and training; Atchely, who was also an avid ham radio enthusiast, also published an article about Ozma in the widely-read amateur radio magazine *QST* (Atchley 1960). Publicity also resulted in a personal visit from Bernard ("Barney") Oliver, vice president of research of Hewlett Packard, who would become highly influential in later SETI efforts.

It might appear that Drake and the NRAO were the main beneficiaries from the announcement of Ozma, but this is not the case; it benefited the research agenda of Cocconi and Morrison as well. The publication of "Searching for Extraterrestrial Communications" provoked significant discussion and a spate of counterproposals within the scientific and astronomical communities, some of whom had prestige equal to or greater than Cocconi and Morrison. Freeman Dyson, for example, suggested in the pages of *Science* that a better strategy would be to look for anomalous infrared sources, which could be planet-sized or even star-sized artifacts of alien engineering projects; laser pioneers R. Schwartz and C. Townes, on the other hand, suggested searching for laser-based signals. Ronald Bracewell, himself a radio astronomer, suggested that aliens might

prefer to use advanced autonomous computerized space probes to initiate contact, rather than long-range signaling between star systems. Drake's Project Ozma, however, provided a concrete manifestation of the abstract ideas found within the Cocconi and Morrison proposal, allowing a paradigm group of like-minded researchers to coalesce which Drake could then enroll for his fledgling research program centered around microwave radio telescopes. Indeed, the excitement surrounding Drake's effort caused competing theoretical alternative programs to be left, at least for a time, on the drawing board.[28] Moreover, Struve's announcement, and Drake's subsequent publications, succeeded in causing Drake (and the NRAO) to be seen as co-founders, along with Cocconi and Morrison, of a new field of scientific endeavor searching for signals from intelligent aliens.

Reacting to the excitement, in late 1961 the Space Science Board (SSB) within the National Academies of Science sponsored a small conference on interstellar communication at Green Bank. J. P. T. (Peter) Pearman was tasked with organizing the conference, which he did in cooperation with Drake. Drake suggested inviting Atchely and Oliver, while Pearman suggested Joshua Lederberg, also a member of the SSB, Melvin Calvin, known for his work in evolution and biochemistry, John Lilly, a

[28] Bracewell himself noted that Drake and Morrison's SETI program was more psychologically appealing than his own, because SETI offered a way for researches to actually do something; his own seemed to require people to wait on the aliens to send a probe. Bracewell therefore later modified his suggested program to suggest that humans search for signals and artifacts in the local solar system rather than at interstellar distances, thus giving human researchers something to do (Swift 1990:152-3). Bracewell's programs have been actively discussed at a theoretical level within the SETI community, but have generated only modest and relatively belated concrete research efforts, namely R. Freitas's search for probes at certain Lagrangian points near the earth (Freitas and Valdes 1980). While networks have formed around Bracewell's notion (now called the Search for Extraterrestrial Artifacts (SETA) or xenoarcheology, the networks are generally small and the endeavor is often portrayed as an adjunct to signal-based SETI. Freitas himself appears to have left the field to pursue an interest in medical uses of nanotechnology.

neurobiologist working in human-dolphin communication,[29] and Otto Struve as the chair. Both suggested inviting Cocconi and Morrison, and also the young Carl Sagan, who Drake knew from joint radio astronomy work, and who Pearman knew through Lederberg and the SSB. Struve added a former student of his to the list, Su Shu Huang.[30]

While the group of attendees was small, the 1961 conference brought together most of the future leaders of "modern," or post-1959, SETI—Drake, Morrison, Oliver, and Sagan—together for the first time to discuss the subject. Within SETI circles and also the broader scientific community it is also remembered as the place where the Drake Equation was first articulated. An early draft of the program had suggested that the attendees would present in a fairly traditional fashion on topics such as recent work in lasers or research in communication with dolphins. Instead, it appears that most of the attendees did not wish to make formal presentations; Drake, in charge of the program content, came up with the equation simply as a heuristic tool to arrange discussion topics:

$$N = R_* f_p n_e f_l f_i f_c L$$

N equals the number of communicative civilizations, R_* equals the rate of formation of habitable stars, f_p equals the fraction of stars with planets, n_e equals the number of Earth-like worlds per planetary system, f_l equals the fraction of planets where life develops, f_i

[29] Dolphins were here used as representatives of nonhuman higher intelligence.

[30] Lederberg and Cocconi did not attend. At about this time Cocconi moved to CERN and lost interest in communication with ETI. Lederberg's absence is unexplained as he had requested an invitation earlier from Pearman and apparently later confirmed his intention to attend. Other persons invited, but not attending, were Freeman Dyson, M. J. E. Golay, Thomas Gold, Edward M. Purcell, C. H. Townes, Harold Urey, O. G. Villard, Martin Schwarzchild, J. R. Pierce, and S. von Hoerner. Drake and Sobel 1992: 46-48; NRAO Archives File 1961; Lederberg Papers, Lederberg to Pearman, 11 April 1961; Lederberg Papers, Pearman to Lederberg, 14 April 1961. Note that Drake and Sobel claim that the first Drake heard of the conference was a phone call from Pearman during the summer of 1961. However Lederberg's letter to Pearman appears to refer to Lederberg's seeing a letter from Drake on 13 March about a conference on ETI, so Drake may have misremembered the date of the call.

equals the fraction where intelligent life develops, f_c equals the fraction of planets where electromagnetic communications technology develops, and L is the lifetime of communicating civilizations. The terms were arranged from least to most speculative; with R_* being the term about which the most was known and L the least. By the conclusion of the conference the conferees appear to have reached something of a consensus that L was the key term; if L is small, say less than a 1000 years, then the universe would not have many communicating civilizations; if large, say 100,000,000, there will be many. The conferees were also very much influenced by the question of the earth's L.

The conference was small but crucial to the new research enterprise in multiple ways. First, it was the place where the new actor network really solidified, establishing the various players in the non-competing roles that they would occupy for the following three decades: Morrison would act as the elder statesman providing intellectual gravitas for the enterprise, while Drake was the applied scientist and technologist actually conducting searches. Oliver would provide boundary maintenance, organizational advice, and, later, connections to benefactors within the computer industry. Sagan, for his part, would continue his role as a networker within the scientific community; at the outset he was the only one with training and professional connections in both the physical and the life sciences. Much like Flammarion some seventy years prior, Sagan was charismatic and a gifted communicator; he also had the ability to strike up strategic professional friendships seemingly at will.[31]

[31] The attendees of the 1961 conference formed a tongue-in-cheek organization called the "Order of the Dolphin" to commemorate their shared experience and interests. Afterwards a few others were made honorary members of the group; these were mainly local colleagues and spouses. In contrast, Sagan

Second, the Green Bank conference also allowed the formation of a common moral vision for the attendees; the factor L was interpreted as not merely a scientific question but also as an existential one. The attendees were very much aware that the earth's own L could be very short due to the Cold War and the threat of nuclear destruction.[32] Searching for aliens provided a means to provoke reflection on this issue, and also to unify the human race in the face of the alien Other. As Sierra Smith convincingly argues, SETI research (and space science in general) was often promoted by scientists as a peaceful and productive alternative to militarism and nuclear weapons

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inducted the legendary British scientist and futurist J.B.S. Haldane. Sagan would also edit and co-author a book, *Intelligent Life in the Universe* (1966), with the top Soviet exponent of extraterrestrial communication, and leading astrophysicist, I. S. Shklovskii. Shklovskii and his students would soon develop their own ETI contact program in the USSR, one which appeared to outflank the USA's first mover status and the US's ownership of sensitive radio telescopes by postulating the existence of Type I, II, and III alien civilizations. In this view, the US was searching for Type I aliens, humanity's technological peers orbiting nearby stars. The Soviets, in contrast, tended to search for more technologically powerful Type II and III civilizations, whose vastly more powerful transmissions would be easily detectable over intergalactic distances with more modest Soviet equipment. From a Latourian viewpoint, it also made the Soviets the spokespersons for races of aliens far more powerful than those represented by the US's program!

The Soviet SETI program eventually declined, however. First, Shklovskii, who was enormously influential in driving the program, became more pessimistic about finding ETI after scans of nearby galaxies failed to turn up signals. Shklovskii expected an advanced civilization to emit powerful signals that would easily be detectable at intergalactic distances (Swift 1990: 176); when such signals were not found, he apparently concluded that technologically advanced aliens must have destroyed themselves, much as humans were threatening to do on earth (Drake and Sobel 1992: 211). The situation became more complex, however, with the dissolution of the Soviet Union into a federation of republics, administration of scientific and technological programs and facilities shifted from centralized Soviet authority to local control, making generalizations about eastern-region SETI difficult. For example, planetary astronomer Alexander Zaitsev has begun advocating for active transmission of messages to alien targets, going so far as to use the Yevpatoria Planetary Radar installation in Crimea to broadcast a series of "cosmic call" messages to nearby stars; however it is not clear that Zaitev has been able build a network to sustain and further these efforts (Cooper 2010; a collection of Zaitev's papers on the subject can be found at the joint SETI Science and Culture Center of the Tsiolkovsky Academy of Cosmonautics andSETI Section of the Astronomy Council, Russian Academy of Sciences (N.d.).

[32] This was especially true of Morrison, who was a founder and the first president of the Federation of Atomic Scientists.

development. Indeed, it seemed to have been proposed as a sort of "do-over" in which world governments could work cooperatively on space science instead of competitively on militarized nuclear science (Smith 2012).[33]

Third, the conference appears to have not only provided a moral vision for the earthbound attendees; rather, it also helped create a space for the social construction of aliens not only as objects of material inquiry, but as (passive) moral agents. If no signal were to be detected, it could mean one of several things: that intelligent, technologically-adept life is not common in the universe, that ETI is present and transmitting, but humans were searching with inappropriate technology, or, as discussed above, technologically-adept life rapidly snuffs itself out. On the other hand, the presence of a signal would indicate the contrary—that it is in fact possible for a technological civilization to escape self-annihilation. The mere existence of such a civilization would provide moral

[33] Note that at the time the military vs. civilian use of space was a question very much in flux. NASA had only been established in 1958, and the US armed forces were very interested in possible military uses of space. For example in 1958 the US initiated a secret U.S. Air Force project, Project A119, intended to use an ICBM to explode a nuclear device on the moon; the Soviet Union had its own version of this plan, called E-4. The US Air Force also conducted a significant amount of research and development on the X-20 (Dyna-soar) spacecraft, a manned space vehicle intended for reconnaissance and strategic bombing. While A119, E-4, and the X20 were eventually cancelled prior to implementation, several projects military-backed space ventures were. The Project West Ford was carried out in 1963; it attempted to create a temporary artificial ionosphere around the earth through placing half a billion copper needles in orbit around the earth in order to aid military communications. At about the same time a series of high-attltidude nuclear detonations by the U.S. (Operation Fishbowl) and the Soviet Union (Project K) unintentionally created an artificial radiation belt around the earth which destroyed or crippled a number of early American and Soviet satellites including, ironically, the Telstar I communications satellite and two US Navy navigation satellites (Hess 1964; Hoerlin 1976). Interestingly Sagan himself worked on A119 and was the person who revealed the existence of the program, though it is not clear whether his security breach was intentional or not.

Indeed, at times the selective naïveté of the peace-minded SETI scientists could be striking; for example, Drake in his popular 1962 book wrote approvingly of the proposed 600-foot radio telescope under construction at the nearby U.S. Navy Sugar Grove, West Virginia site, treating the installation as a possible future asset for SETI research while ignoring its primary purpose, which was to eavesdrop on Soviet radio transmissions (Drake 1962:108-9).

encouragement for humanity in its own struggle against self-annihilation. This vision of the "moral alien" would be further developed by Drake and Sagan in the years that followed, with the two ultimately concluding that the aliens would most likely be benevolently inclined and willing to share advanced technological and moral knowledge with lesser beings, such as humans, who possessed the prevenient wisdom to search for signals coming from the stars (Billings 2013; Drake and Sobel 1992: 61-64 and 159-162; Morrison 1979; Sagan 1973: 180, 191-8, and 215-20; see also Bozeman, in this volume).

Finally, the conference established several research parameters and soft boundaries which would later harden with time as to who should do the research and how it should be undertaken. In regard to the "who" question, it is interesting to note who was invited but then chose not to attend the 1961 conference, namely Townes, Bracewell, and Dyson. Each of these persons had voiced alternatives to radio telescope-based microwave searches. While Drake initially voiced openness to optical as well as radio searches, Oliver was firmly convinced, apparently even before the Green Bank conference, that radio searches were the only possible alternative. Oliver wrote and spoke extensively on this topic, opposing any effort to include optical searches; indeed, it appears that optical searches only came to be seriously entertained within this core group after Oliver died.[34]

[34] Oliver was clearly thinking about the optical vs. radio question early on; he volunteered to present a paper on "Latest Developments in Optical Masers" for the 1961 conference, and in 1962 published a journal article stating that optical masers (i.e. lasers) showed great potential for intra-solar system communication, but would be impractical for use over interstellar distances (NRAO Conference File 1961; Oliver 1962). Later Oliver rejected inclusion of optical ETI detection methods for use in the 1971 Cyclops project. Stuart Kingley, an optical engineer who later organized one of the first optical SETI efforts, regarded Oliver's opposition to optical searches with some bitterness. Only after Oliver died did optical SETI appear to gain ground within the bounds of the core group, when Harvard-based Paul Horowitz, a second generation SETI searcher who was highly regarded within the SETI community and esteemed for his electronics prowess, lost his antenna in a wind storm and subsequently switched to optical search methods. (Horowitz's radio and later optical efforts were funded by Sagan's Planetary Society, rather than

Another parameter established was a "big science" attitude toward research, i.e. the notion that effective SETI science could only be conducted using expensive government-supported facilities. Dana Atchley, who attended the 1961 conference and who was an avid radio amateur, appeared to accept this role in his article about the event in his 1960 article in QST. There he stated two options for the interested radio amateur: find a job at a radio telescope observatory, or persuade one's radio club to build a microwave-band radio telescope, to be used with moon-bounce communications that could in turn assist Drake in calibrating his equipment (Atchley 1960:75).

A Big Science attitude is clearly evident in the Cyclops Study of 1971 (Oliver and Billingham 1972); this NASA-sponsored study, chaired and co-authored by Oliver, assumed a Project Apollo level of government funding to construct a large array of up to 1000 dishes, each 100 meters in diameter, linked together to act as one mammoth unit. Morrison himself concluded that that such a level of funding was unlikely and proposed a more modest plan in 1976 (Morrison, Billingham, and Wolfe [1977] 1979), one using existing radio telescopes additionally equipped with relatively inexpensive receiving and signal processing equipment.[35] Morrison's more modest approach eventually won support within NASA but was only slowly implemented, with observations finally

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through the Oliver-influenced SETI Institute.) For Kingsley's views on the matter see Kingsley (N.d.), especially the "Optical SETI Resource for Planet Earth," "SETI Technology Milestones," and "The Planetary Society" sections. Kingsley had himself attempted to contact Sagan and to work with the Planetary Society, but reported being unable to make any significant headway; he was effectively excluded from the main SETI network.

[35] In a 1981 interview Morrison stated that "I think that Cyclops was a little bit of a mistake. . . . It gave everyone the feeling that *any* SETI search was a ten-billion dollar search, a feeling very hard to dispel. Most people not acquainted with it still think that is the case" (Swift 1990:42-3)." While he denied that a SETI program needed to be vastly expensive, Morrison still maintained a big science paradigm for the research: "We've done about all that individuals can do. … Now it takes money, at least to build equipment, and money involves a number of people supporting the project" (Swift 1990:35).

starting in 1992 as the High Resolution Microwave Survey (HRMS), a survey planned to last ten years for a total cost of $100 million. However the program was abruptly and permanently terminated by congress in 1993 during a period of fiscal budget cutting (Garber 1999). A scaled-down version of the project named Project Phoenix was later completed by the privately-funded SETI Institute (SI), using the equipment from the cancelled NASA project on rented radio telescopes.[36] Even after the HRMS debacle, however, a Big Science attitude continued; when a group of radio amateurs, the SETI League, organized an effort to conduct a low sensitivity full sky survey—a part of the HRMS project that was abandoned during the transition to Project Phoenix Oliver informed them "If your system wouldn't detect the strongest signal the ETI might radiate…even if it came from the nearest star, then years of listening, or thousands doing it, won't improve the chance of success. To cross the Golden Gate, we need a bridge about 10,000 feet long. Ten thousand bridges . . . one foot long won't hack it (Shuch 1995)."[37] Oliver's comment was particularly discouraging given that he was on the League's advisory board.

