

# The Prospect of Interspecies Cybernetic Communication Between Humankind and Post-Humans Designed and Created for Space Exploration and Space Settlement

By George S. Robinson

## Abstract

This paper discusses the creation of a post human “species” and its subsequent communication and physical interactions, using cybernetic principles. It notes that (1) *Homo sapiens sapiens* (i.e., modern man/woman/humankind) made, and continues to make, significant strides in developing the technology for self-metabolizing, self-replicating, and self-evolving, technological post-humans; and (2) rapidly developing artificial intelligence *in extremis* will result in a unique and alien entity functioning both independently and as a representative of humankind off-Earth. It discusses the underlying design and program activity of Earth-bound humankind, i.e., *transhumans*, and then post-humans ... and their self-evolving subsequent generations. It assumes that *Homo sapiens sapiens* can and will use rapidly evolving multi-fields of integrated technology to create a totally post human “species.” It focuses on a non-biotic species of technology; perhaps the incipient stage of self-replicating artificial intelligence *in extremis* on its own, totally technological evolutionary bush.<sup>1</sup>

**Keywords:** Cybernetics, cybernetic communication, *transhumans*, technological post humans, Metalaw, artificial intelligence (AI) *in extremis*.

## Introduction: The Next Frontier in Human Evolution?

What? We’re taking ourselves off the *bush of biotic* evolution? Who really cares? Where is the fun in that? (Anonymous)

Longfellow: “He builds too low who builds beneath the stars.”

Cyril Ponnampereuma (American chemist and astrobiologist): “The division between life and non-life is perhaps an artificial one.”

## I. The Role of Evolving Technology in Biotic Evolution

Over thousands of years, with the help of many changing external and internal environmental biophysical factors, such as those precipitating the formation and evolution of the opposable thumb, components of humankind have been able to survive, evolve, and develop the way they worked, thereby allowing increasing capacities to survive in changing environments. Put somewhat differently, biology and interactively evolving technology have permitted ... seemingly even encouraged in a directed fashion ... specimen and species survival and evolution. In short, evolving biology and technology

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<sup>1</sup> The word “bush” is used since it is a given that, at this point in time of human comprehension, *Homo sapiens sapiens* is not the ultimate conclusion of biotic evolution sitting at the pinnacle of some “tree” of evolution. The applicable principle of biological and biotechnological evolution is explore, migrate, mutate, adjust, and survive ... or ultimately become extinct.

have connected to replace and augment human capacities for survival and what may seem almost like directed evolution on a somewhat ricocheting, hit-or-miss basis.

The absence of adequate empirical and quantifiable data that secularists rely upon to understand and explain both the past and the potential future of human evolution and survival of its changing gamete continues to leave open wide spaces and opportunities for humanist explanations ... of a variety of religious attempts to explain the existence of *Homo sapiens sapiens* and its ongoing changing environments; at least until additional measurable data comes to the fore and provides that empirical, quantifiable, and predictable behavior of humans not available to humanists and religious leaders prior to that time or period. As Ray Kurzweil notes, we are now at a point in the evolution of modern humans and their technology that allows the species to go far beyond its current evolutionary limitations.<sup>2</sup> And the necessary communicative interactions between *Homo sapiens sapiens* and the post-humans they create, and with which they must interact, will be according to Norbert Wiener's<sup>3</sup> definition of the science of control and communications as the discipline of "cybernetics."

A step farther into the near future brings the reader of cybernetics to Hugh Herr's<sup>4</sup> view that the current and evolving capacity to integrate technology directly with the human body, i.e., by merging human and machine ... by creating that intimacy ... will allow increasingly effective survival and *evolution* of the human species. For many decades, neuroscientists and others in related sub-disciplines have been "unlocking the mysteries of the human brain, from identifying the locations where key functions take place to the nature of electrical impulses between neurons that carry information ... like a Morse code."<sup>5</sup> Advancements in prosthetics have also been phenomenal, and the integration with, or substitution for, body parts very likely will lead in the next forty or fifty years to the point where artificial prosthetic devices possess the ability to "feel" whatever touches

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<sup>2</sup> Ray Kurzweil is a highly disciplined and largely respected futurist among his peers and broader audiences worldwide. The basis of much of his studies and conclusions is premised upon his view that, in the context of exponentially evolving human technology, "We are a species that goes *beyond* our limitations" (emphasis added). In this context, and in the ensuing discussions, reference to the Latin phrase *in extremis* is used to characterize the end or death of the characteristics of currently understood limits of artificial intelligence and movement into an advanced form of intelligence or awareness yet to be perceived and fully understood.

<sup>3</sup> Norbert Wiener (November 26, 1894 - March 18, 1964) was an American mathematician and philosopher, who served as a professor of mathematics at MIT. A famous child prodigy, Wiener later became an early researcher in stochastic and mathematical noise processes, contributing work relevant to electronic engineering, electronic communication, and control systems. Wiener is considered the originator of cybernetics, a formalization of the notion of feedback, with implications for engineering, systems control, computer science, biology, neuroscience, philosophy, and the organization of society. For a fuller biographical sketch, see [en.wikipedia.org/wiki/Norbert\\_Wiener](http://en.wikipedia.org/wiki/Norbert_Wiener).

<sup>4</sup> Hugh Herr is with MIT Biomechatronics in Massachusetts, and he is creating bionic limbs that emulate the function of natural limbs. In 2011, *Time* magazine coined him the "Leader of the Bionic Age" because of his revolutionary work in the emerging field of biomechatronics, a technology that closely merges human physiology with electromechanics.

<sup>5</sup> Quotation ascribed to John Donoghue, Brooklyn University neuroscientist and CNN Future Summit Committee member, by CNN's Michael Bay and Matt Ford in "Cybernetics: Merging Machine and Man," *Science and Space*, April 18, 2006.

them. Again, according to Rodney Brooks,<sup>6</sup> former MIT Robotics Lab Director, since increasing types and levels of sophistication of robotic technology will become available, determining the difference between a human and an increasingly technological entity will become messy ... at best, if not impossible. If the result is a post-human with the capacity for self-metabolism, self-replication, and self-evolution, etc., at what point will a new species type be determined to exist? To what extent will it embrace and embody the biotic essence of humankind?<sup>7</sup> Certainly Kurzweil envisages a possibility, if not a strong probability, of a not-too-distant future in which no clear distinctions exist regarding the biotic characteristics of *Homo sapiens* and a purely technological entity ... a post-human, e.g., taxonomically referred to as *Homo sapiens alterios*, metamorphosing into *Homo alterios spatialis*, and perhaps even something like *Technologia alterios spatialis*.

