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TEN THOUSAND REVOLUTIONS:
CONJECTURES ABOUT CIVILIZATIONS

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ABSTRACT

Ten thousand years ago, no-one on Earth was living a 'civilized' life. What has happened since is remarkable and impossible to fully comprehend; yet, everyone has ideas about civilization, and how the world came to be as it is. Such understandings of civilizations on Earth inevitably influence speculation about extraterrestrial civilizations, in two ways. First, sometimes a specific Earth civilization or historical experience is explicitly used as a basis for inferences about extraterrestrial civilizations. Second, more general assumptions about the development and functioning of Earth's societies shape conjectures about alien societies. This paper focuses on the latter, general assumptions, with the aim of considering how we can use multidisciplinary approaches, and our knowledge of Earth's civilizations, to our best advantage in SETI.

INTRODUCTION

Ten thousand years of civilization on Earth have produced some remarkable features in human life, including science, elaborate technology, complex social organizations, multilayered governments, writing, war, and, not least, a tendency to invent theories about what and who we really are, as human beings, and as members of various cultures and nations. These theories then take on lives of their own, in classrooms, history books, national mythologies, and even astronomy conferences.

Of the multitude of theories about civilization and the workings of history, many of them are so embedded in our thinking that they are difficult to see, and are typically discussed only within historical disciplines. Others, often similarly invisible, form the basis for our opinions about current events, and fuel debates about the world today.

Does history progress by major revolutions, *i.e*. the agricultural, industrial, scientific, and technological revolutions? Does history consist of colossal paradigm shifts, by which the new and better supplants the old? Or do societies change incrementally and in patches? Does history have a direction? As a species, do we have a destiny? Or is humanity tossed about on waves of contingency, just staying afloat by building boats from whatever flotsam passes by? Why do some people write code and live in condos while others hunt and live in huts? Does population grow to the limits of available resources? Or does population growth drive innovation, and expand resources? Is war unavoidable? And for each of us, where do our own family, city, country, and civilization fit into the big picture of history?

Civilization is the stuff of our lives, and so we all have theories what civilization is, and how civilizations work. We arrive at these theories by a variety of means, and not all of them are correct – but then again, not all of them are easily tested.

Why is this relevant here, in a session about SETI?

Recently, Marino persuasively argued that bioastronomy is still strongly influenced by some quite old ideas about humanity's place in nature, including the Great Chain of Being, and the assumption that evolution is teleological. These anthropocentric biases, she argues, are ubiquitous, and can interfere substantially with the conceptual objectivity that bioastronomy greatly needs to study the development of intelligence and complex behaviour: "These assumptions affect our thinking about extraterrestrial life and intelligence and therefore, the extent and kind of science we do" [1]. The same is arguably true of our assumptions concerning social evolution and our thinking concerning extraterrestrial civilizations. This is reason enough for some close examination.

Disciplinary differences

Another reason for carefully examining our various theories of civilization is the touchiness of the subject within interdisciplinary discussions about SETI. Scientists and scholars in the humanities and social sciences frequently disagree about matters such as the likelihood that humans could exchange mutually intelligible messages with ETI, and the probability of recognizable, social, technological, communicative intelligences emerging from primordial life forms on other worlds.

Why the differences of opinion? One explanation is given by historian George Basalla, who recently stated that "SETI investigators tend to transfer terrestrial life and culture to the rest of the universe because they operate beyond the limits of their knowledge and competence when they discuss the universality of science and mathematics, biological and cultural evolution, the idea of progress, the nature of technology, and the meaning of civilization."[2] Basalla's claim is that these scientists are often wrong, and that this is because they're discussing subjects which they don't understand. The distinct implication is that the best solution is for them to leave everything involving culture to specialists in the social sciences and humanities.

Basalla's book makes some good points, and I too have remarked on what I perceive to be problematic assumptions about culture in the SETI literature.[3] However, I have strong reservations about this assessment of Basalla's, because I believe that overall, it is more useful to see these as *different* approaches to questions of culture, history, and technology, rather than simply one *right* approach and one *wrong* approach. Scientists' knowledge and competence concerning human civilization may be different from that of a specialist in history or anthropology, but that does not constitute incompetence. (It is a lamentable asymmetry that most scholars in the humanities and social sciences, myself included, *are* completely incompetent in astrophysics.) And besides, none of us has competence in extraterrestrial societies.

So, whence the incredible spectrum of opinion about ET civilizations? Clearly, it doesn't stem from

data about ET civilizations, since we have none. As I've argued before, it stems from different ways of reasoning from the Earth-based data which we do have, and from epistemological diversity, or different beliefs about how we can know the world, where knowledge lies, and how to obtain it.[4]
Of course scholars in the humanities and social sciences have spent generations refining their ways of using of Earth-based data; as one of them, I do have a strong allegiance to these methods. It is, in fact, *because* I appreciate the differences in human cultures that I see these debates as a matter of disciplinary culture, not simply wrong and right. There are, undeniably, some great strengths to the approaches taken by scientists in the SETI literature: in particular, the scales of space and time within which they view human culture are most useful indeed, as is their knowledge of self-organizing systems, and awareness of patterns which recur throughout the known universe. Moreover, an advantage of interdisciplinary exchanges is a chance to check each other's blind spots, and this goes both ways.