The SETI Institute also pursued its Big Science vision through the construction of

[36] The SETI Institute had been organized by Oliver in 1984 as a 501c3 organization for the purpose of lowering overhead expenses for SETI research; it was expected that grant money overhead could be reduced from 40 to 100% using traditional university-based grant procedures down to 20% using the SI as the granting agency. The original board of trustees consisted of Frank Drake, astronomer and educator Andrew Fraknoi, former University California-Berkeley chancellor Roger Heyns, and Berkeley radio astronomer and SETI research William Welch. The institute's first research grant channeled NASA money to Jill Tarter to study targeted microwave ETI searches, research which later became a core part of NASA's HRMS survey.

[37] These comments appeared in *SearchLites,* the quarterly newsletter of the SETI League. Oliver's comment is incongruous given nearly universal assumption among SETI researchers that aliens will be more technologically advanced than humans, and thus could be transmitting at levels detectible with relatively modest equipment.

its own dedicated telescope array, the One Hectare Telescope (since renamed the Allen Telescope Array (ATA) after major donations from Microsoft executive Paul Allen). The design, utilizing a field of small dishes which are then combined to form the equivalent of one large antenna, is basically an updated mini-Cyclops; as in the case of the HRMS survey, this project also encountered grave financial difficulties when its partner, the University of California, precipitously pulled out after a state budget shortfall.[38]

In spite of the various funding challenges, and continued lack of discovery of ETI signals, the network constructed by Morrison, Drake, Sagan, and Oliver has proven remarkably resilient, surviving even the deaths of the majority of the founding members. The SETI Institute, now led by Jill Tarter (with periodic appearances from the President Emeritus, Frank Drake), continues to be one of the major, and perhaps the major, "go-to" group within SETI broadly construed; other SETI projects continue to cite the works of the SETI Institute researchers, and the group maintains a vibrant publishing presence within the field. For the most part this is supported and confirmed by the scientific and popular press, who continue to seek out the opinions of the SI leaders and generally portray the group's leaders in sympathetic light. However, with Drake in the late stages of his career, and Tarter herself moving toward retirement, there is some uncertainty about the future integrity of the network; this concern has also begun to be voiced within the press; research interest in SETI may also have been diluted somewhat by the growth

[38] While the Big Science paradigm has remained a constant within most of this group of researchers, there have been divergences. In 1980 Sagan helped to found the Planetary Society, a group which funded a variety of innovative small-scale research projects involving SETI. More research on the relationship between the Morrison-Drake-Oliver-Sagan (and later Tarter) group and Sagan's Planetary Society is needed.

of other forms of exobiology, particularly efforts to detect signs of microbial life on nearby planets.[39]

Yet even if the second actor network of researchers seeking contact with intelligent extraterrestrial life is itself showing signs of fraying, we may also be witnessing the early beginnings of the formation of a third network, this time searching for artificial light sources shining on the dark side of a distant planet, in the same way that orbiting earth astronauts and satellites are able to perceive large cities through their nighttime illumination (Choi 2011; Loeb and Turner 2012). How this new network will exist in relation to the old one is as yet unclear, but so far they appear to be complementary, with the older SETI group using the findings of the new group to target particular stars for examination. Looking forward, it will be interesting to see where those searching for artificial light signatures will position themselves within the scientific community relative to those searching for biosignatures (i.e. the detection of spectral lines for methane, oxygen, or chlorophyll in the light coming from distant exoplanets), exoplanet hunters, and SETI researchers.

Lowellian Era Work vs. Modern SETI

Drake, Sagan, and other leaders within SETI have tended to view the efforts of Lowell and the other early Martian researchers as historical curiosities or, worse, misguided efforts to be dismissed out of hand. Sagan, for example, begins his seminal

[39] During the 1990s a significant amount of interest was generated by possible microbial fossils found in a meteorite of Martian origin; see Dick (1996). Recent findings of water on the Jovian moon of Europa have also led to speculation about microbial life there as well. *Five Billion Years of Solitude* (Billings 2013) explicitly portrayed Drake and SETI as being a noble quest, but one of an earlier scientific generation. Jill Tarter's retirement plans have been widely reported in the press as well. The financial difficulties of the SETI Institute's Allen Telescope Array have also had a deleterious effect.

1975 paper "The Recognition of Extraterrestrial Intelligence" with the statement,

> The search for extraterrestrial intelligence has recently evolved from a largely disreputable pseudoscience to an interesting although extremely speculative endeavor within the boundaries of science (Sagan 1975).[40]

Morrison, on the other hand, saw the difference in slightly kinder light. In his view prior considerations of extraterrestrial intelligence, or even present-day thoughts about aliens communicating through as-yet undetectable means, were and are legitimate but purely hypothetical; the development of radio telescope technology fundamentally changed the nature of the project by making an empirically-verifiable search for alien signals possible (Morrison 1976). Drake appears to agree with this assessment; when radio astronomer Woody Sullivan directly asked Drake about Tesla's extraterrestrial communication efforts, Drake responded curtly "No quantitative stuff." (Drake 1979).

The reason for this dismissive attitude is rooted in the SETI researchers' belief that they have fundamentally reconceptualized the search for ETI by transforming the question into an empirical problem in a way that Lowell, Tesla, and others could not. In

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[40] This "selective distancing" may be due to a combination of factors. First, it appears that most of the persons taking up the search for extraterrestrial intelligence in the years following 1959 were not immediate students of Lowell, Marconi, Tesla, Todd, or any of the other early Martian searchers; this may have led the later researchers to feel like the true pioneers of the field. Rather, radio astronomers (which many of the early SETI researchers were) trace the origin of their discipline to a different historical lineage that begins with Karl Jansky, who probably did not know Todd or his compatriots. (Jansky, a Bell Laboratory radio engineer, discovered in 1932 radio waves coming from the center of our galaxy--a discovery ignored during most of his life (Berman 1979).

The second factor is the issue of boundary maintenance: SETI researchers, dwelling as they do in necessarily speculative areas of astronomy and exobiology, have felt called to emphasize that they are doing "real" science. From the 1800s to today, a variety of psychic trance mediums, Spiritualists, New Agers, and flying saucer worshippers have made frequent claims to be in contact with alien intelligence, generally (but not always) through psychic means. Some sizable groups of this type that are active today include the Church Universal and Triumphant (U.S.), the Aetherius Society (U.K.), the Raelian Movement (Canada), and the Unarius Academy of Science (U.S.). (I am indebted to Laurence "Frenchie" Thuotte for posing questions to me highlighting this issue in a personal communication.)

this paper I have shown that in fact they did not; the main difference between the two groups appears to have been that while the Lowellian researchers were agnostic about the best technological means for alien communication, modern SETI researchers were committed to the use of radio telescopes. However it is also likely that Drake and his coworkers were not being intentionally disingenuous either. One reason for this apparent disjunction is that the Drake-Morrison actor network was constituted using institutions and personnel that were completely independent of the earlier Lowellian network; they could thus feel that they were an independent movement. However, while the later SETI network had access to more advanced scientific and technical resources, the intellectual foundations, both technical and especially cultural, were nearly identical between the earlier and later groups: both groups appealed to a secularized notion of plurality of worlds (Dick 1996:20), operating on the premise of biological uniformitarianism ("if intelligent life could occur on earth, it is likely to occur elsewhere"), along with an Enlightenment assumption of what might be called moral uniformitarianism ("civilizations, wherever they may be, evolve to become more harmonious and benevolent with time"). Whether on Mars or orbiting other stars, aliens are assumed to be more ancient, more technologically advanced, and more morally developed than humanity, views espoused by Flammarion, Lowell, and Marconi, and continued by Drake, Sagan, and others. Whatever the current topic concern may be in the contemporary culture—militarism, resource shortages, social unrest, etc.—it is assumed that the aliens have overcome it. SETI researcher Paul Horowitz conveyed this in a particularly succinct manner in a 1988 interview: "[The extraterrestrials] know how to do things better than we do in every way. They're like the Japanese, only even better" (Swift

1990:404).

Similarly there is a frequent assumption that aliens will share our mathematical and computational systems, and also much of our sense of vision and aesthetics; it is also assumed that their interests and experiences would be similar enough to our own to allow communication to take place (Lomberg N.d; Vakoch 1998.[41] The parallels between the earlier and later movements are demonstrated most dramatically in the first known intentional radio message transmitted toward the stars with the hope of it being received by aliens, Frank Drake's "Arecibo Message" of 1974; the message encoded pictographic information using a technique similar to a method described in 1920 by Nieman and Nieman's *Scientific American* paper (s*ee Figures 3, 4, and 5*), and by perhaps by others even earlier.[42]

Both groups also share a similar and distinctive attitude toward technology, namely the assumption that whatever the latest human technology is—Morse code, radio, lasers, or bright streetlights--the aliens must also be using it.[43] Often this is combined with a sense of technological anxiety: perhaps the lack of apparent signal is because our technology is so primitive by alien standards that we are missing each other's signals, or else maybe the aliens signaled long ago but have now lost patience, given up, and

[41] Vakoch provides a brief description and critique of some of the visual assumptions encoded into the Pioneer plaques and the Voyager records. He also rather amusingly demonstrates how the "obvious" pictographic information encoded into the Arecibo message could be interpreted upside down.

[42] The variation was that the Nieman plan seems to be aimed at sending a square array of picture elements, while the Arecibo message used a rectangular array which was the product of two prime numbers. Drake claims to have devised this method of encoding independently; Nieman and Nieman were inspired by Native American weaving, while Drake probably derived his from his knowledge of electronics.

[43] An extreme example is a suggestion that alien messages from space should be screened for computer viruses (Carrigan 2006).

stopped sending.[44] Each assumption carries within it the notion that the technology in question may be advanced enough to deserve alien attention, and also enjoins further technological development. Indeed, one is tempted to conclude that much of the allure of searching for alien intelligence, whether on nearby planets or nearby stars, has been driven by the desire to find cosmic justifications for, first, the development of new technologies, and then the construction of monumental versions of these technologies--whether it be through design of giant heliographs, participation in populist distributed supercomputer projects,[45] or the devising of clever yet "obvious" methods of encoding and decoding data to and from hypothetical aliens[46]—rather than by particular expectation of achieving contact with the aliens themselves.[47] Paralleling the

[44] The "maybe they just got tired of sending" hypothesis was voiced at least as early as William Pickering (1924). Statements such as these have led some to ask whether or not SETI might represent a Popperian unverifiable hypothesis in that there is no real way to ever disprove the existence of extraterrestrial life; see, for example, Regis' trenchant essay (Regis 1985). Regarding concern about the possibility of humans overlooking currently undetectable alien signals, see Dyson et al. (1971). The last is a transcript of a conversation between Sagan, Drake, Dyson, and other SETI researchers which includes discussion of humans being unable to detect tachyon-based signals (that is, signals based on hypothesized particles traveling faster than the speed of light).

[45] Here I am referring to the SETI@Home project. This project, conceived around 1994 and initiated in 1999, uses SETI data collected from the Arecibo radio telescope. The data is then broken into small "work units" which are sent via internet to volunteers who allow a small client program to run as a screen saver or background program in their home or work computers. When finished, the work unit is automatically returned to the central database. At the time of this writing, the combined computers form a massive parallel-processing supercomputer running at about 680 trillion floating point operations per second (i.e. 680 teraFLOPS) (Anon. 2014a; Anon. 2015).

[46] Of particular note here is Hans Freudenthal's LINCOS project; published in 1960, it is an artificial math-oriented language created with interstellar communication in mind. See Freudenthal (1960). Cipher A. Deavours and McConnell also address this issue, each using a computer programming paradigm. Deavours is particularly interesting in that, like Marconi and Friedman before him, also expected to see a code-breaking problem (Deavours 1985; McConnell 2001).

[47] The SETI@Home project allowed participants to keep track of the number of work units completed; users could also be ranked. Furthermore, users were allowed to form teams and pool their contributions. The result was the perhaps unintentional creation by the SETI@Home staff of a competitive environment appealing to overclockers, hardware manufacturers, science fiction fans, and other

development the growth of a new religious movement, the enthusiasm and encouragement experienced by the participants in their intra- and extra-group social interactions ends up being taken as a form of validation, at least until objective proof of ETI can be demonstrated in the (indeterminate) future.

Clearly, the study of SETI—both early planetary and current interstellar versions—is a promising field for STS investigation. Indeed, it may turn out that the most interesting part of such searches will not be what we learn about alien life, but rather what our search for alien life tells us about ourselves: our attitudes about technology, and how humans project their own values upon the ambiguous and unknown.

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technologically-oriented special interest groups. Even though the project stated at the outset that the odds of actually detecting extraterrestrial signals were quite low, SETI@Home became a fad. The project's organizers initially expected that the project would run for two years, with a few thousand person donating computer time, by the end of the first phase of the project (now called "SETI Classic," which ran from 1999 to 2005), some 5.4 million persons had signed up. Websites set up by various teams make it clear that they were far more interested in beating other teams than they were with finding ETI; indeed, around July 2000 there was even a hoax in which a person claimed to be selling computer add-on boards containing six embedded CPU's, allowing one to accumulate work units more rapidly! (See Anon. 2014b and Anon 2000.)

Illustrations

Figure 1: Percival Lowell, circa 1907-1909. Lowell received two honorary doctorates during this period, one from Amherst and from Clark. Source: Leonard 1921:106.