In the context of all levels and types of communication, including those involving interspecies communication, the actual capacity to communicate is a reflection of inter-energy particle relationships in the form of directed, as well as *potentially* directed, useable information necessary for individual specimen survival purposes, and/or the survival of an affected species. In this context, responsive and meaningful directed communications do not have to be premised solely on organic chemistry ... from the smallest known energy particle<sup>8</sup> to the most interactively complex energy framework available to receive the communicated information through and by all forms of inter-

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<sup>6</sup> Rodney Brooks is the Panasonic Professor of Robotics (emeritus) at MIT. He is a robotics entrepreneur and Founder, Chairman, and CTO of Rethink Robotics (formerly Heartland Robotics), and he is a Founder, former Board Member (1990-2011) and former CTO (1990-2008) of iRobot Corp (Nasdaq: IRBT). Dr. Brooks is the former Director (1997-2007) of the MIT Artificial Intelligence Laboratory, and then the MIT Computer Science and Artificial Intelligence Laboratory.

<sup>7</sup> One of the latest efforts, if not accomplishments, lending itself to a separate and distinct technological “species” is the work of a start-up company in Montreal, the product of which is in development and named “Lyrebird.” The product relates to advanced speech synthesis technology, i.e., the use of an artificial intelligence algorithm. While many humans are very good at “imitating” the voices of others, Lyrebird picks up the variety of idiosyncrasies that make a voice unique. Clearly, unless properly, adequately, and legally protected, this capacity is replete with downsides with the potential of significantly abusive misuses and lack of protective measures at present. Canada is launching a web service that it claims will allow anyone to replicate all voices individually with just a minute of recorded data. The service, named for the bird, replicates nature in its ability to parse voices to allow others to imitate subject targets. At present, the service is in the proof-of-concept stage, but it represents an important leap forward in technology — specifically, in artificial intelligence. Lyrebird will even be able to “learn” voices when the recorded sample contains background noise. There is a potential for mass voice copying, which may eventually be used to thwart anything reliant on voice authentication. See, generally, [search.aol.com/aol/search?s\\_it=webmail-searchbox&q=Lyrebird%20-%20Montreal](http://search.aol.com/aol/search?s_it=webmail-searchbox&q=Lyrebird%20-%20Montreal).

<sup>8</sup> The definition of what constitutes the smallest energy particle may not be based upon mass as a comparison scale. Considering photons (quanta) as particles, a light quantum with a mass of zero is the smallest particle. Nevertheless, if the comparison is based upon the individual identity of the particle as a particle, the neutrino is the smallest particle in the universe (comment by Prof. Ali Atia Abdulla: [www.quora.com/What-is-the-smallest-particle-in-the-universe](http://www.quora.com/What-is-the-smallest-particle-in-the-universe), April 15, 2016). But note the ongoing arguments among scientists regarding the possibility of paranormal phenomena versus strict reliance on atheism resting on evolving knowledge of empirical data to explain existence on the basis of energy particle interrelatedness. See in this context the views expressed by Dr. Deepak Chopra (University of California, San Diego, School of Medicine), in Notes to the Editor, and the response by Michael Shermer (founding publisher of *Skeptical* magazine, columnist for *Scientific American*, and Adjunct Professor of Economics at Claremont Graduate University) in *Scientific American* (January 2017): 4-6. In this context, see also generally by M. Shermer, *The Moral Arc* (New York: Henry Holt, 2014).

energy communication. And this is what the ensuing discussions are premised upon, and which lead to the potentially directed and positive, as well as undirected and unexpected vagaries, of communications between and among humankind and post-human “astronauts,” who or which are engineered by *Homo sapiens sapiens* ... modern humans ... as purely technological entities embracing or embodying artificial intelligence truly *in extremis*.

In addition to exploring potentially applicable principles of space jurisprudence or legal philosophy with its roots in Natural Law Theory<sup>9</sup> and resultant legal regimes and implementing laws, one of the main issues that must be embraced and addressed is just how purely technologically post-humans should be design-engineered and programmed initially to ensure the most inclusive and productive entity for an interspecies communications capability, particularly between humankind and its “essence-related”<sup>10</sup> representative space travelers, explorers, and settlers. Factors to be considered include the elements of Natural Law Theory, or *jus natural*, which initially was “intended to denote a system of rules and principles for the guidance of human conduct” and understanding the empirical, i.e., quantifiable and predictable, foundation of constantly evolving Natural Law Theory, and its impact on shaping the forthcoming generation of space jurisprudence, or space law philosophy, and implementing positive laws. The subsequent “Stoic doctrine” embellished on the concept by asserting that all life was “according to nature,” which, in turn, “rested upon the purely supposititious existence ... of a state of

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<sup>9</sup> At the root of evolving cybernetic communications between humankind and post-humans is Natural Law Theory, or *jus naturale*. It was, and remains in varying degrees, a philosophical speculation of the Roman jurists of the Antonine age. For the most part, it was considered a system of “rules and principles for the guidance of human conduct which, independently of enacted law or of the systems peculiar to any one people, might be discovered by the rational intelligence of man, and would be found to grow out of and conform to his nature, meaning by that word, his whole mental, moral, and physical constitution.” *Infra*, note 11. See also [legal-dictionary.thefreedictionary.com/Natural+Law+Theory](http://legal-dictionary.thefreedictionary.com/Natural+Law+Theory), in which it is noted that natural law is “[t]he unwritten body of universal moral principles that underlie the ethical and legal norms by which human conduct is sometimes evaluated and governed. Natural law is often contrasted with positive law, which consists of the written rules and regulations enacted by governments,” or what has been referred to in the above text as positive laws implementing the underlying jurisprudence or legal philosophy that is firmly rooted in the “parental” concept of Natural Law Theory. Adherents of the theory are often referred to as “naturalists,” and although there are several approaches to defining and understanding Natural Law Theory, including “divine natural law” and “historical natural law,” secular natural law is relied upon in the approach taken in the discussion herein relating to when post-humans might well become totally independent entities in a fashion that embraces many behavioral characteristics of a biological species, but with no biochemical and biophysical components. For additional interpretations and explanations of what constitutes natural law, see P. A. Harris, *The Distinction Between Law and Ethics in Natural Law Theory* (Lewiston, NY: Edwin Mellen Press, 2002). See also “Natural Law: The Classical Tradition,” in *The Oxford Handbook of Jurisprudence and Philosophy of Law*, ed. J. Coleman and S. Shapiro (Oxford: Oxford University Press, 2002), 1-60.