In short, there is much room for discussion and debate, but I consider that these different ways of thinking can be complementary, rather than mutually exclusive. We have precious few answers, and many ways of asking questions, and we cannot know yet which questions will be most fruitful. So it is in this spirit that I offer the following observations about human history in the SETI literature. My argument has three parts: first, stories about human history are in the very air we breathe; second, there are many grand theories about how history and civilization work, and few simple truths; and third, the specific approaches which SETI scientists use when theorizing about civilization certainly have value, but may also carry biases which can be balanced by using perspectives from other disciplines.

THE AIR WE BREATHE: POPULAR UNDERSTANDINGS OF HUMAN HISTORY

Our conceptions of history play a very important role in our group identities, and thus in shaping world events. Most histories are contested. But even when the broad contours are agreed upon, we often cut history up into pieces to better understand it, or conversely, paste together disparate events into a single story. Either way, we generate discontinuities or continuities which did not truly exist[5]. Indeed, most popular understandings of human history are distilled narratives which are so simplified that they are not, strictly speaking, accurate.

Robert Fulford has described the influence of the great popular historians of recent centuries, among them Edward Gibbon, Arnold Toynbee, H.G. Wells, and Oswald Spengler. All worked as synthesists, on history's biggest canvas. Some, like Wells, chose to portray human history as a tale of never-ending progress, whereas others, like Spengler, considered the West to be in decline, like its predecessors. These historians were hugely influential within popular culture. Fulford remarks,

> "The self-chosen role of these writers was to build the large narrative contexts that give meaning to specific events – and thus show readers how our own societies fit into history. Often they attempted more than they could manage, and in reading them today we may smile at their presumption. Yet there's also something touching in these mega-histories, something moving in the attempt to make a narrative so powerful that it can explain the sweep of history and even predict the future. The master historians sorted, weighed, compared, and analyzed: they made history so potent that sometimes its stories became the governing myths of societies or classes."[6]

And so it is, for example, that most of us recognize the following story of Western civilization:

> "It began in Mesopotamia and Egypt, the Arabs developed our numbers, the Phoenicians the first phonetic alphabet, the Greeks democracy, the Romans large-scale government.... The Roman Empire fell and the Dark Ages descended, until the arrival of the Renaissance, then the Age of Science and the Enlightenment, colonialism, the romantic era, [and] modernity…" [7]

But, as Fulford notes, in recent decades there has been a reaction against such master narratives, because they tend to be arbitrary, exclusive, and simplistic: "The critics of the master narrative, now much louder and more numerous than its friends, argue that this broad, sweeping form of history leaves out or marginalizes much of humanity, and focuses on a few central figures to the exclusion of less powerful elements."[8] He continues: "Academic historians criticize master narratives on more professional grounds, because those who write them often treat facts as props for their theories and thereby fall into misunderstanding and inaccuracy. For much of [the 20th] century, university history departments have discouraged master narratives."[9] Toynbee's work, for example, put him on the cover

of *Time* magazine in 1947, but in the doghouse with other historians within a decade.[10]

And yet… story-telling is what we, as humans, do. Or perhaps, as Thomas King put it, "the truth about stories is that that's all we are."[11] We need stories to situate ourselves as individuals and societies. We need stories to know where we've been, and where we're going. And so it is that every age and society has its guiding stories – religious or secular[12] – and so it is that new syntheses, new master narratives, are always emerging. And so it is that we have recently had scientists like Carl Sagan (*Cosmos*), Jared Diamond (*Guns, Germs and Steel*; *Collapse*), and Ray Kurzweil (*The Singularity is Near*)[13], seeking to explain the entire sweep of humanity's adventure, giving readers a distillation of our history and possible futures. They've done what many historians no longer wish – or dare – to do.

GRAND THEORIES ABOUT HISTORY AND CIVILIZATION

Master narratives describing the course of civilization are woven into our lives and thoughts. So are theories about what makes history go. What drives it? How do civilizations work? How do they change? Why do they emerge, develop, and decline? How, and under what conditions, does technology become complex? Do all civilizations work basically the same way, or are there deep differences between them? If they are different, why? Why do some civilizations, but not others, explore and conquer? What is the relationship between societies, objects, and their environment? Can we predict what will happen next? There are many answers, of course.