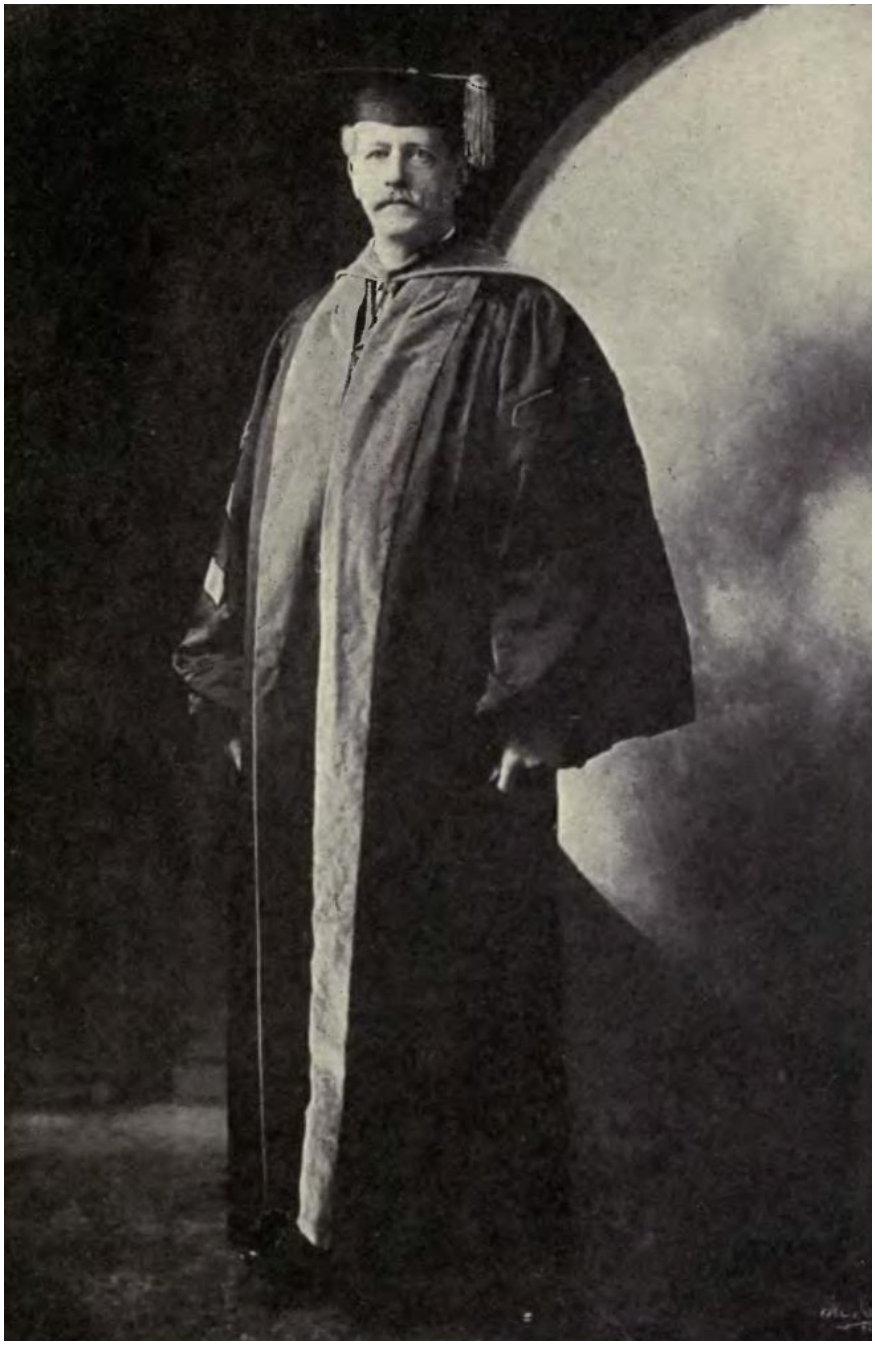
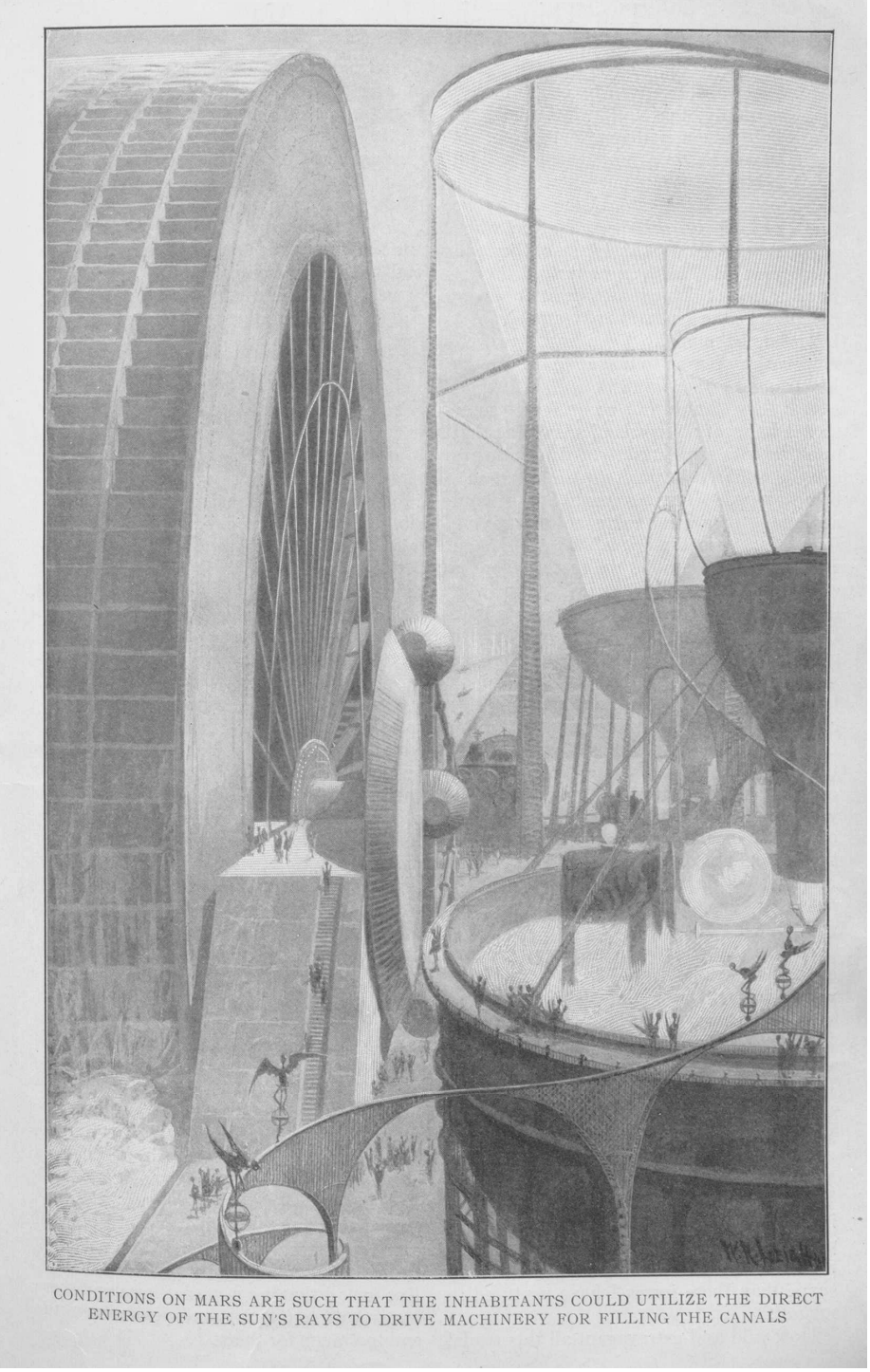


Figure 2: An illustration of imagined monumental Martian technology. This illustration by William R. Leigh accompanied H.G. Wells' 1908 *Cosmopolitan Magazine* article "The Things that Live on Mars" in which Wells, under the influence of Lowell, re-imagined his Martians as benign and peaceful, rather than as bloodthirsty conquerors. (Leigh went on to become a celebrated painter of American western scenes.)



CONDITIONS ON MARS ARE SUCH THAT THE INHABITANTS COULD UTILIZE THE DIRECT ENERGY OF THE SUN'S RAYS TO DRIVE MACHINERY FOR FILLING THE CANALS

Figure 3: Nieman and Nieman's plan for pictographic encoding. Inspired by Native American bead techniques, Nieman and Nieman proposed to encode a picture in a long series of long and short light flashes or wireless signals. The first picture shows a geometric shape built up from a 20x20 matrix. Source: Nieman and Nieman 1920:298.

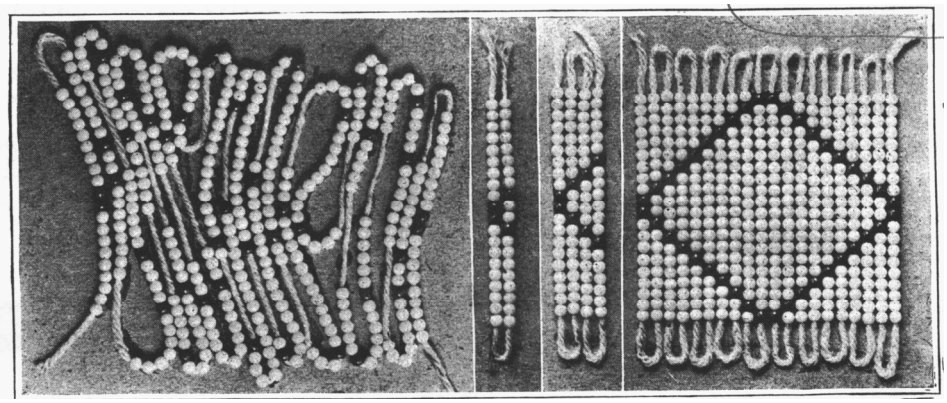


Figure 4: Illustration of how a schematic image of a man could be produced by expanding to a 100x100 matrix. (While one should probably not make too much of a single illustrative example—this was the only picture of its type in the article—a number of interesting artistic conventions and cultural assumptions built into the simple figure, such as use of profile perspective and omission of clothes, hair, and genitalia.) Source: Nieman and Nieman 1920:298.

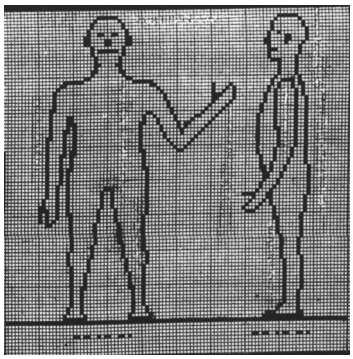
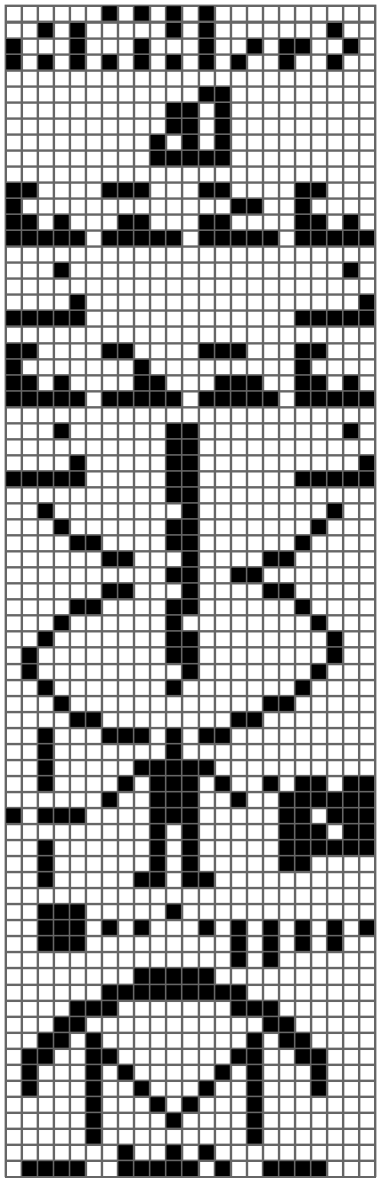


Figure 5: The Arecibo transmission of 1974. This famous transmission was analogous to the Nieman and Nieman proposal of 1920, though based on a 73x23 matrix. From top to bottom, the message includes pictographic representations of the numbers one to ten in binary, the atomic numbers of carbon, nitrogen, oxygen, and phosphorus, chemical formulae for DNA constituents, along with a representation of the DNA double helix, an image of a human, a schematic of the solar system (with Earth raised), and a representation of the Arecibo dish. Source: Nordmann 2007.



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"A wonderful harmony is created when we join together the seemingly unconnected." –Heraclitus[48]

Transhumanism and Xenosalvation: Two Varieties of the Technological Millenarian Experience

ABSTRACT: *David Nye has suggested the existence of an American technological sublime, a cyclic pattern in which natural, and later technological, wonders are invested with broadly shared cultural import and meaning. In this paper I extend the notion to science and technology-oriented movements claiming that humanity will achieve its ultimate destiny through technical means, achieving through science and technology goals once reserved for the venue of religion. Stark and Bainbridge's compensator-based theory of religion is applied to explain how avant-garde technologies and alien beings can function as replacements for traditional religious institutions and aspirations.*

Much has been written about how science and technology influence, and are influenced by, society, with some going so far as to suggest that science and technology are rendering the domain of religion irrelevant in light of more compelling narratives of neutral, universal, and collective human material progress. In this paper I would like to make a different claim: in the United States and elsewhere, the aspirations of science and religion in fact are often fused. Alongside scientific and technological endeavor on one hand and traditional religious practice on the other, there exists a long-running notion that humanity will reach its ultimate destiny through technologically-mediated means (McMillen 2004; Bendle 2002; Bozeman 1997; Noble [1997] 1999; Nye 1985). This paper will describe the origins of this belief and, using Stark and Bainbridge's economically oriented compensator-based theory of religion, analyze how aliens and advanced technologies function within the Search for Extraterrestrial Intelligence (SETI),

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cryonics, space colonization, and other forward-looking technologically oriented groups in much the same way that supernatural elements function in the religious domain. In general I will concentrate my analysis upon organized groups with significant numbers of members, and which have worked, or are still working, to produce concrete manifestations of their vision of the future; less emphasis is given to persons and groups whose primary activities are literary.

We find seeds of a science-based ideology in Francis Bacon's *New Atlantis* (1625), a work that contributed to the later formation of the Royal Society of London; Shapin and Schaffer (1985) in turn have shown how the Royal Society managed to create the notion of the scientific laboratory as being a relatively neutral space able to make authoritative statements about matters of science and nature independent of the authority of either the church or the crown. Over time a compromise was reached in the form of "natural theology," wherein science and religion existed as mutually-supporting narratives testifying to the existence and benevolence of a divine Creator standing behind the overlapping natural and social orders; indeed, many clergy were also amateur naturalists, thus strengthening their claim to understanding the natural world.[49] This accommodation was abandoned in the mid- to late 1800s by an aspiring professional class of biological and social scientists who wished to reinterpret the natural and social orders along naturalistic and materialist paradigms, replacing the clergy as the most competent group to describe and represent the natural and social orders (Turner 1986;

[49] Note, too, that at about the same time medieval angelology was being replaced with speculations about celestial beings inhabiting other worlds; see Smith (2014). Interestingly, in their major works on pre- and early modern discussions of intelligent extraterrestrial life, Dick (1982; 1996) and Crowe (1986) do not dwell on angel/alien parallels to any significant degree. This may be due to their focus on beings with capabilities roughly equivalent to humans, rather than those with vastly greater intellectual or moral powers.

Barton 1998; Callon 1986; Latour 1987; Latour 1983; Stanley 2012; Draper 1875; White 1896).[50]

This move posed a challenge for scientists, however. Neither the natural nor the social order is universally regarded as just and perfect, and the nature of the imperfection and its proposed solution often varies with a person's station within society. Traditional religious forms usually addressed this disjunction using a two-pronged approach. First, they mobilized resources, both cultural and material, to address the wants and needs of adherents and sometimes the surrounding society, providing, among other things, educational resources, relief work, and even entertainment. Second, they provided cosmic explanations for the reason behind hardships and social disparities. To this end religions usually offered promises of near-term individual rewards or punishment in the afterlife and/or the promise of a radically improved earthly millennial age in the more distant future. These future promises, termed "compensators" by Stark and Bainbridge (1985; [1987] 1993), were promises of future supernatural rewards given as IOUs in exchange for hardships experienced or sacrifices made in the present. This combination of earthly action and supernaturally-based compensators allowed the clergy to explain and domesticate both the natural and social worlds, simultaneously positioning themselves as the gateway to both the individual and collective eternal future.

[50] As Latour, Callon, and others in the anthropologically-minded Actor-Network Theory (ANT) school of thought show, becoming the "go-to" authority on a topic in effect makes that person the spokesperson of that phenomenon. Latour describes how Louis Pasteur made himself the representative of microbes and bacteriology, and thus the authority on the origin and treatments of diseases caused by them. Callon applies this model to a case in which local fishermen whose short-term interests were in conflict with scientists working on an unattended scallop re-seeding project; the fishermen had to be convinced that the scientists could speak on behalf of the scallops in order to prevent the fishermen from plundering the project (Callon 1986; Latour 1987; Latour 1983).

Scientists and technologists wishing to challenge these entrenched institutions thus needed to provide their own analysis of the human condition. Moreover, they would also need to supply their own compensators order to underwrite visions of the human future at least as compelling, believable, and desirable as those offered by traditional religious groups (Farber 1994). Doing so would allow scientists and technologists to make their own claim to own the future, and also allow them to demand significant social and economic support from the broader society for both themselves and for the implementation of their vision.