<sup>10</sup> For the purposes of the present discussion, “essence” is considered the most significant element, quality, or aspect of a person; indeed, in varying levels of sophistication, “essence” is a constantly evolving component of *all* biota that appear or have appeared on the bush of biotic evolution. It embraces the core component of biological existence, survival, and evolution, reflecting probing attempts at increasingly quantifiable data and predictable information leading towards an empirically premised understanding of the who, what, and why of Creation.

nature.”<sup>11</sup> The so-called Naturalists believe that natural law principles are an inherent part of nature and exist regardless of whether governments recognize and enforce them. Naturalists further believe that governments must incorporate natural law principles into their legal systems before “justice” (regardless of the amorphous interpretation of that word under a specific, empirically defined fact situation) can be achieved.

There are currently three schools of Natural Law Theory: divine natural law, secular natural law, and historical natural law. Divine natural law represents the system of principles believed to have been revealed or inspired by God or some other supreme and supernatural being. These divine principles are typically reflected by authoritative religious writings, such as Scripture. Secular natural law represents the system of principles derived from the physical, biological, and behavioral laws of nature as perceived by the human intellect and elaborated through reason. Historical natural law represents the system of principles that has evolved over time through the slow accretion of custom, tradition, and experience. Each school of natural law influenced the Founding Fathers of the United States, for example, during the nascent years of US law in the eighteenth century. It continues to influence the decision-making process of state and federal courts to the present. Unfortunately, in the preceding context and historical and quite indecisive explanations in many pivotal instances, there is a frequent reliance on descriptive characterizations of an ephemeral nature; not quite so accurate an understanding, particularly in given contexts of post-human creation possessing biotic and abiotic properties of humankind, and a totally absent understanding of the very nature and essence of abiotic post-humans.

#### **A. Ultimate Specimen/Species Survival = Migration + Cybernetic Communication**

Before shifting to the transitional history of Natural Law Theory, it might be helpful to address in an introductory fashion what likely will be, or perhaps must be, the primary objective of humankind space migration. First, use of the word *humankind*, with the emphasis on *kind*, is intended to highlight the hominid and protohominid evolutionary shoulders upon which *Homo sapiens sapiens*, i.e., modern humans, stand. It also is intended to emphasize the “*transhuman*” and, indeed, post-human entities incorporating biotechnological integration to the point where human descendants ultimately may be considered totally separate and independent, self-replicating and metabolizing, sentient entities with whom or which current moderns humans must interact in the context of Metalaw.<sup>12</sup> Put more simply, and in the context of the ensuing discussions, the reference is strictly to technological and independently “thinking” (based upon the

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<sup>11</sup> For a brief description of the generally understood Natural Law Theory and the Stoic doctrine, see *Black’s Law Dictionary*, 4th ed. (St. Paul, MN: West, 1957), 1177.

<sup>12</sup> Very simplistically for present purposes, Metalaw may be defined as a proposed set of rules regulating relationships between different races or recognizable life forms in the universe. Although many definitional variations exist describing the characteristics and intentions of Metalaw, the basic premise is that all life forms in the universe must be respected for whom and what they are, i.e., do unto others as they would have you do unto them. For a discussion of the concept and history of Metalaw, see G. Robinson “METALAW: From Speculation to Humankind Legal Posturing with Extraterrestrial Life,” *Journal of Space Philosophy* 2, no. 2 (Fall 2013): 49-56.

neurophysiological definition of that word) post-humans created by *Homo sapiens sapiens* and subsequent generations produced by post-humans themselves.

As noted in the discussion, above, in addition to cybernetics and post-humanism, the most critical operative word is communication. So, back to relatively undisputed ... and yet some highly questionable ... basics of existence and meaningful communication of useable information/data; an evolving basis regarding the human understanding of existence in the form of organized and usable information. These are basic considerations for determining the disparity and breadth of information capability that can be instilled ... or be desired for instilling ... in technological post-human entities for the very objectives of that meaningful communication. At the outset, the primary participant in the human-post-human communication is the human designer/programmer(s) of that purely technological entity. So, what is the history, and what is relatively known about the biochemical and biophysical basis of communication that is necessary or desirable for the two-way communication between such disparate entities ... particularly when one participant, the post-human, is operating in a somewhat unfamiliar, non-Earth environment, and given that the communications data needs are pretty much the same?

The study of communication characteristics and dictates between and among humans ... and to some degree between humans and non-human mammals ... might be said to have started approximately 300 years ago, when the Irish philosopher and empiricist George Berkley<sup>13</sup> asserted that the only thing biotic life forms can perceive is perception, itself. Varying degrees of understanding existence depend upon individual perceptions allowed by the neurophysiology primarily in the cerebrum or central locale of an individual biotic entity's coordination of its neurophysiology ... either individually or in the form of a symbiotically collective coordination. Over the centuries (but perhaps even just decades), physicists have relied upon metaphors, visualizations, and the quantifiable aspects of language ... of communication characteristics. But Dr. Robert Lanza<sup>14</sup> asserts that another form of interpretation of these characteristics makes them understandable, makes them sensible, i.e., reality predates life and creates it. He and certain of his colleagues propose that life, and in particular the varying forms or levels of consciousness manifest by biotic life forms, creates the universe, and the universe could not exist without us. In other words, can and does a tree in the forest really fall if there is no one there or in the future to hear or see it fall? Werner Heisenberg's uncertainty principle<sup>15</sup> exists only

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<sup>13</sup> George Berkley (1685-1753) was an Anglo-Irish Anglican bishop, philosopher, and scientist, best known for his empiricist and idealist philosophy, which holds that reality consists only of minds and their ideas; everything save the spiritual exists only insofar as it is perceived by the senses.

<sup>14</sup> Dr. Robert Lanza is an American medical doctor and scientist. He currently is Head of Astellas Global Regenerative Medicine, and Chief Scientific Officer of the Astellas Institute for Regenerative Medicine. Dr. Lanza also serves as Adjunct Professor at Wake Forest University School of Medicine.