On the spiritual end of the spectrum, most religions suggest that deities created the world and continue to affect events here. Philosophers of history also have sometimes turned to the transcendent as an explanatory principle. For example, the tremendously influential Hegel, writing in the 19th century, considered human consciousness, the universe, and Geist (or cosmic spirit), to be part of a whole; conscious beings are finite embodiments of the infinite cosmic spirit, and history is a process through which Geist comes to know itself. This is simultaneously strange to modern ears, and familiar, given recent theories of the conscious universe, and the essential role of conscious beings in the universe. Similarly familiar is Hegel's argument that the basic contours of world history are necessary, but the details are contingent.[14]

The polymaths of the 18th and 19th centuries often preoccupied themselves with the big questions of history, as have specialists in the 20th century and beyond, and not just because of idle curiosity. When one group invades or subjugates another, or when a nation is divided by revolution, people need explanations and justifications for what they are doing. And so it is that social evolutionism substantially preceded biological evolutionary theory – in fact, many of the concepts in Darwinian evolutionary theory actually derived from social theory.[15]

Debates about social evolution have preoccupied scholars in the human sciences for generations. It has run in phases, with arguments for social evolution sometimes being dominant (*e.g.* in the nineteenth century, with Marx, Morgan, Tylor, Spencer, and again in the 1960s), and sometimes being roundly rejected. Of particular interest here is frequent confusion and conflict between *evolutionist* formulations – centred on the notion of a cosmic order, a logical unfolding of a predetermined historical trajectory – and *evolutionary* formulations, which explain historical change as the result of social responses to specific circumstances.[16] This debate persists in a way. The archaeologist and historian Bruce Trigger noted recently that

> "The most important issue confronting the social sciences is the extent to which human behaviour is shaped by factors that operate cross-culturally as opposed to factors that are unique to particular cultures…. At the centre of this debate is a fundamental question: given the biological similarities and the cultural diversity of human beings, how much the same or how differently are they likely to behave under analogous circumstances?"[17]

There is no consensus, but because the question is so crucial to understanding humanity, many are currently using cross-cultural data to address it. Trigger's own assessment, after comparing seven early civilizations, is that the truth lies somewhere in the middle; there are enough significant consistencies and variations that we can say neither that social evolution is driven by convergence nor that it is driven by contingency.[18]

Another recent study addresses a related recurring question: was civilization itself an inevitable result of a progressive trend, or was it a contingent adaptation?[19] We may never know for certain, but a recent metaanalysis of Middle Holocene archaeological data supports the argument, disconcerting to some, that civilization was in fact a last resort, and not a very good one. That is, people

began to live in larger, more permanent groups, and to farm, only when and because environmental changes made their previous, preferable lifeways impossible to sustain. In this model, civilization is itself a form of collapse, rather than progress.[20]

These questions will no doubt continue to be debated for some time, and specialist understandings of civilization and history on Earth will become increasingly nuanced. But regardless, 'grand theories' and major events will always shape our ideas about what we are, where we've been, and where we're going. For example, most people have a theory about what the collapse of the Soviet Union means in terms of world history. Fukuyama, an American political theorist and onetime neoconservative advisor, famously suggested that this marked 'the end of history', *i.e.* that we had all 'arrived' at an end to the wars of ideology, with the global triumph of capitalism and liberal democracy.[21] Even he doesn't think so anymore, but the idea was quite popular in some circles for nearly a decade.

Similarly, most people have a theory about what we're seeing now, in 2006, on the world stage: some see a clash of civilizations, where others see a war between religious fundamentalisms, and yet others see a thinly disguised battle over resources by political-economic elites. Some consider the conflict to be inevitable, while others consider it contingent upon political choices.

Most people also have working theories on a range of cultural topics, including: culture contact, i.e. what happens when two cultures meet for the first time; the role of political revolutions in history; the role of technological innovation in history; and the tempo and mode of historical change (incremental or saltatory). And as a final example, many of us have working theories on the subject of humanity's exploration of space: What are we doing there? Why? What does venturing into space represent in terms of human history?

In short, we actually do not have simple objective answers to many of the largest questions about civilization and history… but that doesn't stop most of us from having theories to which we ascribe. Just as we breathe in 'master narratives' describing our historical journeys, we absorb and exude ideas about why those journeys unfolded as they did. And, of course, we bring those ideas with us when we consider other worlds and alien civilizations.

HUMAN HISTORY AND CIVILIZATION IN SETI

There are notable, recurring patterns in the way that SETI scientists use the historical record. Here are a few broad tendencies of SETI scientists, in comparison to scholars in the humanities and social sciences. SETI scientists generally: lean towards the quantitative rather than the qualitative; aim to establish probabilities and estimate Drake factors rather than examine historical processes for their own sake; formulate general laws rather than describe variations; extrapolate more; are more likely to use single cultural analogies instead of cross-cultural comparisons; and are more willing to assume fundamental similarities between physical, chemical, biological, and social realms.