The result has been the emergence of a variety of technological millenarian movements driven by the idea that science and technology alone will allow humanity to achieve its ultimate destiny. Such groups combine faith in recently-developed science and technology, the limits and shortcomings of which are not yet fully understood, with a normative ethical and/or political vision that vividly addresses pressing social concerns within the society, and the resolution of which will lead to a glorious future. Depending on which set of cultural and technical resources a group wishes to mobilize, such movements may be further divided into groups that include non-human intelligent alien life as actors, and those which exclusively focus on human efforts.

The Extraterrestrial Impulse:

A number of technological millenarian groups focus their analysis relative to an alien Other. In this context aliens act as moral and technological foils standing in judgment of humanity. Compensators are also issued drawing on the hypothesized benefits that will accrue upon contact with these beings.

The Search for Extraterrestrial Intelligence: Philosophical speculation about the existence and nature of life on other planets has existed for centuries. Around the beginning of the 20th century, this discussion was taken up by the biological and physical sciences, particularly as a way to project Darwinian notions onto creatures of other planets (Dick 1998). An early proponent of this in the United States was Percival Lowell who, through lectures and the publication of three widely-read books, *Mars* (1895), *Mars as the Abode of Life* (1908), and *Mars and Its Canals* (1911), popularized the notion that Mars is inhabited by a race administering a planet-wide system of canals. While Lowell attempted to be publicly circumspect about the exact nature of these hypothetical creatures, the planet-spanning nature of the canals, and the age and lower gravity of the planet, led Lowell to conclude that the residents of Mars must be more technologically advanced, more physically efficient, and more mutually cooperative and peaceful than their earthly "cousins," and that Mars □ geologically and culturally □ might give us insight into the ultimate destiny of our own planet (Lowell 1895:201-212; Lowell 1908:215-6; Lowell 1911:37-83).

In spite of the fact that by the 1920s Lowell's views were rejected by most professional astronomers, his vision of an inhabited Mars proved to be long lasting, influencing innumerable books and movies.[51] Lowellian notions also led radio pioneers Tesla and Marconi to believe that mysterious signals that they received might be coming

[51] While Lowell's conclusions were later discredited--over time it was realized that the canals were in fact optical illusions □□ Lowell's views were a matter of great speculation for both scientists and the lay public of that time period, and remained culturally influential for decades. His works heavily influenced H.G. Wells, Edgar Rice Burroughs, Ray Bradbury and Robert Heinlein, among others. These writers later in turn fired the youthful imaginations of a number of later SETI researchers; Carl Sagan, Robert Bracewell, Charles Seeger, and Jill Tarter all mention one or more of these authors as being significant in their youth (Swift 1990:140, 155, 211, 289, 350).

from the red planet. However a new chapter opened in 1959 with the publication of Cocconi and Morrison's paper "Searching for Interstellar Communications." The authors there suggested that large radio telescope dishes then under construction for the new science of radio astronomy might also be used to search for signals coming from civilizations orbiting nearby stars. Coincidentally Frank Drake, a young researcher at the US's National Radio Astronomy Observatory at Green Bank, West Virginia, was in the process of conducting just such a search, having independently reached the same conclusions. While Drake's search, light-heartedly named "Project Ozma," examined only two stars and failed to detect any candidate signals, the National Science Foundation's Space Science Board soon sponsored an informal conference at Green Bank which brought Morrison, Drake, Bernard (Barney) Oliver, and the young Carl Sagan together. This group formed the nucleus of a national, and later international, effort to detect artificial radio signals coming from other star systems.

The initial conception for the searches appears to have focused on communicating with aliens orbiting nearby sun-like stars and in possession of technologies similar or slightly more advanced than those of our own. Moreover, the conferees at Green Bank discovered that their quest would also provide concrete proof that other civilizations could exist without destroying themselves through nuclear war, overpopulation, and/or polluting themselves to death (Drake and Sobel 1992:45-64; Pearman 1963; see also Shklovsky et al. 1971:153-4). In short, the goal was similar to Lowell's: to find a metaphorical older sibling in space who could serve as an object lesson demonstrating that a species could survive its technological adolescence.

Soon, however, these arguments were taken further. In 1971 NASA sponsored Project Cyclops, a study intended to provide an outline of what a state-of-the-art multi-billion dollar search for ETI would entail. Reasons supplied within the report to justify the effort and expense of the project included more or less traditional questions about whether humans are alone in the universe and, if not, how common intelligent life might be. The report writers felt that communication with extraterrestrials might also lead to the discovery of new "social forms and structures most apt to lead to self-preservation and genetic evolution," new aesthetic forms, and new sciences. Most of all, however, the project could lead to:

> [the] end of the cultural isolation of the human race, its entry as a participant in the community of intelligent species everywhere, and the development of a spirit of adult pride in man, rather than childish rivalry among men.
>
> Indeed, the salvation of the human race may find itself cast in a larger role than it can at present visualize, one that offers a cosmic future but one that requires a reorientation of our philosophy and of our mores to fulfill (Oliver and Billingham 1972:31).

One might ask why technologically advanced aliens would spend time and effort educating a technologically and morally primitive society such as that of the earth. Sagan's answer was simple: a combination of selfless benevolence on the part of the aliens, and a cosmic version of the Rousseauean social contract, since the aliens educating us had probably once themselves been helped by earlier alien cultures (Sagan 1973:219). Drake himself shared this opinion of alien benevolence. In 1974, while director of the Arecibo radio telescope, Drake unilaterally transmitted the now-famous "Arecibo Message" from earth toward a distant star cluster (Drake and Sobel 1992:181). Drake expressed his own vision of alien contact:

> I fully expect an alien civilization to bequeath us vast libraries of useful information, to do with as we wish. This "Encyclopedia Galactica" will create the potential for improvements in our lives that we cannot predict.... [A] Renaissance will be fueled by the wealth of alien scientific, technical, and sociological information that awaits us. . . . Some aliens may already know how to transfer immortality from single cells to entire organisms. Or they may be able to transfer the inventory of memories of an old brain into a young brain perhaps even the brain of a clone, or an exact copy of a being whose individuality is to be preserved. . . . Wars probably don't exist among immortals, who would not take the risk of fighting (Drake and Sobel 1992: 160-1).[52]

It is thus clear that aliens, at least in the views of the SETI's most visible spokesmen, tended to be remarkably similar to humans, both morally and technologically; the main difference was their having solved all the pressing political, moral, and technological problems vexing humanity. Regardless of the simplicity of this message it held appeal for many; SETI leaders went on to form a number of organizations to promote their views, including the SETI Institute (Barnard Oliver and Frank Drake); the Planetary Society, in which Carl Sagan was a founding partner; and the SETI League, a group consisting of amateur radio hobbyists desiring to set up a network of backyard SETI observatories.[53] From 1978 to 1982 the movement had its own journal, *Cosmic Search*, edited by John Kraus and Bob Dixon, who themselves operated the longest running SETI search to date (1973-1998) at Ohio State University; SETI

[52]Drake also voiced similar notions of aliens conferring immortality in MIT's *Technology Review* magazine in 1976 (Drake 1976).

[53]As of 2010 the SETI institute claimed to have administered a total of over a quarter of a billion dollars in funded research, employed more than 700 different individuals over the years, and hosted over 100 projects. The Institute is not generally a membership-based organization, but rather earns most of its income from NASA research grants; for the 2011-12 fiscal year, over 95% of its funding came from federal grants (SETI Institute 2012). Recently, however, the SETI Institute has begun efforts to attract member-donors as well; these are called "SETI Stars."

As of 2012 the Planetary Society claimed 33,500 members (Planetary Society 2012). For its part, the SETI League reported about 1500 members as of 2009, and members operated a total of about 147 private SETI observatories as of 2014 (SETI League 2009; SETI League 2014).

enthusiasts also produced a Flag of Earth to fly at observatories engaged in SETI projects, symbolizing human unity before the alien Other (NAAPO 2014).[54]

Interestingly, the compensators issued at the outset of the modern SETI effort to support the search for hypothetical aliens have in fact led to concrete technological payoffs, though not the ones expected: for example, Drake developed automation technology for Ozma which has since become standard equipment for most radio telescopes. More recently a SETI project, SETI@home, was used to develop distributed processing technology allowing volunteers to use their personal computers to automatically search for alien signals that might be buried in radio telescope data. Several million users signed up for the effort, thereby creating one of the most powerful super computers on earth. The distributed processing technology has since been generalized by project members to allow volunteers to also donate computer time to a variety of other projects, including epidemiological work, development of AIDS drugs, and solving complex problems in mathematics and physics. However the primary goal—contact with aliens—remains unfulfilled, often projected to take place at a continually receding twenty to thirty years in the future.[55]

Alien Oriented New Religious Movements: A number of new religious movements have drawn inspiration, either directly or indirectly, from extraterrestrial

[54]The flag was first designed in 1970 and, with a three year gap during the 2000s, appears to have been in production until the present day. For a list of locations that have flown the flag, see NAAPO 2015. http://flagofearth.org/flown.html.

[55] Drake, in 1981, thought contact would occur "before 2000"; Oliver, interviewed the same year, estimated twenty to thirty years (Swift 1990). Seth Shostak, senior astronomer at the SETI Institute, has continued this tradition; on 21 May 2014 he testified before the House Committee on Science, Space, and Technology that "It is not hyperbolic to suggest that scientists could very well discover extraterrestrial intelligence within two decades' time or less, given resources to conduct the search" (Shostak 2014).

influences. Emmanuel Swedenborg and the Swedenborgian Movement, influential in European and American culture during the 1700 and 1800s, included at least peripheral themes of aliens; trance mediums also reported alien contact on occasion. However, scholars of new religions find that explicitly alien-themed religious movements began to emerge in earnest during the 1950s with groups such as the Aetherius Society and the Unarius Academy of Science. Scholars have generally analyzed and classified these groups in terms of history and beliefs (Tumminia 2005; Melton 2009); however, I would suggest that these groups' attitudes toward and engagement with science and technology are also of interest.

Some, which I will call "mentalist," continue in their mesmerist/trance medium (later renamed channeling) heritage, holding that the only means required to converse with the aliens is an enlightened and/or disciplined mind. Others, which I will call "technologically facilitated," allow for more physically concrete forms of technological facilitation and mediation, though these technologies may be spiritual, rather than material, in nature, and thus may function outside of the realm of conventional science and technology. The Church of Scientology, for example, uses an electronic device called an electricpsychometer ("e-meter") in their religious practice of auditing, a form of guided reflection allowing adherents to rid themselves of spiritual disabilities and improve their individual abilities (Church of Scientology N.d.). The Aetherius Society uses spiritual energy batteries to store prayer and meditation power to ward off natural disasters. Unarius for its part also builds devices, such as an allegedly functioning scale model of Nikola Tesla's mysterious electrical broadcasting tower of Wardenscliff. This and other Unarian devices are based on designs derived in part through channeled

communications from the higher dimensions of the spirit world. For each of these religious groups the devices act as physical testimony to the truth of the moral and metaphysical teachings of the group. However it is also clear that these devices are merely tools and tokens; while helpful, the tools are not essential for the salvation of either an individual or of humanity as a whole. This is especially true for the Unarians, who look forward to an apocalyptic landing of flying saucers in the near-to-intermediate future; at this time the benevolent and spiritual Space Brethren will begin tutoring all of humanity in both advanced technology and spiritual understanding, which are viewed as intertwined and mutually supporting.

However there is a third category of alien-oriented religious groups, which might be called "technocentric," incorporating technology integrally into the religious message and practice, and similarly demanding a technological response on the part of humanity to reach its ultimate destiny. An example is found in the Raelian movement, one of the larger of the alien contactee faiths. The group's earthly founder, Rael, has been entrusted with a message from aliens explaining that humans, along with most of our plants and animals, were created in the distant past by powerful aliens as part of a huge genetic engineering experiment. Similarly the earth's major religions are all based on encounters between humans and aliens with advanced technologies, the latter of which were often mistaken for magic and miracles. In contrast to many of the other contactee religions, Rael's message is strictly materialistic; there is no higher spiritual plane existing above the material world. However, meritorious humans will be rewarded by being scientifically reincarnated on the aliens' paradisiacal home world; there they will enjoy a form of immortality while fellowshipping with their alien creators. While some humans

may escape death in this fashion, this number is capped at 144,000. Rael thus teaches that humanity as a whole needs to strive for ethical and scientific advance. If humanity pursues an unenlightened path it could destroy itself, or even be destroyed by the aliens, with nuclear weapons. If, on the other hand, humanity chooses instead an enlightened path of ethical and especially technological development, humans will be rewarded perhaps with alien help with their own ability to regenerate themselves indefinitely and to administer this power as the human race sees fit. Eventually humans themselves will travel to other stars and populate other planets in their own image as did their alien forebears.[56]

The Raelian vision is distinctive in that, in spite of the promise of later assistance from the aliens, the pursuit of science and technology is not merely desirable; rather, it is a sacred duty that has been commanded by the aliens and through which humanity will achieve its ultimate destiny.[57] Unlike many religious and secular groups, the Raelians support conventional genetic research, including research on genetically modified crops. More controversially, Raelians promote research in human reproductive cloning, going so far as to organize a company, Clonaid, to help achieve this end (Palmer 2004; Clonaid 2009).

[56]This description of Raelian beliefs is somewhat simplified for the sake of brevity. A more detailed description can be found in Rael's book, *Intelligent Design* (Rael 2005), which is a collected volume of three of Rael's earlier works. See also Palmer (2004) for further discussion of Raelians and their attitudes toward technology.

[57] Interestingly, Raelians believe in psychic communication with aliens, but do not display much interest in research into psychic phenomena. Rather, they appear to feel that earth should advance using its own "home grown" science and technology, with the aliens providing moral guidance and inspiration rather than serving as conduits of technical knowledge.

Alien Conflicts: Some of the ETI-oriented mentalist and technologically-facilitated groups discussed above developed a common semiotic pool, with the various groups and leaders using a common vocabulary and claiming non-exclusive contact with a more or less fixed group of ascended masters and alien entities (Fricke 2004). Others, such as the technocentric Raelians, have a more exclusive revelation focused on a single message and prophet that subordinates or denies the revelations of competing groups. The rift is most clear-cut between the alien religionists and the practitioners of SETI research, with SETI researchers going to great pains to deny any connection at all with UFOs or flying saucers, whether in a secular or religious context; most of the core SETI researchers maintained that all UFO reports were simply mistakes and all stories of contacts the products of fraud, hoax, or delusion. The researchers also developed elaborate arguments, often based on human economics, as to why advanced alien cultures would only attempt contact through radio transmission and not via spacecraft (Oliver and Billingham 1971:34-5; Drake 1962:77-81; Sagan 1973:199-204).[58]

SETI researchers, aware of the contentious nature of their research, assiduously attempt to follow the dictates of good conventional scientific methodology and practice, in part to shield themselves from charges of being biased or, worse, engaging in sectarian pseudoscience. SETI scientists thus caution aspiring SETI scientists not to enter the field directly, but instead to build reputations and credentials in more conventional areas prior

[58]Robert Bracewell was the primary exception to this general rule. Bracewell felt that most of his fellow SETI researchers incorrectly assumed that an interstellar probe would have to be both huge and hugely expensive, assumptions which he himself questioned. Bracewell eventually concluded that his fellow SETI researchers did not like his probe idea because it rendered the human side of SETI passive, with humans having no role but waiting for a probe to appear. He thus suggested that another SETI avenue might be to search for alien probes parked near the earth, which would restore a measure of human agency to the search. (Swift 151-3).

to moving into the SETI field, a practice they themselves have tended to follow. In spite of the hard line drawn by the SETI researchers and their attention to good methodology and professional credentialing, when examining the role that technology plays for the SETI scientists on the one hand, and the ETI-oriented religionists on the other, there is a striking similarity of *meanings* of both aliens and their advanced technologies within each group. Both the scientists and the religionists use the aliens as a canvas upon which to project one's highest individual and collective aspirations; both agree that aliens are more technologically advanced, more benevolent, and more peaceful than humans. And in both cases human technology offers a first step toward demonstrating to the aliens our own sincerity and readiness for contact, at least for those wise enough to embrace the teachings of the enlightened, whether they are SETI scientists or leaders of a religious group. In both cases the aliens, once their presence is finally demonstrated, will shock the rest of the world into a higher state of consciousness, in particular uniting the human race through recognition of a common human heritage. Each group also assumes that the aliens will then convey marvelous scientific and technical knowledge to earth, perhaps even including the key to immortality, through the conduit of the ETI scientists or religionists, who have volunteered to serve as the intermediaries in a process of human techno-cultural and techno-spiritual evolution.