<sup>15</sup> Werner Heisenberg was a German physicist who published a 1927 paper titled "On the Perceptual Content of Quantum Theoretical Kinematics and Mechanics." The more familiar form of the equation became available a few years later after he had refined his thoughts in various subsequent lectures and papers. The uncertainty principle is perhaps one of the most misunderstood, yet most famous, concepts generated in the study of physics. The principle emphasizes that Nature embraces a certain fuzziness, i.e., a basic limit to what humans can understand about quantum particles, resulting in a failure to grasp and comprehend the smallest entities or scales of nature. In other words, the most humans can hope for is their calculation of probabilities regarding where energy particles in various forms of complexity exist and how

in the eyes of an observer as a rather blurry and unpredictable phenomenon with “no well-defined location or motion until the moment it is observed” ... individually and/or collectively. In other words, it is what physicists call a mathematical function or an expression that allows what directs the quality of communication, particularly between humans and post-humans; and to what extent can post-humans be invented and programmed to communicate energy particle orientations with anticipatory, independent, and meaningful data to the energy levels where it is receivable and useable ... or not ... by the recipient(s) of that communication.

Dr. Lanza has presented interesting views of the universe and the genesis of its existence ... particularly in the context of communication by and between the simplest forms of energy to the most complex organisms ... and perhaps inorganic entities as well that are known to date.<sup>16</sup> In the context of communication and what constitutes its basic characteristics, Lanza notes that

In 1997 University of Geneva physicist Nicolas Gisin sent two entangled photons zooming along optical fibers until they were seven miles apart. One photon then hit a two-way mirror where it had a choice: either bounce off or go through. Detectors recorded what it randomly did. But whatever action it took, its entangled twin always performed the complementary action. The communication between the two happened at least 10,000 times faster than the speed of light. It seems that quantum news travels instantaneously, limited by no external constraints – not even the speed of light. Since then, other researchers have duplicated and refined Gisin’s work. Today no one questions the immediate nature of this connectedness between bits of light or matter, or even entire clusters of atoms.<sup>17</sup>

Prior to this series of underlying experiments, most physicists viewed the universe as independent and objective, i.e., independent of any life form’s perception of the universe and the progressive empirical and theoretical awareness of its components and manifestations of the known laws of physics.

Nicolas Gisin’s concepts may well be a necessary part of the increasingly known properties of communication ... and very applicable to effective use of cybernetic communications between and among humans, *humankind* transhumans, and post-humans serving as increasingly independent astronauts, regardless of their physical

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they behave. Sir Isaac Newton, on the other hand, projected the universe as consisting of physical components responding to clear-cut laws regarding movement, etc. Prediction of these movements, according to Newton, becomes easy when you know with certainty the dictating physical characteristics and laws. If you do not know these laws, but still trust them, the prospect of introducing Heisenberg’s view of Nature’s fuzziness comes to the fore. For a further elaboration of Heisenberg’s uncertainty principle and the ongoing evolution of attempts to explain the theory or principle, see [www.theguardian.com/science/2013/nov/10/what-is-heisenbergs-uncertainty-principle](http://www.theguardian.com/science/2013/nov/10/what-is-heisenbergs-uncertainty-principle).

<sup>16</sup> In this context, see, generally, by Lanza and co-author Bob Berman, *Biocentrism: How Life and Consciousness are the Keys to Understanding the Universe* (Dallas: BenBella Books, 2009).

<sup>17</sup> See, therefor, R. Lanza, “The Biocentric Universe Theory: Life Creates Time, Space, and the Cosmos Itself,” *Discover Magazine*, May 1, 2009, [discovermagazine.com/2009/may/01-the-biocentric-universe-life-creates-time-space-cosmos](http://discovermagazine.com/2009/may/01-the-biocentric-universe-life-creates-time-space-cosmos).

locations.<sup>18</sup> As Lanza noted, if the universe exists only for the perception by various levels of organic life-forms, what an “incredible coincidence.” A second view would be the sanctuary of all religions, i.e., “God did it.” Clearly, this discussion explores the genesis both of biotic and non-biotic, purely technological “life forms,” and poses the questions whether post-humans, purely self-metabolizing, self-replicating, and self-evolving (including levels of artificial intelligence *in extremis*), reflect or embrace the empirical, measurable, and predictable properties necessary for interspecies communications?

Certain forms and variations of biotic communications that may be desirable, even necessary or critical, to incorporate technologically into post-humans for desired and effective interactions with humans (particularly when being design engineered as “astronautical emissaries” of humankind), might well include appropriate modifications. In attempting to define the requirements for effective and highly sophisticated communication between humankind and fully technological post-humans, it is helpful to note that, in a broad sense, there are several types of communication between and among people and between and among humans and other animal life forms, all of which can be design engineered technologically into a post-human. While keeping in mind that all forms of biotic communication are reflections of biochemical and biophysical interactions in comparatively organized ways, the first type is referred to as “haptic communication,” i.e., communication by touch that relies primarily upon surface textures as the initial point of communication. In other words, it is non-verbal and non-visual. Touch is a vital form of intimacy for humans and other life forms ... and not necessarily strictly animal life. The question in this context, however, is whether comparatively large areas of touch (and not just energy particle interactions of relatively simple types) are necessary parts of effective biotic-to-non-biotic communication, i.e., between humankind and post-human technology, the latter of which is functioning in an off-Earth space environment (interstitial or planetary/celestial body) as an *initially* human fabricated and programmed, completely technological, and self-generating entity with artificial intelligence *in extremis*.

But is human touch, with its design engineered and programmed post-humans, and the latter’s reciprocations, essential for independently perceiving, self-energizing, self-metabolizing, self-egesting,<sup>19</sup> and self-evolving post-humans off Earth, truly necessary? Is it necessary for the next step in the evolution of *Homo sapiens sapiens* and its

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<sup>18</sup> Nicolas Gisin’s observations regarding the strange, yet interesting, properties of photon communications existing 18 kilometers apart, are reported in Daniel Salart, Augustin Baas, Cyril Branciard, Nicolas Gisin, and Hugo Zbinden, “Testing the Speed of ‘Spooky Action at a Distance,’” *Nature* 454 (2008): 861-64. Apparently, theoretical calculations have shown that performing tests over a full spin of the globe would challenge all possible reference frames. The research team did just that, and they came up with the same result in all tests. The bottom line, according to Gisin, is that “there is just no time for these two photons to communicate.” The experiment succeeded in “teleporting the quantum state of a photon as a significant step in understanding the physics” involved in the concept of energy communication. According to Terence Rudolph, one of the experimenters and a theorist at Imperial College, London, the experiment shows that, “in quantum mechanics at least, some things transcend space-time.” He also argues that it shows that humans have attached undue importance to the three dimensions of space and the one of time that we live in. For an expanded discussion of the experiment and purported observations and conclusions, see [phys.org/news/2014-09-quantum-teleportation.html#jCp](http://phys.org/news/2014-09-quantum-teleportation.html#jCp).