Realizing that some of these are matters of narrative preferences as much as fact, we might say that there is no one correct way to do it, but that it depends on the stories one knows, or the story one wishes to tell… For example, on the question of whether chemical, biological, and social evolution are truly similar, some scientists tend to assume that they are, considering them to be unified on the broadest imaginable scale[22], whereas many scholars of humanity will vigorously dispute the application even of biological evolutionary concepts to human societies. Should one emphasize the continuities or the discontinuities, the analogies or disanalogies, between these realms? There are, in truth, legitimate reasons for either approach.

A bigger difference, however, stems from the nature of our respective enterprises. Physical scientists often have the chance to test their hypotheses, whereas researchers in the historical disciplines frequently do not. We have, therefore, a different fundamental approach to our theorizing. Scientists appear to be more comfortable with bold hypotheses, because the truth will come in the testing. In the case of SETI, the scientists involved may theorize about alien civilizations without too much wariness, for the test, and the truth, will come when or if the Search itself succeeds. Bold conjectures are perfectly legitimate and useful in this context. In contrast, I propose, scholars of the social sciences and humanities are habitually faced with a different imperative: we build up our theories very cautiously from our data, because we generally have the task of making reliable, realistic inferences without the subsequent cross-check of an objective experimental test. The differences we see in our theorizing about ET civilizations are, I submit, partly a result of these latter differences in our approaches to data.

All that said, it is of course true that we won't *really* know anything about an alien civilization until or unless we contact one. But can we usefully explore different approaches to theorizing alien civilizations in the meantime? I think so, and it is with this goal in mind that I comment below on some recent uses of human history by scientists working on SETI and related research areas. My aim is primarily to highlight our different reasoning strategies.

The drive to quantify

Obviously, equations are a cornerstone of scientific reasoning. Not only is quantification essential for understanding relationships between known phenomena, but mathematics can also predict things that have not yet been observed, thus leading to their discovery. But mathematics has limitations in the realm of the social, and this can be relevant to considerations of ETI.[23]

For example, we can consider plots of various aspects of human history, recently made by the scientists Lemarchand, Kurzweil, and Maccone[24]. In each of these cases, the sweep of time considered is a century or much more. In some, historical milestones are chosen which are conventional but which some historians might consider to be arbitrary, contestable, or ethnocentric. Each author explicitly uses history as a basis for forecasting the future of our own species, and one then further extends that extrapolation, using it as a basis for inferences about intelligent species on other worlds.

In each case, the quantification significantly helps to convince the reader of the author's version of history and of the future – many readers tend to regard mathematical expressions or graphs as more factual or robust than a mere sentence.[25] But in some cases, there is a sense that the author may have begun with a hypothesis in mind about the trajectory of history, chosen examples which fit that curve, dismissed other significant events or trends as distracting noise, and finally used the plot as proof of concept. There may sometimes be a mild circularity at work, as is often the case with arguments about history. In logarithmic plots, there is also a little circularity at work; we are generally more interested in events which have occurred more recently, thus tend to break those apart into multiple points to plot them, which increases the number of points at the recent end of the plot, which makes it appear that more has been happening lately, which underscores the claim that the change is in fact exponential.

Mathematical representations of human history do have value as exploratory tools. Unquestionably, they can provide hypotheses to test, and can give hints about the actual processes of history. But when viewed as statements rather than questions, then they essentially constitute mathematical master narratives. And like their literary counterparts, they therefore carry the risk of oversimplifying history to the extent that it becomes wrong, and of simultaneously being so self-reinforcingly persuasive that noone notices. Further, if they are not handled with care, mathematical master narratives carry an additional risk – it could be easy to believe that one has shown the inner workings of human history by mathematically describing part of the pattern. But just as the map is not the territory, the graph is not the mechanism. And what most social scientists would argue is that we really need to understand the mechanisms and conditions which produce historical patterns, for otherwise it is impossible to know whether or not observed trajectories are likely to continue, let alone be applicable to other species on other worlds.

Infer and extrapolate: when to stop, and why?

Inference is also essential to science; science cannot be done with deductive reasoning alone. But it begs the question of limits.

An older example is useful here: Huygens' *Cosmotheoros* from 1698. Huygens began with the observation of dark spots on Jupiter, and then happily proceeded to say that these are clouds of water, which means rain, which means plants, which means animals, and ultimately means creatures endowed with reason, which in turn inevitably means house construction and farming. These reasoned creatures, he assumed, are probably faced with adversity, which means the triumphant emergence of industry, war, commerce, systems of morality, geometry, and science, including, of course, astronomy, and all its instruments, including the skill of writing.[26]

Notably, Huygens admitted that if any one of his assertions of principle about other planets fails, then his edifice tumbles down. However, in contrast, he did not express concern about his cultural assumptions and their effects on his argument. And indeed, why would he? For these were matters of faith: Huygens assumed that the lives of men are the way they are on Earth because that's the way God likes it, and thus of course He will arrange things in more or less the same way elsewhere.