Human-centric Movements

Many technological millenarian movements look to human, rather than alien, agency to create technologies necessary to usher humanity (or perhaps an elite subset) into a millenarian future state. Examples of this abound, but include eugenics, cryonics, and space technology.

Eugenics: Notions of using breeding as a means to the betterment of humanity has a long history, one extending at least as far back as Plato (Galton 1998). Arthur de Gobineau is sometimes credited with being the first science-based racist, using heredity and bloodlines as reasons to deplore the spread of democracy in France, as well as to explain the failures of his own political party; however, his thought does not appear to have become influential until it was appropriated and significantly reinterpreted by German ultra-nationalists during the years leading up to the second world war (Kale 2010). "Modern" eugenic thought, however, is generally traced to the 1859 publication of Charles Darwin's *On the Origin of Species*, an event the led Darwin's cousin, Francis Galton, to begin applying Darwin's notions to human racial improvement. Galton was particularly struck by his finding that exceptional talent, or "genius," tended to run in eminent families more strongly that found in random samples drawn from the populace at large. His investigations were especially influential in his development and application of statistical techniques to biological processes, ideas which were furthered by famed statistician and eugenicist Karl Pearson (Gillham 2001; Kevles 1998).

Eugenics largely remained a concept in England. In the United States, however, the eugenic concepts were actually put into practice to a significant extent. In the late 1860s the Oneida and Wallingford utopian communities, led by John Humphrey Noyes, instituted a eugenic program that fused Darwinian, Galtonian, and progressive Christian thought into a program of directed human breeding called "stirpiculture."[59] Noyes' goal appears to have been further two traits: "receptivity to inspiration, and obedience." Noyes further seemed to feel that this was a form of moral genius associated with physical

[59] Galton would not coin the word "eugenics" until 1883.

neurological development, and that science could rapidly increase this form of genius where in the past divine providence had confined it to the lineages of Hebrew prophets (Noyes 1865).[60]

Over time, however, the optimism embodied in Noyes and other American progressive Christians began to darken. Heavy immigration, a rapid series of "boom and bust" economic cycles, increased physical and social mobility, increased taxation for welfare programs, industrialization and labor unrest, and emerging feminism convinced many that American institutions were on the verge of collapse. Eugenics promised to offer a science-based path to a stable and well-ordered society oriented around a family's supposedly objective genetic merit, with the ultimate goal of a society free of the banes of moral degeneracy, "feeblemindedness," and hereditary disease. The eugenicists built their case through appealing to a several pools of knowledge. Primary was the emergence of Mendelian genetic science, which appeared to show that biological organisms, including people, were composed of individual and immutable genetic traits, many of which could be classified as being either good or bad (Witkowski and Inglis 2008; Kevles 1998). This understanding of human nature was used to fortify existing Darwinist, Social Darwinist, and Malthusian understandings already popular in American society. Such ideas were easy to convey to the broader public through parallels with animal and plant breeding, concepts with which many agrarian and newly-urbanized persons were familiar. Eugenicists were also quick to enroll religious concepts as well, pointing out biblical

[60] While Noyes was unique in setting up an actual directed human breeding program, he was not alone in his views; proto-eugenic ideas, which also appear to have developed in response to Darwin's *Origin*, appear in the 1861 edition of Horace Bushnell's best-selling book, *Christian Nurture*, in a chapter entitled "The Out-populating Power of Christian Stock." This chapter did not appear in the 1847 edition of the book (Bushnell 1861).

references to a person's good heritage and family as a sort of precursor to modern eugenic science; another favorite theme, clearly aimed as Christian progressives, was that of eugenics as a form of ultimate charity:

> Eugenics is a charity to end charity a charity which in the end will make the present form of charity largely unnecessary, since people will in the main be born capable of standing on their own feet and fighting their own way through life Whitney 1926; see also Stoddard 1925).

Woven into these scientific and progressive visions was a collection of assumed norms. The idealized "human" was an independent white male able to simultaneously master, yet remain independent of, cultural expectations (Kasson 2001; Cold Spring Harbor Laboratory N.d). Women, on the other hand, were viewed primarily as a means to the production of eugenically-sound children.

Eugenic visions for society were able to garner significant support, particularly among the upper classes. In the U.S. a great deal of eugenic research was carried out by Charles Davenport and Harry Laughlin who, with support from wealthy benefactors and the Carnegie Foundation, established the Eugenics Record Office in 1910. In 1922 Davenport, Laughlin, Madison Grant, and others formed the American Eugenics Society, an organization which coordinated successful campaigns to implement immigration restriction and eugenic sterilization laws. The group popularized its message through a variety of books and publications (including a popular magazine, *Eugenics: A Journal of Race Betterment*), sponsored Fitter Family for Future Firesides family pedigree contests at regional fairs, and maintained a Committee for Cooperation with Clergymen to promote the message within American religious organizations. The movement succeeded in getting a federal law passed significantly restricting immigration, and also in having eugenic sterilization laws implemented in a number of states. The latter led to the

sterilization of approximately 60,000 to 70,000 US citizens (Kevles 1998; Bozeman 2004; Rosen 2004).

Cryonics: Eugenics, as we have seen, was based in belief in the power of genetic science combined with racial- and class-centric social values. Progress in genetics, the onset of the Great Depression, and especially the advent of World War II, rendered many of these assumptions untenable; confronted with the racialized science and regimented society of Nazi Germany, Americans began to celebrate a populist egalitarian individualism to which elitist and collectivist eugenic thought was anathema. In a literal sense, however, individualism only lasts as long as the lifetime of a particular individual. In the early 1960s this limitation inspired a physicist, Robert Ettinger, to propose the voluntary freezing of critically ill or recently deceased persons with expectation of their being revived in the future.[61] These notions are encapsulated in the titles of Ettinger's books, *The Prospect of Immortality* (1964) and *Man into Superman: The Startling Potential of Human Evolution-and How to Be a Part of It* (1972). In keeping with the egalitarianism of his era, Ettinger took care to point out that his vision of the future was intended to be open to all; the poor, he stated, simply would not tolerate the prospect of the wealthy enjoying immortality while they did not. More positively, he wrote that that "The Golden Rule must know nothing of class or caste." He also wrote that a person of modest genetic endowment would no longer be "a prisoner of his genetic inheritance"

[61] In cryonics parlance, death is termed "deanimation" and revival "reanimation" to emphasize the non-permanent nature of cryonic suspension. The cryonic movement has fought a number of interesting legal battles because of their view that a cryonically preserved person is in a state of suspended animation; the broader society views that person as being dead and thus largely devoid of legal rights. Cryonics adherents usually support legislation legalizing assisted suicide, since under current laws a person having themselves frozen while still alive is engaging in suicide, and the person facilitating the process a murderer.

but, after thawing and rejuvenation, might be enhanced to be every bit as capable as the most high born (Ettinger 1962:165-6).

Cryonics gave rise to a variety of organizations, research institutes, and freezing and storage facilities; organizations include the American Cryonics Society, the Cryonics Institute and its affiliated Immortalist Society, and the Alcor Life Extension Institute. The future, for cryonics adherents, assumes two things: first, that medical and cryonic technologies will progress to allow successful revival, since this presently is not possible. Second, this same technological progress will lead to a future that is radically superior to the present, both in terms of life span and quality of life for the individual. Descriptions of this future are common in cryonics literature:

> Wealth grows exponentially—and will grow much faster when we have Drexler machines to do the work…. [Within] the next century or two there will remain no such disadvantaged wretch as a millionaire. The frozen patient's funds may grow relatively rapidly while they wait; eventually both individuals and society should have almost unlimited resources.
>
> In a golden age we also forsee [sic] the final triumph of the Golden Rule—not the result of preaching or teaching alone, but of simple necessity. Today's sociopaths and bad neighbors mostly feel they have little to lose; they focus on immediate gratification and dog-eat-dog. But an immortal—or an immortalist—expects to share space for a very long time and face his neighbors again and again. We *must* keep the planet clean and earn the trust of others. Immortalists make the best citizens; we and our children will build the world of the awakening…. With limitless life, we will design many futures, and live in them as long as we like or conditions permit. Some will choose long periods of quiet, serene living. Some will adventure to the stars. All who survive will have the chance to live & love & work & play & grow. . . . Join us. (Immortalist Society N.d:16).[62]

[62] "Drexler machines" are microscopic machines capable of rearranging atoms one at a time into almost any configuration; they were popularized in Eric Drexler's best-selling 1986 book *The Engines of Creation.* The broad concept came earlier from a 1959 talk, and later paper, by physicist Richard Feynman called "There is Plenty of Room at the Bottom." While a few simple devices have now been fabricated, Drexler and others feel that future machines will be capable of self-replication and possess nearly miraculous powers, including the ability to repair most forms of human tissue damage. As of September 2014, Alcor

As the excerpt above illustrates, cryonics adherents tend to operate under the conviction that many of humanity's problems are caused by short-term thinking on the parts of humans. Cryonics, with its promise of a vastly extended life span, promises its adherents a future life similar to some traditional views of paradise: there will be vast universal wealth in a clean, orderly, and immortal future in which virtuous living is both required and rewarded, for those born either rich or poor.

Space Colonization: The American space colonization movement crystallized around Princeton physicist Gerard K. O'Neill in the early 1970s. O'Neill was a particle physicist of some renown who became convinced that space colonization offered limitless opportunities for human expansion and development, offering solutions to planetary overpopulation, energy shortages, pollution, poverty and income disparity, and even political unrest that he saw during his day (O'Neill 1981; McMillen 2004). O'Neill used his technical knowledge to develop a number of non-profit and commercial technical ventures to support this vision, especially after it became clear that his vision did not garner significant support from NASA or the US Congress. Groups that he founded, or were inspired by his work, include the Space Studies Institute, the L-5 Society, and Students for the Exploration and Development of Space (SEDS). Among the companies that O'Neill founded to support his colonization effort was Geostar Corporation, which attempted to develop a global location system prior to the advent of the current Global Positioning System (GPS) (Geostar N.d.).

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reported 129 persons were in cryonic suspension at their facility (Alcor 2014). The Cryonics Institute currently reports 118 persons in cryonic suspension as of September 2013 (Cryonics Institute 2014).

Space colonization offered a vision midway between that of the eugenicists and the cryonicists. While not offering a form of personal immortality as did cryonics, space colonization offered adherents the excitement of personal adventure in an imaginable place, rather than the abstract and distant goals offered by either eugenics or more conventional national space programs (McCray 2012:68). This vision of combined personal and collective liberation through space colonization was taken up by Robert Zubrin, a nuclear and aerospace engineer who in 1998 founded the Mars Society. Zubrin and his followers advocate for Mars exploration and colonization; currently the group conducts elaborate simulated space missions and other research activities. Included in the group's founding declaration are the following statements combining scientific exploration with interplanetary manifest destiny to create a future of unbounded opportunity and new beginnings:

> **We must go for the challenge.** Civilizations, like people, thrive on challenge and decay without it. The time is past for human societies to use war as a driving stress for technological progress. As the world moves towards unity, we must join together, not in mutual passivity, but in common enterprise, facing outward to embrace a greater and nobler challenge than that which we previously posed to each other. Pioneering Mars will provide such a challenge. Furthermore, a cooperative international exploration of Mars would serve as an example of how the same joint-action could work on Earth in other ventures....
>
> **We must go for the opportunity.** The settling of the Martian New World is an opportunity for a noble experiment in which humanity has another chance to shed old baggage and begin the world anew; carrying forward as much of the best of our heritage as possible and leaving the worst behind. Such chances do not come often, and are not to be disdained lightly....
>
> **We must go for the future.** Mars is not just a scientific curiosity; it is a world with a surface area equal to all the continents of Earth combined, possessing all the elements that are needed to support not only life, but technological society. It is a New World, filled with history waiting to be made by a new and youthful branch of human civilization that is waiting to be born. We must go to Mars to make that potential a reality. We must go, not for us, but for a people who are yet to be.... (Mars Society 1998)

Transhumanism as a Bridge Culture: Each of the human-centric movements above has tended to focus on one particular emerging science or technology as being the path to the future. The emergence of computers and the internet has influenced this trend significantly. On the one hand, computers themselves have come to be viewed as a means to humanity achieving a form of apotheosis through a technology such as "mind uploading," whereby human minds would be transferred either to a paradisiacal virtual world or to an immortal robotic body. More broadly, however, there has emerged a recognition of the interdependency and interdisciplinary nature of the various technologies, each of which has been augmented by the pervasive use and exponential growth of computing power. We can see this in several ways: first, the growth of transhumanism, a philosophical view that humans can, and should, transform themselves and improve their situation, both individually and collectively, through the application of any technologies possible: genetic, cryonic, space-based, computer, or nanotechnological. Transhumanism has given rise to a number of organizations seeking to further this goal, and to strengthen relations between the various technological movements mentioned. We also see circulation of leadership among the various transhumanist-oriented groups. For example Max More, philosopher and founder of the transhumanist Extropian Institute, now serves as president and CEO of the Alcor Life Extension Foundation, and nanotechnologist Ralph Merkle is on the board of directors.[63]

[63] Similarly, Keith Henson, co-founder of the L-5 Society, was also an early Alcor member, served as the Alcor treasurer in the past, and is reported to have assisted in carrying out cryonic suspension procedures. Eric Drexler, an early leader and promoter of nanotechnology, himself studied under Gerard O'Neill and assisted in building prototypes of some of O'Neill's devices. Hans Moravec, promoter of human to computer mind interface and transfer, also wrote articles for the L-5 Society.

Particularly noteworthy, however, are movements within transhumanism toward rapprochement and reconciliation with broader cultural values. Transhumanism has frequently been criticized for the strident libertarian individualism endemic to the movement, as well as implicit or explicit elitism within precursor movements. In response, the World Transhumanist Association changed its name to "Humanity+" to transmit a more inclusive attitude reflecting collective, rather than purely individual, human enhancement. Another interesting convergence of transhuman and religious aspirations is found in the Mormon Transhumanist Association, members of which aspire to use transhuman technologies to achieve social and religious ends compatible with the values of the Church of Jesus Christ of Latter-day Saints (Mormon Transhumanist Association 2015).

Perhaps the most explicitly religious transhuman group, however, is the small Terasem Faith movement, which aspires to be an ecumenically inclusive religion, complete with ritual practices, clergy, and a faith statement of "Life is purposeful. Death is optional. God is technological. Love is essential." Founded by Martine and Bina Rothblatt in 2012, the group offers a form of personal immortality through the creation of a "mind-file" through intentional recording of one's characteristics using current technology as well as unintentionally through traces of one's personality encoded through networked computer activity and electronic transactions. The goal is to capture a person's "beme," the smallest element of a person's consciousness. At some point in the future, technology called "mindware" will become available which will allow the creation of one's "mind clone." Ultimately nanotechnology and a form of computing will be used to connect all consciousness in the cosmos, creating the equivalent of the omniscient,

omnipotent, and benevolent God found in more traditional faiths. The group is particularly noteworthy in its explicit use of material technologies to achieve spiritually and emotionally fulfilling ends beyond that of simple indefinite continuation of an individual's subjective experience of existence (Terasem 2012; Terasem 2014; Rothblatt 2013; Terasem Movement Foundation 2014).[64]

* * *

In contrasting SETI and other ETI-oriented groups and their human-focused transhumanist counterparts, the core difference is the locus of salvific activity. Regardless of its technological instantiation (cryonic, computer-based, nanotechnological, etc.), human-centric technological millenarians place the focus on human agency, especially the collective agency of humans in the future.[65] ETI millenarians, on the other hand, accord a great deal of agency to aliens, who are assumed to be more technologically advanced and thus command far greater technical resources. More subtle is the question of moral leadership. Human-centric technological millenarians assume, for better or for worse, that humans are ultimately individually and/or collectively responsible for their fates, both physically and morally. ETI millenarians, on the other hand, look to an outward source for moral validation. In the case of the followers of ETI-oriented religions, this message has been revealed; the SETI researchers, on the other hand, appear completely confident that the moral values of the

[64] Unlike most other transhuman groups, Terasem has also demonstrated openness to the ETI-centric paradigm as well; the group has also taken to broadcasting mind files into space in case they might be intercepted by advanced aliens who have already developed mindware and wish to fellowship with humans.