<sup>19</sup> i.e., the elimination of waste and/or non-convertible waste energy in a form not currently useable by ISS inhabitants



“essence”? Other forms of haptic communication also exist. For example, striking, pushing, pulling, pinching, kicking, and strangling, or other forms of physical abuse, are forms of communication (i.e., forms of communication through reliance on physical abuse). But can reactionary pain be programmed into a post-human? Is it necessary? Can a reactionary and/or desired response to such pain be communicated in a meaningful fashion, other than biotically (i.e., through a multifaceted and biologically premised nervous system)? Again, one can be neurophysiologically touched as a form of communication, e.g., being touched by music or a birthday card, or a letter of condolence, etc., all in the form of organized energy. Depending on the objective of the post-human programmer, these stimuli and reactions can be manifest in the reactionary behavior of post-humans. They are intra- and extra- species and interspecies forms of communication, a kind of interactive touching by organized energy at more basic levels.

Another form of communication is referred to as olfaction, i.e., the sense of smell. It is a component of biotic systems that detects fluid-phase chemicals for which olfactory receptors serve as specialized mediators ... “in the nasal cavit[ies] of vertebrates that are analogous to sensory cells in the antennae of invertebrates.” Olfaction and taste comprise what is referred to as chemoreception. While the sense of smell is comprised of extraordinarily interactive chemical complexities, its ultimate purpose can be achieved in a helpful and productive fashion for purely technological entities represented by evolving post-humans.

The non-verbal form of communication through body motions, such as facial expressions and body movements and gestures, is referred to as kinesics, or, as more simply referred to by R. Birdwhistell as “body language.”<sup>20</sup> These characteristics are more frequently viewed in a limited fashion as rather sophisticated aspects of current and anticipated robotic capabilities applicable to production in manufacturing and assemblage businesses/facilities.

In the context of exploring cybernetic communication characteristics between and among *Homo sapiens* and strictly technological post-humans possessing artificial intelligence *in extremis*, it is important to recognize that “‘communication’ also can be defined for these purposes as the interactive relationship of all energy particles, from the smallest to those that universally are the most interactively complex.” Put somewhat differently in the context of human-post-human communication, including existing and unfolding applicable philosophical or jurisprudential roots and implementing positive laws, the controlling factor is that all existence represents a “process by which information is exchanged between [and among] individuals through a common system of symbols, signs, or behavior.”<sup>21</sup>

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<sup>20</sup> See, generally, in this context, R. Birdwhistell, *Kenesics and Context* (Philadelphia: University of Pennsylvania Press, 1970), and in the context of the discipline of kinesics, or body and body-part movements as a primary form of communication between and among humans and between and among humans and other animal life-forms, see S. Jolly, “Understanding Body Language: Birdwhistell’s Theory of Kinesics,” *Corporate Communications: An International Journal* 5, no. 3 (2000): 133-39.

<sup>21</sup> See, therefor, “communication” as defined in Merriam-Webster’s Collegiate Dictionary, 11th ed. (Springfield, MA: Merriam-Webster, 2009), 251. For a more comprehensive discussion of the level of recognized interspecies communication, see “Interspecies Communication – Theory of Universal Language” at [www.ancestryofman.com/interspecies-communication/](http://www.ancestryofman.com/interspecies-communication/).

Somewhat differently, it may be defined as quantifiable and organized interactive relationships of energy as an expression of communication or transfer of informational data between and among all forms of energy ... from the smallest to the most complex at seemingly endless levels in the known universe. All levels of communications are reflections of inter-energy particle relationships in the form of directed, as well as potentially directed, useable information ultimately for survival purposes. But responsive and meaningful (i.e., directed) communication does not have to be premised on organic chemistry. With this basic understanding of the role of all currently known forms of energy involved in interactive communications, the ensuing discussions are premised in large part on issues directly relating to the use of cybernetics<sup>22</sup> in communications between and among humans/humankind, transhumans, and post-humans in furtherance of space-related activities.

## II. An Emerging Complexity and Confusion Deriving from Communications-Based Upon Cybernetics

Many definitions of cybernetics currently exist, and many are used in seemingly unrelated contexts, disciplines, and sub-disciplines. Numerous individuals relying on cybernetic definitions, and representing many disciplines and related sub-disciplines, use their own defining versions of the word with respect to the discipline being addressed, and what that discipline or sub-discipline represents. Nevertheless, for this discussion, cybernetics refers generally to the design or discovery and application of principles of communication and their regulation.

Cybernetics does not reflect or physically embrace animate objects or systems ... at present. Rather, currently, it addresses non-biotic behavioral characteristics. In other words, it does not ask "what is this thing?" But rather "what does it do, and what can it do?" Those who work in this discipline and its sub-disciplines are working with the concept of a *metadisciplinary* language ... hopefully allowing for a better understanding of existence and how it may modify human existence constructively ... particularly in a favorable, survival-oriented context. But this also may be a much too limited definition, particularly when addressing communications between *Homo sapiens* and post-human technology created initially by the biochemically based human species itself. There seems to be an endless number of variations of the definition of cybernetics in a variety of contexts. Essentially, they incorporate some form of the informational relationships created between humans and non-human technology. As a somewhat dated and confusing, but still helpful, compilation of cybernetic definitions referenced by Larry Richards in 1999 from a list put together as a 1987 American Society for Cybernetics (ASC) compilation of cybernetic definitions, the views, as quoted in large part and set forth below, lay the groundwork for developing forms of communication between *humankind* and purely technological post-humans.<sup>23</sup> Note that where it exists, the

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<sup>22</sup> For the current segment of the discussion, cybernetics can be defined as the science of communications and automatic control systems in, between, and among machines and biological specimens. A multitude of provocative definitions of the word exist in different usage contexts.

<sup>23</sup> Larry Richards stated that his intent in preparing the list of definitions, consistently modified and added to in the ensuing yearly meetings of the ASC, was twofold, i.e., cybernetics could have a variety of

italicized and bracketed information following each definition is a description of the author of the quote.