Of course modern-day scientists do not ascribe to quite the same reasoning when it comes to SETI.[27] But many do share Huygens' strong drive to infer and extrapolate; this is an interesting feature of the way that scholars of the physical sciences approach the matter of extraterrestrial intelligence. Huygens' contemporary, Fontanelle, described this phenomenon amusingly in his charming 1686 *Conversations on the Plurality of Worlds*, when he compared lovers and mathematicians. With both, he noted, one thing inevitably leads to another, which, in turn, inevitably leads to another…

More specifically, Fontanelle wrote, "These two sorts of people, lovers and mathematicians, will always take more than you give them." [28] For example, the moon is like the earth, thus inhabited. Other planets are like the moon, thus inhabited. The stars are like the sun, thus have planets which are inhabited… *etc.* But Fontanelle also astutely identifies our subsequent dilemma. Of all these worlds: "the difficulty is to know wherein they differ." In other words, where should the rampant entailment stop? This is a problem which all academic disciplines share, but deal with differently. We all must sometimes reckon from the known to the unknown. But we have different general rules about where we draw the lines, and why – *i.e.*, about which matters we may extrapolate, and exactly how much. What is reasonable?

A nice example is provided by Heidmann, who wrote of humanity's journey that:

> "Between these first steps taken by our ancestors [the Laetoli tracks], and our own first steps on another heavenly body, the Moon, 3.7 million years have elapsed; in other words, one-thousandth of the age of life on Earth. In scientific terms, one-thousandth is a very small difference. Our immediate reaction is that we could reasonably try to extrapolate conditions another one-thousandth part into the future."[29]

And indeed, this is reasonable to an astronomer, who habitually deals with time scales in the billions of years. To an anthropologist, however – whose professional life may be devoted to examining a period of decades or centuries, and whose discipline is fixated upon identifying the precise differences separating all the intermediaries between the Laetoli hominids and spacefaring *Homo sapiens* – this is a mortifying and indefensible proposition.

Who is right? Neither and both, of course. Heidmann shows considerable sensitivity to this when he subsequently suggests that "This physicist's point of view needs to be complemented by those involving other disciplines", and carefully notes some reasons why we should perhaps not underestimate evolutionary contingencies and stalling points.[30]

The differences here are partly in scales of analysis, and partly in assumptions concerning historical contingency and necessity. But there is also a difference concerning the ultimate point of it all. Anthropologists, for example, are often much more in the business of uncovering and describing than we are of inferring / predicting. This is because in the world of humans, in which we specialize, very little is logical, very little is systematic, and very little is unchanging, and it can even sometimes be quite hard to establish whether something is objectively true or not, let alone whether correlations are meaningful. We also have to contend with the messy business of human agency and free will. Thus, it is rare indeed that we consider a situation to be actually predictive of another, and indeed, prediction is not often our goal. So, although a scholar in the physical sciences might say "aha, here you have x which, by analogy, means that you must have y, which means you have z", a scholar in the human sciences will often not venture past "x could conceivably under the right conditions (long list) lead to y, which then might conceivably under the right conditions (long list) lead to z, but x most certainly does not NECESSARILY lead to z." But of course, the latter doesn't make such a good story…

Uniformitarianism: will what we see on Earth today continue tomorrow… and be repeated elsewhere?

In a recent paper mentioned above, Lemarchand carefully expands upon Sagan's concept of the "Technological Adolescent Age", *i.e.,* the period during which we have newly acquired the capability to drive ourselves to extinction (through technology, environmental degradation, or pronounced inequalities between groups), and are at real risk of doing so.[31] Assuming that this stage is finite, terminated either by extinction or by transition into the "Technological Mature Age", Lemarchand sets about estimating the time it will take for Earth civilization to make this transition. He bases his estimate upon three indicators: projected time to the completion of a global demographic transition (assuming this transition has begun); projected time to a population-exterminating war (extrapolating from historical data on wars); and the speed of the diffusion of state-level democracy (assuming that democracy is a disembodied technology, superior

to other modes of social organization). Lemarchand concludes that we began our TAA after WWII and may grow out of it after the middle of this century.

Finally, Lemarchand discusses the implications for the Drake factor L: if we accept the Principle of Mediocrity (*i.e*., we are average), and assume that that "life and intelligence will develop by the same rules of natural selection wherever the proper surroundings and the needed time are given", then "we may also assume that the average lower boundary for a technological civilization lifetime with interstellar communication capabilities would be close to L ≈ 150-200 years."[32]

This is fascinating work, which makes a laudable effort to extract as much information as possible from our own civilization. One social scientific knee-jerk response to it, however, is to isolate all the additional premises which are essential to Lemarchand's argument, but which are unacknowledged and contestable. To begin with, adolescence is such a human metaphor, grounded in our own specific biological realities…is this the best framework for understanding social-technological turbulence? And it certainly is interesting that humanity's capacity for efficient auto-extinction developed more or less concurrently with our ability to transmit signals to space, but is this a necessary coincidence that would occur elsewhere? Similarly, it is unquestionably useful to consider what we know about war, and what we know about population growth, and what we know about the spread of technology, but quantifying these, extrapolating, and then transferring to another context involves leaps too big for most social scientists. Even if we could agree that the TAA might be in principle a universal stage, it makes little sense to a social scientist to think that it can be usefully measured in Earth years, rather than in a measure relative to the life spans or social cycles of an ET civilization.