[65] The human-centric technological millenarians using cryonics implicitly and explicitly task future human society with maintaining, reviving, and reintegrating suspended individuals into the society of the future.

aliens will be similar to their own, being creatures of peace, progress, and benevolent charity. Indeed, this conviction has often been manifested among leaders of SETI scientists and others who have periodically engaged in their own attempts at extraterrestrial communication with little concern of possible negative repercussions should contact actually occur.[66]

Despite their differences, both extraterrestrial- and human-centric groups possess significant common characteristics that allow them to compete with older religious visions. Key among these is the plentiful issuance of technology-based compensators to followers in ways that are remarkably similar to those of their religious forebears; technological millenarians, whether xenosalvific or transhumanist, garner resources based on promises grounded in fabulous but non-existent technologies, whether of earthly or alien origin. Further, the exchange of these compensators helps facilitate the creation and maintenance of a common shared vision for the future. Moreover, these compensators may themselves achieve a measure of social reality as they are issued and exchanged with such regularity that their provisional nature is forgotten; they may then be treated as established features upon which other assumptions may be based.

For example, both Raelians and transhumanists operate with the notion of contingent embodiment, in which body and mind/soul are viewed as separable. While

[66] This resulted in censure for Drake in 1974 by Martin Ryle; similar concerns led to a split within the SETI community due to concerns voiced by David Brin and others. Brin strongly supports the search for incoming signals, but feels that some effort should be made to guarantee the benevolence of the aliens prior to humans replying (Brin 2006). Interestingly, prominent SETI researchers in the Russian Federation are at least as confident of the benevolence of aliens as their Western counterparts; this is apparently due to the belief that social and moral progress inevitably converges upon a benevolent form of dialectical materialism. This would be a fruitful area for further research.

discussions of ensoulment have usually been confined to the spiritual realm in the past, technological millenarians see consciousness as a completely physical process in which the human "soul" is viewed as a large data set; this perspective allows for the preservation, enhancement, or even the creation of entirely new consciousnesses using material means. Bendle (2002:47) has insightfully observed that transhumanists conceive of humans as being "essentially information that is only *contingently* embodied and therefore capable of being 'uploaded' into 'super-intelligent' communication and information systems that know no limitations of time or space [emphasis in the original]." This denial of the absolute nature of finite human embodiment, which at least a portion of the ETI-centric millenarians also share (Palmer 2004), offers an open-ended promise of an eternal life—open ended in that the exact nature of this life (cloned, robotic, and/or virtual; gender; super-human enhancements, etc.) is left up to the imagination of the individual. The fact that the technologies for this to happen simply do not exist appears to be of only minor consequence to adherents, in part because all advances in computer or nanotechnology can be interpreted as confirmations of the inevitability of their technological millenarian vision.

Transhumanist and xenosalvific groups, similar to religious organizations, also expend care in balancing "carrot" and "stick," or attraction and fear, in the technological millenarian visions presented. On the fear side is the realization of one's own mortality and the worry that one's most cherished values and institutions may not persist in the future. Technological millenarians offer a means to address these worries, offering to preserve the best of the past and present, while offering an enhanced future. This future, however, must not be too different from the past or present; an unfamiliar future would

be more frightening than inviting. We thus find the futures offered by the technological millenarians tend to be much like the present, only vastly better: life will be longer, with less sickness; there will be work, but it will be more interesting to the worker and more beneficial to the surrounding society; there will be relationships, but they will be more rewarding; there will be greater material abundance (or its cyber equivalent), but less waste. There may also be worthy ethical and technical guidance from paternal but unobtrusive alien beings. In these ways the unknown future is harnessed and domesticated by the millenarian technologists, who claim to offer a controlled, benevolent, and meaningful gateway to an otherwise menacing and meaningless, but inevitable, future.

While some of the movements examined here might appear eccentric, we see that the underlying hopes and aspirations of technological millenarians are in fact quite traditional. The concerns that seek to address are not idiosyncratic, but are broadly shared: modern SETI, for example, coalesced around the question of whether humanity could survive in a nuclear era, a question that also propelled artistic works such as *On the Beach*, *Alas Babylon*, and *Doctor Strangelove* to best-seller status. Space colonization addressed urgent concerns such as overpopulation and limited energy resources, while cryonics offered persons in time of individualism to preserve their identities beyond the limits of a normal lifespan. Eugenics promised to address white middle- and upper Americans' concerns about immigration, expansion of welfare, and fear of not being able to measure up to self-imposed expectations, the same sorts of near- and intermediate-term worries that have always concerned humanity. Technological millenarians provide answers similar to those offered by their religious forebears: promises of both a well-

ordered earth and eternal life in a paradisiacal state to those willing to make short-term sacrifices in the present. Indeed, the contrast between xenosalvific groups, which depend on alien assistance, and transhumanist groups, which look solely to human effort, parallel long running theological debates over whether humans can contribute anything to their eternal salvation, or whether humanity is so weak and depraved as to require outside assistance. The difference is merely one of means: technological millenarians eschew the supernatural and embrace the material, though the posited final results are remarkably similar. This similarity of vision should not be surprising. Visions of the future, whether spiritual or technological in nature, are not normally created in isolation; rather, they are co-generated through a dialog between an individual or group and the broader society and are motivated and given credibility by the dreams and aspirations of each. This co-generation allows for both group and society to adapt to changing circumstances with the passage of time, and for specifics of the visions to evolve as well (Latour 1996; Pinch and Bijker 1987).

SETI, Raelians, transhumanists, and other technological millenarian groups, like their religious predecessors, portray themselves to both themselves and others as mandatory passage points into the technological and moral future.[67] By portraying itself

[67] The primary exception to this general rule is the Terasem Faith, which inclusively embraces the possibility that the individual's personality might be reconstructed in a happy state either through human effort, or through the help of benevolent aliens who intercept mind-files beamed randomly into space. Terasem appears idiosyncratic in this regard due to their conviction that the goal is to preserve and multiply an approximation of one's personality across space and time, without preserving the subjective sense of consciousness of a particular individual. Most other groups view the preservation of the individual consciousness at being of paramount concern. Future work might examine the extent to which Transhumanist and xenosalvific movements mirror the religious goals and expectations found in the surrounding culture: are the American movements Christian, as opposed to, say, Jewish or Hindu, flavored in their concern for the preservation of an individual's sense of consciousness?

as the most accurate interpreter of both the natural and the social worlds, and also the controller of the most socially powerful technology, each group also supports the continued worth of the compensators that the group issues. SETI practitioners, for example, will be the first to receive, and presumably decode and disseminate, their immortality-bearing Encyclopedia Galactica when it is received by their radio telescopes. Those who faithfully follow Rael and his alien-inspired genetic teachings will be first in line to receive an eternal life filled with worthy adventure and satisfying sexual relationships. And transhumanists, too, claim to provide the only way toward immortality, via some combination of cryonics, nanotechnology, and computer engineering, providing its adherents with the promise of waking up in a perfected, immortal body. However, whether conveyed through advanced aliens or solely through human effort, in each case salvation is mediated through scientists and technologists claiming to be the truest and most effective channel to nature's future material bounty. And even if the followers, or the leaders themselves, are not ultimately able to cross over into the promised land of immortal bliss, they can operate in the moral certitude and satisfaction that they are prophets of technoscientific advancement and meaning, and therefore the best and surest path toward human material and moral betterment.[68]

[68] It is important to realize that that these visions of the future are not usually created, or discovered, by an individual and only then released into the broader culture; rather, these visions are co-generated through the dialog between the individual or group and the surrounding society. This co-generation allows for both group and society to adapt to changing circumstances with the passage of time (Latour 1996).

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Now faith is the substance of things hoped for, the evidence of things not seen. – Hebrews 11:1 KJV

To Infinity and Beyond! What SETI and Other Speculative Technologies Teach Us

In this dissertation I have examined SETI from two directions. The first case was an examination from the inside out, using Actor Network Theory (ANT) as an interpretive framework to show how SETI has been constituted twice in America, first around the beginning of the 20th century with Percival Lowell, and again during mid-century with Drake and Morrison's group. In both the earlier and later cases we see individuals acting as scientific and cultural entrepreneurs who were able to build long-lived scientific enterprises based around the science and technology of their day, combined with cultural hopes and aspirations projected upon the ambiguous canvas of infinite space.

In my second case I have examined SETI from the outside in, using a combination of ANT and a Miller/Nye/Kasson "myth and meaning" interpretive analysis to show that SETI is in fact one of a number of technological millenarian movements which have been, and continue to be, active today. I also employed Stark and Bainbridge's economically-oriented compensator-based theory of religion to show how, as with religious groups, purveyors of avant-garde technologies such as SETI allow researchers to borrow against the utopia of tomorrow in order to secure the resources today which are required to bootstrap the technical and social construction of a new enterprise. We also see that, in spite of the updated canvas, these marvelous technologies of the future tend to play on familiar themes, tropes, and aspirations found in traditional religious and spiritual venues being recast in technological terms, only with humanity's

ultimate destiny being achieved through material technology, rather than through spiritual, or non-material, means. In this way scientists and technologists may thus lay claim to (some might say usurp) the social and moral authority of traditional religious institutions, but without overtly challenging traditional social values and cultural assumptions which, if undermined, would destabilize the social and political order upon which the research professionals themselves professionally and personally depend.

In this concluding section I would like to elaborate a bit further on the notion of compensators, and also show how they can be used to help explain how an avant-garde technical movement has begun to transition from offering promises of a utopian future into real tangible rewards—though not the rewards initially promised by SETI. My analysis of the implementation and operationalization of SETI-derived technologies is here also influenced by Bijker and Pinch's Social Construction of Technology (SCOT), which shows how persons using a technology may reinterpret it in ways unintended by its initial creators (Pinch and Bijker 1987).

Compensators and Understanding Individual Motivation

In 1985 Stark and Bainbridge published *The Future of Religion* in which they outlined an economically-based theory of religion, which they developed more systematically in *A Theory of Religion* ([1987] 1993). In these works they lay out a set of axioms and a vocabulary. Axiomatically they state that humans generally try to maximize rewards while minimizing their costs; further, humans will exchange various rewards in pursuit of greater rewards. However some rewards are very rare, or even non-existent. In such cases compensators may be generated and exchanged. Compensators are basically IOUs or scrip which are produced and exchanged in lieu of an actual reward itself,

balanced against the credibility of the guarantee. For example, a person works today in part for pay (a concrete reward), and also for the promise of a comfortable and secure future retirement (a compensator); indeed, a person may forego some measure of current pay and/or change jobs based on an intangible but subjectively credible promise of future benefit, discounted against known and unknown hazards (early death, personal or society-wide economic disruptions, etc.).[69]

Stark and Bainbridge note that rewards and compensators may be specific or general. In terms of rewards, an example of a specific reward might be a food item, which meets a fairly narrowly defined need; a general reward might be a sizable sum of money, which can be used in any of a number of ways. Similarly, specific compensators may be given in exchange for specific present narrowly-defined inconveniences ("I will do the dishes for you now, if you will do them for me in the future"), while general compensators are more broad and versatile. For example a person pursuing an educational venture expends time, personal effort, and perhaps tuition in the present in exchange for promises that may include personal growth, improved career prospects, and/or an increase in social status. Key for Stark and Bainbridge, however, is the promise and exchange of compensators for future rewards which are simply nonexistent, at least not in any materially-provable sense (a perfectly just society, or eternal life in paradise). Compensators thus circulate in our society in much the same manner as any other good or

[69] The examples of specific and general rewards and compensators that I give here are my own; Stark and Bainbridge only define specific and general compensators relative to each other: "Rewards are *general* to the extent that they include other (less general) rewards," and "Compensators which substitute for a cluster of many rewards and for rewards of great scope and value are called *general compensators"* (Stark and Bainbridge [1987] 1993:28 and 36).

service, with individuals making rational evaluations and choices as to which rewards and compensators to produce, retain, and exchange.

Stark and Bainbridge were primarily concerned with applying their concept within the sociology of religion, seeing the religious world as a marketplace in which money, goods, and services are exchanged for supernaturally-based compensators. The strength of the Stark and Bainbridge model is encapsulated by one of its alternative names, which is the "rational choice" model of religion. Rather than simply seeing religion as being the domain of wishful thinking and maladjustment, or of persuading people to support a cause, or even as acting as the reservoir of mutually agreed upon social values that hold a society together, religion becomes all of these and more as people choose to "purchase" and exchange religious goods, services, and compensators based on how well individuals see them as serving their individual needs. Similarly, religious groups may in turn be seen as marketing a range of goods, services, and compensators which they may choose to adjust based on the demands of their clients.[70]

Central to the Stark and Bainbridge model is the notion that there is a clear difference between religious compensators and those that are not; they define religious compensators being those "based on supernatural assumptions," and in subsequent work during the 1980s they tended to view actions motivated by supernatural vs. non-supernatural compensators as a bright line of division, with religiously-based compensators existing in an economy independent of secular compensators. The examples of my preceding papers clearly demonstrate, however, that the "supernatural"

[70] Stark and Bainbridge's ideas here seem to parallel notions found in the work of ethicist Kenneth Arrow, who has been interpreted as saying that happiness can best be modeled as individual preference satisfaction (Arrow 1951; Hinman 2003).

line may not be as bright as one might initially believe: purveyors of religion, and purveyors of avant-garde technologies of personal and cultural self-transcendence such as SETI, both exist by providing very general compensators (the prospect of immortality, an *Encyclopedia Galactica* of advanced alien knowledge, the possibility of world peace, etc.) in exchange for financial and social support in the present. Further, religious, xenosalvific, and transhumanist adherents can form hybrid economies based on the exchange of both tangible rewards, and also promises and prospects of potential technologies that cannot be formally verified in any meaningful way at the present time, and are thus effectively non-existent.

Yet, as in the case of earlier religious movements, real technologically-based economies can coalesce around physically non-demonstrable but socially real compensators. An example of this can be found in the case of early space exploration. Pioneering rocketry theoreticians Konstantin Tsiolkovsky of Russia and Hermann Oberth of Romania both embraced a space-based technological utopianism in which humanity would reach its ultimate fulfillment through space exploration. Oberth's works in particular inspired the young Werner Von Braun, a major architect of the German Nazi rocket program and, later, of the American space program. With time, Von Braun's space vision, along with many of his associates at NASA, became suffused with strains of evangelical Christian apocalypticism (Noble [1997] 1999; McMillen 2004). While Tsiolkovsky, Oberth, and Von Braun's desire for large-scale escape from the confines of earth via space technology remain as yet largely unfulfilled, their visions became socially real enough to manifest as ballistic missiles and a launch infrastructure robust enough to

support near-earth human space exploration, as well as deep space operations via robotic space probes.