- Use the word “cybernetics,” Norbert, because nobody knows what it means. This will always put you at an advantage in arguments. [*Widely quoted and attributed to Claude Shannon in a letter to Norbert Wiener in the 1940s.*]
- Cybernetics seeks to develop general theories of communication within complex systems.... The abstract and often formal mathematical nature of its aim ... makes cybernetics applicable to any empirical domain in which the processes of communication and their numerous correlates occur. Applications of cybernetics are widespread, notably in the computer and information sciences, in the natural and social sciences, in politics, education and management. [*American Society for Cybernetics Constitution.*]
- Cybernetics treats, not things, but ways of behaving. It does not ask “what is this thing?”; materiality is irrelevant, and so is the holding, or not, the ordinary law of physics. [*W. Ross Ashby, an English psychiatrist and early pioneer in the late 1900s of the growing discipline of cybernetics and complex systems.*]
- a branch of mathematics dealing with problems of control, recursiveness, and information. [*Gregory Bateson, an English anthropologist in the early 1900s, and who also was considered a social scientist, linguist, visual anthropologist, semiotician, and a cyberneticist whose work intersected many other fields of inquiry.*]
- So, a great variety of systems in technology and in living nature follow the feedback scheme, and it is well known that a new discipline, called cybernetics, was introduced by Norbert Wiener<sup>24</sup> to deal with these phenomena. *The theory tries to show that mechanisms of feedback nature are the base of teleological or purposeful behavior in man-made machines as well as in living organisms, and in social systems [emphasis added]. [This observation was made by Ludwig von Bertalanffy (1901-1972) who has been considered one of the more acute*

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definitions that did not necessarily contradict one another, and at the same time it should stimulate dialogue regarding what the motivations might be of those proposing varying or differing definitions.

<sup>24</sup> *Supra* note 3. Note, further, that Norbert Wiener was an expert in mathematical communication theory, ultimately relating his work with guided missile systems and information handling in electronic devices to the mental processes in animals. His publications *Cybernetics, or Control and Communication in the Animal and the Machine* (Cambridge, MA: MIT Press, 1948), and *The Human Use of Human Beings: Cybernetics and Society* (New York: Da Capo Press, 1988), helped to popularize cybernetics as a science and particularly as a scientific term regarding processes in animals. His publications *Cybernetics, or Control and Communication in the Animal and the Machine* (Cambridge, MA: MIT Press, 1948; 2nd ed., 1961), and *Human Use of Human Beings* helped to popularize cybernetics as a science, and particularly as a scientific term.

*minds of the 20th century, particularly as expressed in his General Systems Theory. The first part of that text focuses on the function of the theory of systems and on the main features of closed and open systems. The second part presents a conception of the human being, not as a robot aiming at reducing tensions by satisfying biological needs, but as an active personality system creating his/her own universe.]*

- For cybernetics is an interdisciplinary science, owing as much to biology as to physics, as much to the study of the brain as to the study of computers, and owing also a great deal to the formal languages of science for providing tools with which the behavior of all these systems can be objectively described.... Wiener found just the word he wanted in the operation of the long ships of ancient Greece. At sea, the long ships battled with rain, wind, and tides – matters in no way predictable at the time. However, if the man operating the rudder kept his eye on a distant lighthouse, he could manipulate the tiller, adjusting continuously in real-time towards the light. This is the function of steersmanship. As far back as Homer, the Greek word for steersman was *kunbernetes*, which transliterates into English as *cybernetes*. [*Stafford Beer was a highly acclaimed professor of management, and a description of his professional life and publications is at [www.cybsoc.org/contacts.people-Beer.htm](http://www.cybsoc.org/contacts.people-Beer.htm).]*
- Cybernetics is the science of effective organization, of control and communication in animals and machines. It is the art of steersmanship, of regulation and stability. [*Chris Lucas, former president of the American Society of Cybernetics.*]
- And finally, by Dr. Margaret Mead: The set of cross-disciplinary ideas which we first called “feedback” and then called “teleological mechanisms” and then called “cybernetics” – a form of cross-disciplinary thought which made it possible for members of many disciplines to communicate with each other easily in a language which all could understand. [*Dr. Mead, born in 1901 in Philadelphia, pursued her graduate work at Barnard College. There, she met Franz Boas, with whom she went on to do her anthropology PhD at Columbia University. She became a curator of ethnology at the American Museum of Natural History, where she published the bestseller, Coming of Age in Samoa.*]

The present definitions applied to the concept embodied in the term cybernetic approximate a somewhat more refined understanding in current uses, particularly when examining underlying philosophical differences between artificial intelligence, both in simplistic configurations and *in extremis*, and cybernetics. They show how each is construed in increasingly more complex terms. In this context, “representation” may be considered significantly different depending upon the perspective being pursued, i.e., as noted by Larry Richards,

our nervous systems discover the world-as-it-is, but the relations are non-hierarchical. They are circular to reflect a “constructivist perspective,” where the world is invented (in contrast to being discovered) by an intelligence acting in a social tradition and creating shared meaning via hermeneutic (circular, self-defining) processes.<sup>25</sup>

Clearly, even among the so-called experts, the term cybernetics has been widely misunderstood and misapplied, perhaps for two broad reasons: First, “its identity and boundary are difficult to grasp.” Further, the complexity of the concept(s) of cybernetics and the breadth of its/their applications, particularly in light of the multitude of the working definitions of the word, make it very difficult for people who are not routine practitioners of one or more of the concepts embraced by the term and their respective applications, to grasp working or effectively useable definitions. In many respects, this caveat or concern confronts many professionals attempting to use the concept, since cybernetics is not a universally accepted professional discipline for the most part in its own right ... yet! Secondly, except for a comparatively few professionals, the rather carefree use of “cyb” and/or “cyber” as a prefix to a multitude of disciplines, and particularly sub-disciplines, has led to significant confusion between and among those people relying on the terms to describe their particular areas of interest and inquiry, e.g., “cyborg” relating to various levels of robotic capabilities, and “cyberspace” relating to the Internet.

Despite the relative confusion and the misunderstandings regarding the proper usage of the concept embodied in cybernetics, the concepts and origins of the word have become progressively of increasing and greater interest, especially since around 2000. Lack of success by artificial intelligence in creating intelligent machines has increased curiosity about alternative views of what a brain does, and alternative views of the biology of cognition. There is a growing recognition of the value of a science of subjectivity that encompasses both objective and subjective interactions, including conversational communication. Designers are rediscovering the influence of cybernetics on the tradition of 20th-century design methods, and the need for rigorous models of goals, interaction, and system limitations for the successful development of complex products and services (including interspecies communication), such as those delivered via today’s software networks. And, as in any social cycle, students of history reach back with minds more open than was possible at the inception of cybernetics to reinterpret the meaning and contribution of a previous era. Nevertheless, this discussion represents only a comparatively short summary of the word cybernetic and its broad variety of meanings and applications in an equally broad variety of contexts.