There are more questions, of course, as must be the case with any bold conjecture extrapolating from history to the future, from Earth to the universe. But my main purpose here is not to ask all those: rather, I wonder if the production of a new lower limit for "L" is the best use of all the intellectual effort involved in a substantial undertaking like this? What if one tried instead to describe in words the interrelationships of population growth, war, and technological diffusion? Would this not be just as worthwhile as a number necessarily laden with caveats?

The co-evolution of intelligence and technological behaviour

It is often noted by astrobiology optimists that life emerged on Earth nearly as soon as it was remotely possible for it to do so, and by extension, that the same will be true on other worlds.[33] Life, in this view, is both immanent and imminent wherever there's suitable chemistry. There is a parallel sense of inevitability in some writings on SETI concerning technology, *i.e*., that technology arises and evolves as soon as intelligence provides the necessary ingredients.

This is not strongly supported by the archaeological and anthropological record of our own species, however. Human beings have always been technological – our dependence upon tools is one of the defining characteristics of our species – but it seems equally clear that humans do not always use as much technology as they can. To the best of our knowledge at present, the florescence of durable human technology began tens of thousands of years after the emergence of *Homo sapiens sapiens*, probably as a result of worsening climate and changing social patterns. Specifically, during the last Ice Age, some human communities began to aggregate in larger groups, which led to increased territoriality, sedentism, specialization of labour, and more elaborate tool kits. Once those trends were set in motion, they were somewhat autocatalyzing and ultimately led, in some places, to the complex states of today. However, it is inescapable that many other human groups with the same biological capabilities did not follow this particular social and technological path. Indeed, gathering-hunting lifeways with quite minimal technology worked very well under some circumstances, and persisted in many parts of the world until very recently, until these communities were forced by political circumstances to change. If we compare all human cultures, we must conclude that there has been no uniform endogenous trend towards greater technological complexity.

A related point emerges from Davies' remarks upon the evolution of human intellectual capabilities:

> "The case of the Australian Aborigines is intriguing. These people remained almost completely isolated from the rest of the world for 40 000 years until the arrival of the Europeans. Yet they are today essentially indistinguishable from Europeans in their artistic, linguistic and musical abilities and, when educated, in their mathematical ability too. This suggests that either the 'maths' gene and others were selected for more than 40 000

> years ago, and have remained hidden and 'unexpressed' for countless generations, or that these higher abilities have developed in parallel with the rest of humanity as a bizarre form of biological convergence with no apparent use. Either way, there is a mystery as far as orthodox Darwinism is concerned."[34]

There is, however, no mystery as far as anthropology is concerned. All humans on Earth today are of the same species and have the same essential genetic endowment of intellectual abilities – but we do use them differently. Just because a group of people has the capability to do higher mathematics in a written form, or to build and use complex scientific instruments, does not mean that they must do so. Nor does the absence of written math or modern science among a people mean that their intellectual capacity is latent or unused; it is typically being used in another way. This is simply because biological capabilities enable but do not determine cultural activities.

As a whole, *Homo sapiens sapiens* is now a highly technological species. However, the data we have about ourselves do not indicate that we became this way because technological prowess is an inevitable result of technology-capable intelligence. Perhaps the contingency of the Ice Age was merely a catalyst for a technological florescence which was waiting to happen. Or perhaps without the Ice Age, this change would never have taken place. We do not at present have the necessary data to determine which alternative is true. Indeed, we may never have such data.[35]

Why is all this important? It's a matter of defining the set of phenomena which are useful to consider. It is a given in SETI that we will only encounter other technological civilizations, and so it can be argued that intelligence which does not result in detectable technology need not concern us. With this in mind, Tarter has defined "intelligence", for SETI's purposes, as the "the ability to construct and operate large transmitters", while noting that this and other related definitions are "more than a tongue-in-cheek exercise. They encompass, and specifically acknowledge, all the anthropomorphic biases with which we are burdened, while admitting that there is nothing we can do about them until such time as we discover an example of life (including perhaps, intelligent life) as we don't yet know it."[36] This is obviously a cogent argument. However, there is usually something, however small, to be done about biases, and it is often worth it to try.