A second example of this can be found in the case of the growth of the personal computing industry. Many of the early movers in the field were profoundly influenced by 1960s and 1970s dream of a communitarian and just society, to be facilitated through networked computers that would somehow lead to the empowerment of the common person. This compensator—the promise of a universally egalitarian society—inspired many within the computer field and led to the creation of a number of institutions and publications dedicated to the furthering of this vision. Examples of publications include the *People's Computer Company*, the title of which was inspired by Janis Joplin's band, "Big Brother and the Holding Company," and *Dr. Dobb's Journal of Tiny Basic Calisthenics & Orthodontia.* The former publication eventually became *Recreational Computing*, an early magazine dedicated to computer gaming that was published until the early 1980s, while the latter eventually grew into a long-running mainstream computer journal, *Dr. Dobb's Journal*). Another manifestation was the WELL ("Whole Earth 'lectronic Link"), an influential and still active computer bulletin board service and online community originally dedicated to the spread of popular empowerment and other counter cultural ideals (Freiberger and Swaine [1984] 2000; Turner 2006; Markoff 2005; Levy [1984] 1994).[71]

[71] The WELL was in part the brainchild of Stewart Brand, who was also publisher of the best-selling *Whole Earth Catalog,* a series of publications aimed at providing tools and resources to facilitate counter-cultural experimentation. Interestingly, Brand himself became a supporter of O'Neill's space colonization efforts.

Within the SETI realm a cogent contemporary case can be found in the SETI@home effort, in which volunteers use their personal computers to process data collected at the Arecibo radio telescope with the hope of finding signals from intelligent extraterrestrials. In the initial version of the project, which publicly launched in mid-1999, tapes of Arecibo data recordings were subdivided into small "work units." Volunteers then downloaded these work units via the internet, along with client software that doubled as a screen saver. The client program would then inspect each work unit for possible ETI signals, with the average work unit taking a few days to process; at the end of this period, the home computer would automatically transmit its result back to the SETI@home servers and a new work unit downloaded for processing. Volunteers could keep track of how many work units they had completed on a public web site, and friends were allowed to form teams as well.

As originally conceived, the compensators offered were completely non-tangible: the prospect of detection of extraterrestrials, and a possible place in history as the person owning the computer on which the first verifiable alien signal was detected. Similarly, the immediate rewards offered to participants were also not economically valuable: a subjective sense of satisfaction of volunteering otherwise wasted personal computer power for the search for ETI, a downloadable certificate of appreciation, and use of a visually interesting, vaguely *Star Trek*-themed, screen saver. The project's creators expected perhaps 100,000 volunteers to sign up (Sullivan et al. 1996).

Soon, however, what was intended to be a fairly straightforward and limited project for volunteer distributed processing mushroomed to several million participants. Contributing to this explosion of interest was the unexpected development of a

SETI@home culture as an additional reward system developed: different individuals and groups began to compete with each other as to who could process the most work units. SETI@home offered a way of publicly demonstrating one's computing prowess through the contribution of large numbers of work units and/or through providing tips as to how to optimize one's computer to maximize work unit output. Some participants set up specialized computers for no other purpose than to "crunch work units," and others wrote unofficial add-on caching programs to allow work units to be processed more efficiently, or to hide the SETI software should one wish to install and run the client on computers at work or other unauthorized places.[72] Eventually the project had to put measures in place to guarantee the authenticity of the client software because some users rewrote the software to run more efficiently, while others simply tried to boost their numbers by returning phony work units in an attempt to increase their overall work unit scores.[73]

With SETI@home we thus find a compensator—the discovery of hypothetical alien beings—serving as the nucleus around which a complex economy of reward and compensator exchange developed. Indeed, rather than simply volunteering idle computer time and passively watching work unit numbers, participants took an active (and sometimes illicit) role in the generation and exchange of new types of rewards in ways unanticipated by the project's administrators. Further, the popularity of SETI@home served as both and inspiration and foundation for a variety of other volunteer distributed

[72] While unauthorized installation of SETI@home client software was conspicuously and explicitly discouraged by SETI@home project leaders, the desire for work units on the part of participants resulted in this issue being an ongoing concern.

[73] Parody sites also emerged which made fun of the SETI@home enthusiasm; these included YETI@home, which claimed to wish to set up an automated network of webcams to watch for any yeti that happened to walk through participants' back yards, and Carolyn's Clinic, dedicated to helping those with SETI@home addictions. See YETI@home (1999) and Carolyn's Clinic (2000).

processing projects, generating new types of compensators and rewards for people outside of the SETI@home community. The creators of SETI@home eventually generalized the client software into a software platform called the Berkeley Open Infrastructure for Network Computing (BOINC); this is made available to researchers around the world who may then adopt it as a platform for their own computationally-intensive projects. Lay volunteers then chose to contribute varying amounts of leftover CPU (and now video card graphics processing unit, or GPU) time to a sizable menu of research efforts. In addition to the ongoing SETI@home project, BOINC users have the option of donating processor time to a wide variety of pure and applied research areas, including astrophysics, physics, cryptography, climate study, mathematics, molecular biology, epidemiology, and drug development.

It is important to note here that SETI@home did not originate the notion of distributed computing. It was also not the first large volunteer-based distributed computing; that honor goes to distributed.net, which went live in 1997, some two years before SETI@home (distributed.net 2014; distributed.net 2010).[74] The multivalent nature of SETI@home, however, resulted in generating immense interest and helped propel the development of a multitude of other distributed computing projects. Hypothetical aliens became socially real enough to act as a social force leading to concrete technological and scientific advancements, even though the exact form of the advancement has not, and may never, occur in the way that Flammarion, Lowell, Morrison, Oliver, Drake, and Sagan had anticipated.

[74] As of 2010, distributed.net claimed about 60,000 volunteers. Unlike SETI@home, the group has focused on two projects: encryption cracking and Golomb rulers. (The latter is of interest in applied mathematics for uses in data error correction and radio applications.)

Indeed, in SETI's multiple manifestations (Lowellian SETI, modern SETI, SETI@home, etc.) we see a pattern emerge that is periodically repeated in science and technology, one which parallels analogous events in the emergence of religious and philosophical movements: if a group of talented technologists come to share a compelling common moral vision, they will then share their collective talents, sparking innovations driven as much by moral fervor as by any sense of practicality or utility.[75] While not all of these ideas will catch on, some will resonate with sectors of the broader society, garnering attention and resources for further development. Indeed, the innovators themselves may participate in this, seeing this development and commercialization not simply as ways to personal wealth, but rather as means to address some pressing social problem or, more generally, as means toward human betterment. With time others may then in turn further develop and commercialize the technologies and techniques developed, often expanding and reinterpreting the technologies along lines unanticipated by the originators.

The power of the initial paradigmatic vision upon the innovators may provide moral coherence and fortitude to the researchers, allowing the formation of a shared collective identity and helping them to persist in the face of initial adversity. However it may also render them resistant to seeing negative consequences or downsides to their projects as well. SETI enthusiasts thus desire to establish contact with aliens, with only the most cursory consideration as to whether the aliens are like to exist or be friendly.

[75] While my study here focuses primarily on the "technology" end of the science and technology spectrum, a similar pattern also sometimes emerges among scientists. See, for example, Kohler's description of the moral economy that developed among *Drosophila* geneticists in Thomas Hunt Morgan's laboratory (Kohler 1994: 91-132).

Cryonicists search for immortality, but do not carefully consider the consequences of what would happen if and when their technology actually works. Eugenicists worked on genetically improving society without regard to the suffering inflicted upon those deemed "eugenically unsound." Nano- and biotechnologists promise a future cornucopia of benefits, but do not dwell overmuch on possible environmental hazards.

Nor is this pattern confined to non-mainstream and avant-garde sciences and technologies. Nuclear technologies, for example, have often been pursued with minor regard to possible hazards. For example, the U.S. Government spent almost a billion dollars on Operation Plowshare, dedicated to using nuclear explosions for large-scale excavation and gas and oil extraction; specific proposed projects included construction of a replacement for the Panama Canal (the "Pan-Atomic Canal") and construction of an interstate highway and rail line in California. The program was only abandoned due to public outcry over possible radiation hazards, ground water contamination, and other environmental hazards after some twenty-six test explosions had already been conducted (Sovacool 2011; Rogers 2012).

Similarly, antibiotics have been developed and used extensively, especially on farm animals,[76] without regard to possible downside medical or environmental hazards. More recently social media and computer networks have been promoted with only modest attention given to personal and collective risks of such massive data collection and interlinkage. Further examples could be given, but the overall pattern is clear:

[76] The controversy here is not use of antibiotics on sick animals, but rather widespread use of antibiotics on well animals as a preventative measure to lower the chances of their becoming ill.

downside risks are often overshadowed by the promise of a more morally perfect and economically prosperous future.

Compensators, Supernatural and Not

We can also see how compensator and reward exchanges may easily cross between the material and the supernatural realms in other avant-garde technologies. For example, a person considering their final arrangements and drafting a will could rationally do a risk-to-reward and cost comparison between cryonic suspension and more traditional funeral arrangements, weighing the advantages and disadvantages of each option in terms of 1) faith in/plausibility assessments of the cryonics process, 2) faith in/plausibility assessments of an afterlife, 3) expenses and social burdens placed on the family by each choice, 4) the likelihood of one's survivor's executing the various options, and so on. While one might hypothesize a conflict developing between transhumanists and xenosalvationists on the one hand, and traditional religious forms on the other, this is not necessarily the case; in the case of cryonics, cryonics practitioners have made explicit efforts to portray their work as an extended form of medical care, rather than as a challenge to traditional religious authorities. It is less certain, however, that this cooperative view will be able to be maintained for technologies which view embodiment as unimportant and the human essence completely capturable, with the concept of data replacing the earlier idea of spirit.[77]

[77] The artificial nature of the natural/supernatural divide later became more apparent to Stark, and especially Bainbridge, as well; however, they took their analyses in different directions from mine. At the time that they devised their rational choice model, Stark and Bainbridge both claimed to be "personally incapable of religious faith" (Stark and Bainbridge [1987] 1993) and appear to have been simply modeling religious behavior in an instrumentalist fashion; they also concluded at the time that religion and religious innovation would probably continue into the indefinite future. Both researchers later appear to have

The above cases mainly focus on understanding that religion and technology both offer rewards and compensators which may overlap or compete with each other. But what about the case of the motivation of a particular researcher? Here again we see general compensators in action. For example, one can easily explain why students are currently encouraged to study and enter STEM (Science, Technology, Engineering, and Mathematics) areas; correctly or not, there is wide-spread belief that effort devoted to STEM-field study now will yield ready rewards in the form of jobs for the participants, and economic growth and prosperity for the country as a whole. STEM here acts as a fairly specific compensator, promising gainful employment in the future for those who study in a technical field now.

However, the notion of the general compensator can be used to illuminate STS studies as well, helping us to better understand the fascination science and technology

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become realists, and have moved away from their original positions. Stark has since professed Christianity and has written a number of historically-oriented books linking Christian faith and practice to the rise of science and western power, while Bainbridge has become a strident transhumanist, claiming that "magic and religion arose in human culture as pseudosolutions to the problem of providing help when people were obligated but unable to offer real solutions….", with religion inevitably opposing the personal freedom and power offered by transhumanist technologies (Bainbridge 2005). Bainbridge has since published voluminously on the promise of nanotechnology, computer-based personality transfer and emulation, and similar topics; he also expects an eventual civilization-threatening show-down between religious fundamentalists and the forces of scientific enlightenment (Bainbridge 2007a, Bainbridge 2007b).

Perhaps because of their later conviction that the objects of their study are ontically "real," rather than models or approximations of reality, both researchers appear to have moved away from the use of the term "compensators" in their work. While Bainbridge (2007a:17) continues to hold that his compensator model is fairly neutral toward religion, he views recent research in cognitive science and his own agent-based computer simulations of religious behavior to demonstrate concretely and definitively the falsity of religion. However I continue to view the compensator model as being useful because it can be used to describe how concrete goods and services can be exchanged for things—either religious or technological—which are presently imaginary. Symmetric treatment (Bloor [1976] 1991) of religious and technology-based compensators in this fashion does not seem to occur to Bainbridge, who now appears to view religion as a complete social fabrication that will eventually come into violent conflict with purveyors of "real," if as-yet-undeveloped, transhumanist technologies.

holds for those working in more speculative areas of endeavor—say, in the fascination displayed for personal computers during the early 1970s, when there was not yet a clear understanding of their use, or even usefulness, in society, or in the fascination with space that emerged in the 1950s and remained vibrant in some groups for decades. For example, Paul Edwards, in his work *The Closed World* (Edwards 1997), posits the existence of two fundamental forms of social life at work in American culture: a "closed world" and a "green world." The core of Edward's work is dedicated to an analysis of how a desire for security on the part of Americans led to the construction of a vastly expensive and complex digital computer-focused military-industrial behemoth promising physical, and especially cultural, security against Soviet military and political incursion. Edwards then shows how this system, which remained unused during the Cold War, completely and totally failed when employed by Robert McNamara in Vietnam, in part because computer simulations of military operations and their supposed outcomes were mistaken for representations of military and political reality on the ground.

However, Edwards' analysis is not able to explain why people allowed the systems to be built and sustained in spite of their manifest deficiencies. I argue that the military and the politicians of the era offered concrete rewards to computer contractors, who in return provided fabulously complex computer-controlled military systems. These systems functioned as general compensators, promising military and cultural security; these promises were backed by the credibility of the science and technology which had been devastatingly effective in creating radar, the atomic bomb, and code-breaking during World War II. The anticipated Soviet attack never came, however, allowing the reward for building the system to be deferred indefinitely; it also let the concrete

effectiveness of the systems to remain largely untested and the credibility of the compensators to go unchallenged. Indeed, these general compensators appear to have worked well during the 1950s and much of the 1960s; despite much anxiety on both sides of the conflict, the Euro-American and Soviet power blocs managed to hold each other at bay. The underlying compensators only began to lose plausibility for socially influential sectors of society during the early 1970s as the systems and strategies which had apparently been effective at defending high-tech superpowers from each other conspicuously failed when confronted with low-tech Viet Cong adversaries.[78] The result was a conspicuous loss of plausibility on the parts of both the military and the scientific establishment: the promissory IOU had been called, but the reward—military supremacy over a seemingly poorly-equipped and economically backward enemy—was demanded but not forthcoming. Some have suggested that the loss of credibility endured by the military also contributed significantly to loss of popular support for the Apollo space program, which in the mind of the public was both expensive and supported by many of the same values and compensators as was the military (Tribbe 2014).[79]

Thus various new sciences and technologies act as general compensators: promises of future, and as-yet-imaginary, rewards. And, since the compensators are general, they can be imagined in grandiose terms on the canvas of the imagination. Space thus becomes the arena of limitless freedom and boundless resources, while genetics

[78] A similar loss of compensator effectiveness may have occurred in the Soviet Union when it found itself unable to prevail in its 1978-1989 conflict with the vastly smaller and less technologically-developed country of Afghanistan; it may not be a coincidence that the Soviet Union dissolved only two years after its withdrawal from the Afghan region.

[79] Interestingly, a significant number of transhumanists appear to be persons for whom the promise/compensator of space exploration and computers remained persuasive, coming to transhumanism via the space colonization movement.

offers the promise of human physical, and perhaps moral, perfection. Cryonics offers immortality, and nanotechnology promises an improved version of the Midas touch, though shorn of drawbacks. All are seen as being relatively risk-free, at least to those constituencies and audiences deemed important enough to merit consideration.

Tacit Assumptions about Values

Of course, man does not live by compensators alone; the quasi-economic nature of compensators means that they are supported as socially-constructed beliefs and desires as much as by material needs. Compensators maintain their value through appeal to a convincing mythos. As discussed earlier in this dissertation, believers in ETI maintain theirs by positing a universe of not only uniform physical and biological laws, but also of moral and emotional development as well. Flammarion, Tesla, Drake, Sagan, and even Rael all subscribe to the notion that at least some aliens will have evolved in a way that allows both humans and aliens to be comprehensible to each other, both intellectually and emotionally. During the Lowellian era this intellectual and moral uniformitarianism appears to have been supported by viewing Mars as being the Earth's older geological sibling; analogically, Martians would be the same biologically. Universalistic notions rooted in the Enlightenment, which supplied a mythology of perpetual and coterminous moral and intellectual progress, implied that the Martians would be more culturally and technologically advanced as well. These assumptions appear to have been absorbed by modern era SETI researchers, only applied on an interstellar, rather than interplanetary, scale.