In various presentations and publications, and particularly at the outset of his assessments regarding extraterrestrial life, Philosopher Frank J. Tipler<sup>26</sup> asserted a

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<sup>25</sup> “The implications of these differences are very great and touch on recent efforts to reproduce the brain ... which maintain roots in the paradigm of ‘brain as computer.’ These approaches hold the same limitations of digital symbolic computing and are neither likely to explain, nor to reproduce, the functioning of the nervous system.” See *supra* note 22; Larry Richards at [www.ascybernetics.org/foundations/definitions.htm](http://www.ascybernetics.org/foundations/definitions.htm).

<sup>26</sup> Frank Jennings Tipler is a mathematical physicist and cosmologist, and holds a joint appointment in the Department of Mathematics and the Department of Physics at Tulane University. Tipler has written books and papers on the Omega Point based on Pierre Teilhard de Chardin’s religious ideas, which he claims are

negative view on the likelihood of such life ... and even a hint particularly of extraterrestrial *intelligence* (including post-humans as the definition herein is used). In his initial conclusion that extraterrestrial life does not exist, and certainly not without the evolution of technology, Tipler did assume the initial position that, despite Enrico Fermi's paradoxical view to the contrary,<sup>27</sup> extraterrestrial life does in fact exist and is a natural outcome of cosmic evolution. If so, he continues, "then cultural evolution may have resulted in a post-biological universe in which machines are the predominant intelligence" ... *not the only intelligence*, but the predominant form of intelligence; however, the latter is defined in specific contexts. And this leads to the principal issue being examined herein, i.e., the useable definition of intelligence necessary to establish working principles and methodologies for interspecies communication based upon constantly evolving and ultra-sophisticated technology. This would characterize a *quasi*-post-biological relationship between humankind representing terrestrial intelligence, and non-Earth indigenous forms of extraterrestrial intelligence, i.e., strictly post-biological intelligence in the universe. According to space historian Steven J. Dick, and based in part on discussions with this author, three underlying scientific premises exist in support of arguments tending to favor post-biological intelligence:

- 1) the maximum age ... of extraterrestrial intelligence is several billion years;
- 2) the lifetime ... of a technological civilization is ... [more than] 100 years and probably much longer; and
- 3) in the long-term, cultural evolution supersedes biological evolution, and would have produced something far beyond biological intelligence.<sup>28</sup>

### **III. From the Immediate Past of World War II Reconstruction to the 21st Century: Conflicting Views about Science and its Relation to the Core Concepts of Many Religions**

This stumbling transition from humanism, or religious doctrine, toward secularism based upon the availability and securing of evolving empirical data, is reflected in an inching toward the basics of all passive as well as active awareness of empirically obtained data/information. For example, in many if not most respects, the founding father of current space transportation and the development of near and deep space as the catalyst for the evolution and need for increasing compatibility between and among nations after WW II, is considered to be Wernher von Braun, the so-called father of modern spaceflight. For present purposes, using von Braun as the pivotal fall guy in this discussion regarding

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a mechanism for the resurrection of the dead. There have been some strong differences of opinion, with some implying that this view is pseudoscience.

<sup>27</sup> In this context, see Paul Patton, "Beyond 'Fermi's Paradox' I: A Lunchtime Conversation – Enrico Fermi and Extraterrestrial Intelligence" *Universe Today*, December 23, 2015, [www.universetoday.com/119727/beyond-fermis-paradox-i-a-lunchtime-conversation-enrico-fermi-and-extraterrestrial-intelligence/](http://www.universetoday.com/119727/beyond-fermis-paradox-i-a-lunchtime-conversation-enrico-fermi-and-extraterrestrial-intelligence/).

<sup>28</sup> See, generally, Steven J. Dick, "The Post Biological Universe and our Future in Space," *Futures* 41 (2009): 578-80; and "Cultural Evolution, the Post Biological Universe, and SETI," *International Journal of Astrobiology* 2 (2003): 65-74.

secularism versus humanism, in the January 1, 1961 issue of *This Week Magazine*, von Braun wrote of his inflexible belief in the lessons of the Christian Bible, and noted that he could not

help feeling at the same time that this space effort of ours is bigger even than a rivalry between the United States and Russia.... The heavens beyond us are enormous beyond comprehension, and the further we penetrate them, the greater will be our human understanding of the great universal purpose, the Divine Will itself.

Further, von Braun emphasized his view of the relationship between humanism and secularism in a letter he wrote to the California State Board of Education on September 14, 1972:

Dear Mr. Gross

In response to your inquiry about my personal views concerning the "Case for Design" as a viable scientific theory for the origin of the universe, life and man, I am pleased to make the following observations.... For me, the idea of a creation is not conceivable without evoking the necessity of design. One cannot be exposed to the law and order of the universe without concluding that there must be design and purpose behind it all.... In the world around us, we can behold the obvious manifestations of an ordered, structured plan or design. We can see the will of the species to live and propagate.... The better we understand the intricacies of the universe and all harbors, the more reason we have found to marvel at the inherent design upon which it is based.

Von Braun then went on to state, somewhat *sub rosa*, the issue upon which secularism versus humanism, as opposed to the objective of Secular Humanism as an integrated objective for seeking to understand "existence" and its Creator, is premised, i.e.,

To be forced to believe only one conclusion—that everything in the universe happened by chance—would violate the very objectivity of science itself.... Some people say that science has been unable to prove the existence of a Designer ... [and that] the day will soon arrive when we will be able to understand even the creation of the fundamental laws of nature without a Divine intent.