Why might it be worth it in this case? Not because of search strategies, implications for the Drake factors f_i or f_c , not because of a 'bottom line' projection for N, and not for the purposes of assigning a probability that technology will arise in an intelligent species. We simply have no solid bases upon which to assign those numbers. But that isn't of much import, since no matter which number we assign, the size of the universe provides a multiplication factor that makes even hugely improbable events possible, and this of course makes the search worthwhile. Rather, I think it's worth it to tackle our biases as much as we can, to think constructively and clearly about what technology really is, and how it interacts with intelligence, by striving to thoroughly understand the ontogeny of our own technology. If we explore this relationship, past and present, without concern for numerical values, and without trying to decide the degree of inevitability, we could achieve some interesting understandings which just might be of use in the event of a future contact.

IN CONCLUSION….

The remarkable experiment of civilization on Earth proceeds, though according to what logic and with which outcome, we cannot yet say. Ten thousand revolutions later, humanity is mired in various messes of our own making, and we are not entirely sure even how to understand ourselves. But our best guesses permeate our days and years, our hopes and fears, and our dreams of space and Others. At the same time, we believe different stories, told in different languages, from different perspectives, but this diversity is, as ever, one of humanity's strengths. Just as the last Ice Age spawned a multitude of tools for human hands, our age of scholarship has produced a wealth of ways to think. And we need them all – every intellectual tool that we collectively have – to refine our best guesses and generate new ways of contemplating the unknown.

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ENDNOTES

[1] Marino, Lori. 2004. "Objectivity in the Study of Intelligence: The Cornerstone of New Methods and Discoveries." Bioastronomy 2002: Life Among the Stars. IAU Symposium vol 213, 2004. R.P. Norris and F. H. Stootman, eds. San Francisco: Astronomical Society of the Pacific. p 352.

[2] Basalla, George. 2006. *Civilized Life in the Universe: Scientists on Intelligent Extraterrestrials*. Oxford University Press. p 176.

[3] Denning, K. forthcoming. "Learning to read: Interstellar message decipherment from an anthropological perspective." In *Archaeology, Anthropology, and Interstellar Communication*. Edited by D. Vakoch and S. Dick. NASA History Series.

Denning, K., forthcoming. " 'L' on Earth". In: *Culture in the Cosmos: Extraterrestrial Life and Society*. Edited by D. Vakoch and A. Harrison. Berghahn Press.

[4] Denning, K., forthcoming. "Learning to read."

[5] Zerubavel, Eviatar. 2003. *Time Maps: Collective Memory and the Social Shape of the Past.* Chicago: University of Chicago Press.

[6] Fulford, Robert. 1999. *The Triumph of Narrative: Storytelling in the Age of Mass Culture*. Toronto: House of Anansi Press. p 33

[7] Fulford 1999:44

[8] Fulford 1999:35

[9] Fulford 1999:36-7

[10] Fulford 1999:42

[11] King, Thomas. 2003. *The Truth about Stories*. Toronto: Anansi.

[12] Denning, K. 1999. "Apocalypse Past/Future." in *Archaeology and Folklore*, edited by A. Gazin-Schwartz and C. Holtorf. London: Routledge.

[13] Sagan, Carl. 1980. *Cosmos*. New York: Random House.

Diamond, Jared. 2005. *Collapse: How Societies Choose to Fail or Succeed*. New York: Viking.

Diamond, Jared. 1997. *Guns, Germs, and Steel: The Fates of Human Societies*. New York: Norton.

Kurzweil, Ray. 2005. *The Singularity is Near: When Humans Transcend Biology*. New York: Viking.

[14] Charles Taylor. 1991(1975). *Hegel*. Cambridge University Press. Ch 3.

[15] Hallpike notes: "The idea that societies have developed according to some regular principles was current long before it was supposed that biological species could ever change. Aristotle, Lucretius, Ibn-Khaldun, Vico, Hume, Hegel, Comte, and Marx all developed theories of social evolution independently of any contribution of biology, many of whose evolutionary concepts have in fact been derived from social prototypes – 'competition', 'adaptation', 'selection', 'fitness', 'progress', and so on." C.R. Hallpike. 1988. *The Principles of Social Evolution*. Oxford: Clarendon Press. p 29

[16] Toulmin, quoted by Sanderson, Stephen K. 1990. *Social Evolutionism: A Critical History*. Oxford: Blackwell. pp 2-3.

[17] Trigger, Bruce. 2003. *Understanding Early Civilizations: A Comparative Study*. Cambridge University Press. p 3.

[18] Trigger 2003:684-88.

[19] N.b. Specialists in the physical sciences could be excused for being surprised that we actually don't know this yet, not least because the master narratives which most of us were taught in school distinctly implied that we do have an answer. But knowledge develops a little differently in the social sciences/humanities from the way it does in the physical sciences…

[20] Brooks, Nick. 2006. "Cultural responses to aridity in the Middle Holocene and increased social complexity." *Quaternary International* 151, 29-49.