This assumption of mutually comprehensible intellectual and moral understanding between humans and aliens has, however, been questioned from several directions. A number of natural scientists have suggested, for example, that beings with significantly different evolutionary histories, different sensory experiences, and different biologies would have such different mental processes as to be utterly and permanently incomprehensible to each other due to lack of commonly-shared referents of meaning and goals (Sheridan 2009).

At root, however, this difference may not be one of biology, so much as one of philosophy. Within the philosophy of biology there has been a long-running debate as to whether anything like purpose exists within evolution, or whether "purposes" found in nature are simply projections of the human observer's mind upon the near-infinite variations found within the material world. For our purposes here, however, it is sufficient to observe that xenosalvationists exist in a teleological universe, or one in which humans have some sort of ultimate purpose. In this they share much with their religiously-minded forebears, except that the xenosalvationist teleology is materialist, rather than spiritual, in nature. However, it is this teleological stance which leads them to assume not only that intelligent aliens are likely to exist, but also that should they be encountered they will be both comprehensible and likely benign.

It is, however, possible to invert such philosophical assumptions. Author H.P. Lovecraft, for example, explicitly rejected such notions, stating:

> …all my tales are based on the fundamental premise that common human laws and interests and emotions have no validity or significance in the vast cosmos-at-large. To me there is nothing but puerility in a tale in which the human form—and the local human passions and conditions and standards—are depicted as native to

> other worlds or other universes. To achieve the essence of real externality, whether of time or space or dimension, one must forget that such things as organic life, good and evil, love and hate, and all such local attributes of a negligible and temporary race called mankind, have any existence at all… [W]hen we cross the line to the boundless and hideous unknown—the shadow-haunted Outside—we must remember to leave our humanity—and terrestrialism at the threshold (Lovecraft 1927).

Lovecraft's view, which he termed "cosmicism," hews to a strict materialism, devoid of purpose or divinity, in which humanity is of utterly no consequence in a vast universe; it is thus a sort of anti-mythology in that it adamantly denies the existence of any purpose beyond that of an individual person's cosmically insignificant desires (Joshi 1997:12; Joshi 2015; Joshi 1996; Campbell 1996; see also Oakes' [2000:29-62] excellent study of the place of Lovecraft's work within the American gothic literary genre).[80] Yet, while Cosmicism and its variants may offer a certain aesthetic and philosophical consistency in a way that xenosalvific schools of thought do not, its existence raises an important

[80] While Lovecraft was very clear about his cosmicist views and literary intentions, he was not alone in his embrace of indifferentism. Lovecraft's near-contemporary, Olaf Stapledon, also examined these themes, and his work may have exerted an influence on Lovecraft, who held Stapledon's *Last and First Men* in high regard (Campbell 1996; Lovecraft 1936). Though a philosophical idealist of British origin rather than an American materialist, Stapledon, especially in his works *Odd John, Sirius*, and *Last and First Men,* deals with encounters between humans and both alien and advanced human intelligence. While the results of these encounters in Stapledon's works are generally unhappy for both sides, these outcomes are generally the result of misunderstanding, differing needs and goals, and indifference over the welfare of the weaker race by the stronger. In Lovecraft's work, on the other hand, human encounters with powerful aliens are often accompanied by collective human barbarism and/or individual psychic breakdown in the wake the meeting. Similarly, aesthetic differences between races in Stapledon's stories are generally portrayed with each side experiencing the other as strange and unfamiliar; in Lovecraft's works the protagonists find the unfamiliar unremittingly hideous and often malicious.

Stapledon's work was initially more influential that than of Lovecraft due to Lovecraft's initial publication in amateur and "pulp" magazines of limited cultural influence; Stapledon, on the other hand, was noticed by a number of cultural luminaries of his day, including J.B.S. Haldane and Bertrand Russull; his work also influenced such indifferentist science fiction authors as Arthur C. Clark (most notably his work *Childhood's End*), Poul Anderson, Isaac Asimov, Theodore Sturgeon, Brian Aldiss, and others. C.S. Lewis was inspired to write his "Space Trilogy," especially *That Hideous Strength* (1945), in part as a form of rebuttal to Stapledon (Crossley 1994: 193, 225, 330, and 364; Crossley 1986; Fiedler 1983: 6-7). In the present era, however, the roles have been reversed, with Lovecraft now garnering much more attention than Stapledon in terms of both readership and critical recognition.

question: could such a school of thought act as a spur to any sort of positive research program? The answer so far appears to be negative, leading one to suspect that some sort of positive mythology may be a requisite for positive action in a way that a negative, or even a neutral, mythology cannot provide.

Final Conclusions, and Avenues for Further Research

Stark and Bainbridge's rational choice model of religion (here expanded to include avant-garde science and technology), when combined with ANT, shows how studies of SETI in particular, and technological millenarianism in general, are in fact extremely relevant to understanding our contemporary society, providing a map for viewing other, more culturally entrenched and/or culturally volatile, ongoing debates taking place both in the United States and internationally. One ready example of this is the ongoing debate over healthcare. On the one hand, healthcare is often portrayed as being the domain of "medical science," whose core questions can supposedly be addressed (given sufficient resources) with the material tools of bacteriology, biochemistry, and now information science. Yet such material and utilitarian approaches, which are seemingly open to inspection by all, can obscure deeper assumptions about the ends and goals of current medicine. Most people would probably agree with the traditional understanding that the goal of medicine is the amelioration of the suffering caused by major and minor ailments encountered by most persons during the course of their lives, such as influenza, broken bones, and appendicitis. With the advance of medical technology, however, the question of endpoint has become less clear: is the goal of medicine to help a person maintain more or less average levels of health and mobility during the course of an average life span of about 78 years, and then manage the ensuing

inevitable decline with as much dignity and freedom from suffering as possible? Or should medicine be instead viewed in a way more in keeping with that of many technological millenarians, as helping in an individual's quest for personal immortality, with anything less than this is a loss? Public opinion on the matter is divided; a 2013 study by the Pew Research Center found that about 41% of persons surveyed felt that radical life extension would be beneficial to society, with 59% disagreeing (Pew Research Center 2013).[81] While slightly in the minority, it appears that a vast number of Americans are open to a using technology to significantly extend their lifespan.

More broadly, to what extent should one's body, and/or one's children, be reshaped in comparison to socially- or Platonically-inspired ideals, or utilized as canvas for personal self-expression? Looking at speculative sciences such as SETI may help us to cast light on the assumptions and compensators that we, to our detriment, unthinkingly take for granted in our understanding of the technological society in which we live.

As is often the case, the research contained within this dissertation leads to further questions. A number of avenues for further research are suggested:

The Defunding of NASA's SETI Work in 1993: In the area of the history of SETI, further work could be done examining the precipitous loss of federal funding in 1993. While a few small SETI-oriented projects were undertaken by persons not closely tied to the Drake/Morrison/Oliver group, most notably John Kraus and Robert Dixon's "Big Ear" project at Ohio State University, which ran from 1973 to 1997 (Kraus 1995; NAAPO 2008), other groups may have gained increased traction after congress defunded

[81] Interestingly white Protestants and white Catholics were the two groups least likely to hold favorable views of radical life extension (34% and 31% respectively), and black Protestants the most likely (51% favorable). Person not identifying with a religious group were close to the overall national average, with 43% approving.

Morrison, Drake, Oliver, and Tarter's NASA-sponsored SETI project. Possible beneficiaries include the SETI League (a confederacy of amateur radio operators with interests in radio astronomy and SETI), the University of California, Berkeley's SERENDIP project, which placed its own antenna on the Arecibo radio telescope and now collects SETI data from wherever the telescope happens to be pointing, the related SETI@home project, which allows volunteers to reprocess SERENDIP data in vastly greater detail using home computers, and various optical (rather than radio) SETI efforts. While some work in this area has been done by Fricke (2004), more work remains to be done analyzing institutional dynamics and the differing strategies used by various groups to garner resources.

Such work could also be done as part of a more general study of the history of SETI; most work to date has focused on initial paradigm group of Drake, Morrison, Oliver, Sagan, and others; however, as Swift pointed out in the conclusion of *SETI Pioneers* (1990), a new generation of SETI researchers was arising, exemplified by his brief concluding interview with the then-early career Paul Horowitz. These persons, as well as lesser-known early SETI researchers such as Ken Kellermann, who conducted the second known SETI search, in Australia, in 1965 (Kellermann 1965), and John Kraus' collaborator Bob Dixon, need to be written into the story as well.

Detailed Comparison of American and Soviet SETI Research: Similarly, much interesting work could be done comparing the American SETI effort and its Soviet-era counterpart. Even more than the US, the Soviet Union had a version of the technological sublime, and this conspicuously influenced the development of their search programs. Soviet scientists were convinced that any aliens encountered would be dialectical

materialists, and also much more technologically advanced than humans; they thus focused on searching for evidence of civilizations that could be easily detected at intergalactic, rather than merely interstellar, distances. Further, since it was held that such advanced civilizations would inevitably be peaceful, Soviet scientists placed much more emphasis on transmitting messages to their alien counterparts; their program was explicitly one of METI (Messaging Extraterrestrial Intelligence, implying the possibility of two-way communication) rather than American SETI, which focused more heavily on listening and detection alone. (Perhaps not coincidently, searching for easily detectible galaxy-level civilizations also fit well with Soviet technological abilities, whose signal detection equipment was recognized as being less sensitive than that of the Americans.)

SETI vs. METI: Similarly, while the modern American SETI program has primarily focused on listening, there is a growing contingent wishing to begin systematic transmissions in the hope of attracting alien attention. While unintentional transmission has been going on for some time in the form of leakage of commercial broadcasts into space, it is uncertain how easily such signals could be detected by aliens; it is universally agreed, however, that intentional and focused transmissions into space would be much easier for aliens to detect. While a few such intentional transmissions have occurred in the past, they have usually been generally been undertaken by others outside of the SETI research mainstream or as one-off ventures.[82]

The prospect of systematic long-term broadcasts has been divisive within the SETI community between those confident that any aliens encountered will be friendly, and

[82] Drake appears to view his own attempts in this regard (the Arecibo message, the Pioneer 10 and 11 plaques, and the Voyager 1 and 2 records) primarily as symbolic activities conducted for the benefit of his fellow humans, rather than as serious attempts to send a message to aliens (Drake and Sobel 1992).

those who are less confident in this regard. This conflict deserves further investigation as it uncovers a fault line within alien social construction: those who suspect that powerful aliens exist, are beneficent, and are willing to bet humanity's collective future upon this conviction; and those who suspect that powerful aliens exist but are not willing to bet on alien friendliness. While traditional "listening" SETI contains tacit political assumptions, active transmission invites direct political scrutiny in a way that merely listening does not. First, questions about risks to humanity are highlighted, given the unknown nature of the aliens. Second, nation-states and bodies such as the United Nations are tasked with matters of diplomacy; transmissions appear to intrude into this realm in a way that merely listening for signals does not (Brin 2013; Achenbach 2015a; Achenbach 2015b).

Interactions between Xenosalvific and Transhumanist Groups: How do the various xenosalvific and transhumanist organizations interact? Do they operate and behave in the same way that religious denominations (and their international equivalents) exist in the United States and elsewhere, perhaps with certain groups of transhumanists acting as exclusivist technofundamentalists, others acting as inclusionists, and groups like the Terasem Faith acting as universalists?

Interactions between Technological Millenarian Groups and the Broader Society: To what extent do SETI and other technologically millenarian movements explicitly and implicitly use science and technology to mirror the religious and political concerns of the surrounding cultures in which the efforts are found? How do they serve to support, or undermine, the interests of other groups within the surrounding society? Similarly, to what extent do other scientific and technological enterprises operate, both internally and/or at a popular level, as religion analogs, both in the garnering of resources, and also

in their promises to supply ultimate meaning and purpose to both adherents and to the surrounding society? In particular, more work needs to be done on the way compensators can be used to model and extend our understanding of the social side of scientific and technological innovation and adoption, especially in regard to how they may help groups—either secular or religious—make credible claims about being pathways to the future.

For example, in this work I have primarily focused on what Stark and Bainbridge (1985, [1987] 1993) call primary compensators—IOUs offered to an individual in exchange for something that is either unavailable or non-existent. However, they also describe so-called secondary compensators, which are IOUs for things that we desire for, and on behalf of, other people. While Bainbridge has made mention of secondary compensators in some of his subsequent work (Bainbridge 2002), more work needs to done in this area; emphasis on primary vs. secondary compensators may be quite significant for understanding the difference between technologies that serve the aspirations of the individual, and technologies which serve to a) facilitate social and affective ties between the individual and others, and b) greatly enhance the collective material and social reification of broadly-shared social values.[83]

[83] Consider, for example, the aspirations that drove the development of the military and computational behemoths of the Cold War and Vietnam eras; if the compensators offered were simply aligned toward the protection of the individual (a primary compensator), the efforts would probably have been much more modest. Rather, it was the allure of the secondary compensator—offering protection to one's family and society—that resulted in monumental collective action. One could argue that a move away from focus on secondary, to primary, compensators during the late 1960s and early 1970s led to the collapse of this system and the rise of the neo-Romantic counterculture in the U.S. Tribbe (2014) points out how this cultural shift socially undermined support for Project Apollo, and the space program in general; many within the counter-culture rather liked the idea of space exploration, but wanted to be space explorers themselves, rather than watching somebody else do it on television. However, as Janet Abbate has pointed out to me, at the very same time that space exploration was coming to be seen as a primary compensator, the environmental movement—driven in large part by the secondary compensator of helping the earth for

This question can also be addressed from the direction of legitimating (and delegitimating) mythology. This dissertation has primarily examined groups that mounted technological responses to traditionally spiritual questions and concerns. Such responses presuppose a faith in the efficacy of the technological enterprise or, more specifically, faith in humanity's scientific and technological abilities, and in the cases of xenosalvific groups its ability to productively detect and engage with superior beings. However there are also those who feel that this may not be the case at all; such persons sometimes point out that human encounters between technologically advanced societies and technologically less advanced cultures have overwhelmingly been detrimental to the technologically less advanced groups. Are such naysayers influenced by negative mythologies, such as those purveyed by H.P. Lovecraft and Olaf Stapledon, each of whom saw advanced beings as being profoundly indifferent to human strivings and aspirations (VanDenBos 2013; Oakes 2000; Joshi 1990; Crossley 1994), in a way that parallels the moral optimism that modern SETI researchers inherited from Flammarion and Lowell? Is it possible to have a "negative compensator" that instills avoidance of certain topics and endeavors that parallels Stark and Bainbridge's positive compensators, or can individual and collective fear and avoidance be modeled more effectively in a different way?

Further investigations, particularly those using a compensator-based mode of analysis to supplement and extend the tools of ANT, may not only cast light on specific projects (say, why particular SETI or other technoscientific projects capture the attention of the

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the sake of other species, for future generations, and for the sake of the earth itself—was rapidly gaining ground. Clearly more work could be done exploring what context renders something as a primary vs. a secondary compensator.

broader society), but may also provide understanding of how individuals and groups within the fields of science and technology mobilize resources and garner support at the macro level. Consider the case of "big science" projects, for example. While there has been some historical debate as to what exactly counts as big science, no consensus has been reached; it seems to exist in a "I know it when I see it" category. However, it may be that a core aspect of big science is not only size and institutional complexity, but also its ability to engage large sectors of society in the exchange of primary and secondary compensators in a collective quest to own the future.[84] Opportunities for further investigation are both plentiful and inviting.

[84] Indeed, looking back to the Lowellian era, a future study might reveal that big science would have had trouble existing in that era because the culture at that time mainly offered space for negotiation in the realm of concrete rewards and primary compensators; the "market" for secondary compensators was dominated by family and church connections. Only as these ties loosened could other markets for secondary compensators develop.

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"the greatness of a nation and its moral progress can be judged by the way its animals are treated." mahatma gandhi

"until one has loved an animal, a part of one's soul remains unawakened." anatole france, french author, nobel laureate