Further, "the 'Case for Design' as a viable scientific alternative to the current 'Case for Chance' lies in the inconceivability, in some scientists' minds, of a Designer." What is missed here, of course, is that the Creator of the Universe, and life as we currently know it, may well have determined that the next step in biotic evolution is up to a cognizant, sentient, and perhaps even sapient group of specimens or entire species (individually or collectively) to evolve at will ... or not to evolve at all. In other words, the quietly implied position of this heavenly booming voice is that the Creator has brought *Homo sapiens sapiens* this far on the bush of biotic evolution; now it is up to the species to determine if,

how, and when the next step in evolutionary survivability will take place ... migrate, mutate, adjust, and survive ... or not and become extinct. This leads to the next step in humankind's evolution: transhumanism and post-humanism; i.e., transitioning from a completely biotic species to a biotechnologically integrated human, and on to a completely technological post-human. Nevertheless, this approach as a strictly scientific understanding of a chancy next step in humankind's evolution to post-humanism, is inconceivable in the minds of many of the strictly secular scientists.

Von Braun then concluded his letter to the California Board of Education with the assertion that

It is in the same sense of scientific honesty that I endorse the presentation of alternative theories for the origin of the universe, life and man in the science classroom. It would be an error to overlook the possibility that the universe was planned rather than happened by chance.

Earlier, in 1963, von Braun had asserted that

The two most powerful forces shaping our civilization today are science and religion. Through science man strives to learn more of the mysteries of creation. Through religion he seeks to know the Creator.... Neither operates independently. It is as difficult for me to understand a scientist who does not acknowledge the presence of a superior rationality behind the existence of the universe as it is to comprehend a theologian who would deny the advances of science.<sup>29</sup>

Perhaps succinctly, von Braun, serving in this discussion solely as an example, was asserting the endless interdependence between humanism or religious faiths and secularism, the increasing predictability of empirically premised reality (i.e., scientifically based data) at the expense of faith in the unarguable control of a creating deity. The former leads to a more quantifiable understanding of the who, what, and why of Creation. All biological/biotechnological/technological evolution embraces the endless evolutionary journey, itself, of the evolving individual and collective essences seeking that understanding in an increasingly secularly, empirical fashion. Under present global circumstances reflected in tense international relations, it might be safe to say that the conflicts are still between cultures, societies, and civilizations competing for biological, biotechnological, and ultimately post-human technology dominance ... and 'twas ever thus.

## **Conclusion**

The primary underlying given of the preceding discussion is not if, but when post-humans will become totally independent, self-replicating, self-metabolizing, and self-evolving entities possessing some form of independent and perhaps unique intelligence characteristics biotically recognizable and interactive as such. Further, it is a given that

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<sup>29</sup> W. von Braun, "My Faith: A Space-Age Scientist Tells Why He Must Believe in God," *American Weekly*, February 10, 1963.



this will lead to an effective communication between and among humankind and post-humans, relying on a carefully defined use of cybernetic principles. Rather, given the ongoing explosive evolution of human technology, the question is really when? This would not be a distant step in the evolution of so-called smart machines, already displacing large numbers of humans in manufacturing facilities, as well as providing routine chores in private homes.<sup>30</sup> Further, as noted in that portion of the discussion regarding the sophistication, complexity, and rapidity of advancing research in disciplines of technology, its mind-boggling sophistication for most people, and its applications to, or expressions in, seemingly independent entities possessing manifestations of artificial intelligence *in extremis*, it is safe to assume that domestic and international laws relating to cybercrimes and breaches of applicable civil-cyber laws relating to post-humans in space and elsewhere are barely in the gestation phases.

Renaissance eras are never easy on the human populations experiencing them. They have a strong tendency to create hectic and contradictory behavior, as well as disparate chaotic events. New values become inherent in those people directing and/or contributing to those events. While pursuing vastly different goals, the reality emphasized is the uncharacteristic, evolving dissimilarities between humans/humankind and post-humans, the creation of which they have initiated. But, given the global network between and among humans, the objective of space migration of the human genome and its naturally and technologically directed evolving gamete is becoming more widely and commonly shared. This, despite the ongoing fight for control between and among biological representatives of differing cultures, societies, and civilizations competing for dominance on Earth ... and despite frequently relying on shared and/or non-shared migratory activities and resources in near-earth orbit. And humans, transhumans, and post-humans must participate in the migratory process for the preservation of the evolving essence or purpose of all Earth-indigent biota that have found their temporary places as fibrillating leaves on the bush of evolution.

Finally, the process of post-humanism and evolving technology to an independent and totally technological species results in the application of the principle of Metalaw based upon Andrew Haley's concept of doing unto others as they would have you do unto them, i.e., between and among separate and independent entities/species with which/whom communication has been established and premised upon the basic principles of cybernetics ... communication between and among humans and non-biotic life with artificial intelligence *in extremis* that establishes a variety of physical relationships, most of which are yet to be conceived.

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<sup>30</sup> For an interesting, provocative, and readable view of one nation's survival reliance approach to the importance of rapidly evolving technologies (i.e., South Korea), see G. Shteyngart, "Thinking Outside the Bots," *Smithsonian Magazine* (June 2017): 66-80.

**About the Author:** Dr. George S. Robinson, III is a space law pioneer and international space expert. His book, book chapter and professional article publications – over 100 – are found throughout the aerospace and Space literature and continue to date. He served as International Relations Specialist for NASA, legal counsel to the FAA, and legal counsel at the Smithsonian Institution in Washington, DC. He serves on numerous Boards of Directors for science research. Dr. Robinson was a strong supporter of the Aerospace Technology Working Group, which was the forum from which Kepler Space Institute and University emerged.

Dr. Robinson has taught and lectured in law and business relating to space commerce at numerous universities in the United States and abroad, including George Mason University, Oxford University, McGill University, George Washington University, and Georgetown University. He serves on the board of directors for various science research facilities, foundations, and hospitals. He has also consulted for the National Research Council, the Smithsonian Institution, the Department of the Interior's Remote Sensing Data Archives, the Maritime-Aerospace Liaison Project of the Maine Maritime Academy, and NASA, where he serves on the Planetary Protection Advisory Committee.



**Editors' Notes:** Dr. George S. Robinson is a senior Space Law expert, consultant, and member of distinguished boards of directors. The Smithsonian Institute and NASA have benefitted from his legal counsel. After decades of work with public and private organizations to enhance cooperation for international Space development, in this article he falls back to his major in biology at Bowdoin College in Maine to delve into future possibilities for humans to evolve into post-humans through Space exploration and settlement. This is a complex discussion and analysis which ends with his comment:

“The primary underlying given of the preceding discussion is not if, but when post-humans will become totally independent, self-replicating, self-metabolizing, and self-evolving entities possessing some form of independent and perhaps unique intelligence characteristics biotically recognizable and interactive as such.” *Bob Krone and Gordon Arthur.*