[21] Fukuyama, Francis. 1992. *The End of History and the Last Man.* New York: Free Press.

[22] For a recent example, see Eric J. Chaisson. 2004. "The Rise of Complexity in Nature." *Bioastronomy 2002: Life Among the Stars.* IAU Symposium vol 213. R.P. Norris and F. H. Stootman, eds. San Francisco: Astronomical Society of the Pacific. pp 531-534. For an earlier example, see I. Rasool, D. DeVincenzi, and J. Billingham. 1977, "Cosmic Evolution" in *The Search for Extraterrestrial Intelligence*, eds. Philip Morrison, John Billingham, and John Wolfe. Washington DC: NASA Scientific and Technical Information Office. NASA SP-419, p 39-45.

[23] Attempts have even been made to systematically quantify the uncertainty in the theoretical calculations of Drake's N, and to collate a series of subjective probability estimates in a distribution function. Sturrock, Peter. 1980 "Uncertainty in Estimates of the Number of Extraterrestrial Civilizations". In *Strategies for the Search for Life in the Universe*. Ed. Michael Papagiannis. Dordrecht/Boston/London: D. Reidel Publishing. pp 59-72. To an archaeologist, this is utterly baffling; it is not clear what exactly the use of such an operation might be.

[24] Lemarchand, Guillermo. 2004. "The Technological Adolescent Age Transition: A Boundary to Estimate the Last Factor of the Drake Equation" in *Bioastronomy 2002: Life Among the Stars*. IAU Symposium vol 213, 2004. R.P. Norris and F. H. Stootman, eds. San Francisco: Astronomical Society of the Pacific. pp 460-466.

Kurzweil, Ray. 2005. *The Singularity is Near: When Humans Transcend Biology*. New York: Viking.

Maccone, Claudio. 2005. "Past and Future of Astronomy and SETI Cast in Maths." IAC-05-A4.2.11.

[25] Maccone for example, worked to express history mathematically explicitly because "Real scientific progress… only stems out of a profound mathematical understanding of facts." (2005:2)

[26] C. Huygens, Cosmotheoros, or New Conjectures Concerning the Planetary Worlds, Their Inhabitants, and Productions (1698), as excerpted in Don Goldsmith, ed. 1980. *The Quest for Extraterrestrial Life: A Book of Readings*. Mill Valley, California: University Science Books. pp 11-15. Available online: www.phys.uu.nl/~huygens/cosmotheoros_en.htm

[27] Basalla argues that Huygens' problem was that he simply projected Earth's attributes onto other worlds, and that more recent scientists, Sagan among them, have done much the same thing (p 105). I do not agree with Basalla, however, that the source of this pattern is simply chauvinism. George Basalla. 2006. *Civilized Life in the Universe: Scientists on Intelligent Extraterrestrials*. Oxford University Press.

[28] Bernard le Bovier de Fontenelle, Conversations on the Plurality of Worlds (1686), as excerpted in Don Goldsmith, ed. 1980. *The Quest for Extraterrestrial Life: A Book of Readings*. Mill Valley, California: University Science Books. pp 8-9.

[29] Jean Heidmann. 1995 [1992]. *Extraterrestrial Intelligence*. Cambridge University Press. trans Storm Dunlop. p 107.

[30] Heidmann 1995:110.

[31] Lemarchand 2004:460

[32] Lemarchand 2004: 465

[33] Davies notes that this sense of inevitability is supported by three principles: the uniformity of the laws of nature throughout the universe, the tendency for whatever is possible in nature to actually happen, and the assumption that Earth is typical rather than exceptional. Paul Davies. 1995. *Are We Alone? Philosophical Implications of the Discovery of Extraterrestrial Life*. New York: Basic Books. pp 22-23.

[34] Davies, Paul. 1995. *Are We Alone? Philosophical Implications of the Discovery of Extraterrestrial Life*. New York: Basic Books. p 86.

[35] Contra the optimistic position, of 1977, that "The past two decades have seen a revolution in our understanding of human behaviour and a deluge of paleontological discoveries, especially of fossil hominids. As a result, we are, perhaps for the first time, able to make a rough assessment of the probability that evolution will produce an intelligent, technological species, and have some degree of confidence that the assessment is correct." (Mark Stull. 1977. "Cultural Evolution" in *The Search for Extraterrestrial Intelligence*, edited by Philip Morrison, John Billingham, and John Wolfe. Washington DC: NASA Scientific and Technical Information Office. NASA SP-419, p 49.) Three decades' worth of additional data since that assessment have not clarified matters particularly.

[36] Tarter, Jill. 2004. "Life, the Universe, and SETI in a Nutshell" in *Bioastronomy 2002: Life Among the Stars*. IAU Symposium vol 213. R.P. Norris and F. H. Stootman, eds. San Francisco: Astronomical Society of the Pacific. p 397.