The Mystery of Space and Human Nature

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The mysteries of space are intimately tied to the mysteries that humankind has been grappling with since its appearance on Earth. Questions of life, time, love, energy and matter, and the fundamental forces of nature drive the quests for knowledge, both scientific and philosophical, of our universe and of our nature as human beings. What is life? What makes us Human? Are we alone in the Universe? Where did we come from and how did we get here? Where are we going? How are we related to each other and to the rest of creation? Is there a universal Law governing everything in the Universe? Is there a Creator? What is our Destiny, and how can we systematically improve life on our home planet and work towards the well-being and prosperity of humankind? Some of these are questions that science, through experimentation and exploration, seeks formally to answer. By investigating the smallest scales to the largest, exploring the mysteries of sub-atomic particles to the grandeur of super-novae and distant galaxies, humankind is piecing together a puzzle, possibly an infinite one. Metaphors of space -- the heavens, stars, celestial spheres, vastness -- have long been used to express aspects of the human condition. This talk seeks to explore several aspects of the mystery of space and human nature: 1) The human fascination with Space and the connections between advances in space science and shifts in human thought, and 2) The odyssey of the exploration of Space and its potential for playing a role in the Unity of Humanity, and the prerequisites for progress toward this goal.

Introduction[1]

Some of the most compelling outstanding questions facing humanity today are the same ones that have been occupying the minds of thinkers, scientists, and mystics from the earliest days of thought. Through every means and through every human faculty, humankind has sought to explore and comprehend Reality. Science, philosophy, religion, and art, have been used in this search for Truth in increasingly specialized domains of human experience. Science has taken the lead in providing understanding of physical, measurable phenomena, while religion, philosophy, and art have tackled the mysteries of the purpose and meaning of human existence and spiritual reality. The trend towards increasing specialization and separation of these domains of inquiry, as well as the historical competition that has arisen between them, has in very recent years begun to shift towards a new trend of interdisciplinary fields of study and organized attempts to find points of commonality. One example of this new paradigm is the formal creation in the last decade of the 20th century of the field of Astrobiology – The study of life in the Universe, comprising biologists, geologists, astronomers, astrophysicists, chemists, mathematicians, social scientists, psychologists, and engaging historians, writers, theologians, actors, entrepreneurs, and society at large. Another is the exploration of space, in general, which is inherently interdisciplinary, and ever-increasing in scope. Although the formal recognition is recent, Space Science and technology have served as a unifying force for the various domains of human exploration of Truth throughout history. The same phenomena visible in the heavens – stars, planets, comets, the sun and moon – have provided both data and inspiration for every kind of inquiry and expression of Truth and Beauty. For this reason, it is worth examining the role of space science in the development of humankind's

[1] Before beginning this talk, the author expressed delight and gratitude to ABS Japan for being invited to address this group, and offered apologies for the strong Western-bias of this talk, especially regarding the history of science and philosophy.

understanding of itself and its relationship to the Universe.

The Role of Science and the Mysteries of Human Nature

Of particular interest here is the relationship between science and religion/spirituality in the context of space science. In one of His Tablets (*Makatib-i 'Abdu'l-Bahá*, vol. 1, pp 13-32 – "The Tablet of the Universe")[2], 'Abdu'l-Bahá, the son of Bahá'u'lláh, founder of the Bahá'í Faith, said that one should investigate all things in a methodical and scientific way, and by clear proofs, perspicuous signs and incontrovertible evidences, seek to discover the undisclosed verities and the hidden mysteries which are concealed in the inmost heart of the realities of the universe. He furthermore stated that to those to whom God has granted insight, whose inner natures are illumined, whose outer natures are refined, whose hearts are pure and whose minds are open and receptive, it is not acceptable, in this great and majestic cycle, to rely unquestioningly on the views of others in matters such as these.[2]

As to the specific mysteries to be addressed, the origin, evolution, and nature of life – terrestrial and extraterrestrial – are clearly at the top of the list. One of the most prominent scientists in history, Charles Darwin, articulated his approach to addressing compelling mysteries in his opening paragraph of *The Origin of the Species* in 1859,

> When on board *H.M.S. Beagle* as a naturalist, I was much struck with certain facts in the distribution of the organic beings inhabiting South America, and in the geological relations of the present to the past inhabitants of that continent. These facts, as will be seen in the latter chapters of this volume, seemed to throw some light on the origin of the species – that mystery of mysteries, as it has been called by one of our greatest philosophers. On my return home, it occurred to me, in 1837, that something might perhaps be made out on this question by patiently accumulating and reflecting on all sorts of facts which could possibly have any bearing on it. After five years' work I allowed myself to speculate on the subject, and drew up some short notes: these I enlarged in 1844 into a sketch of the conclusions, which then seemed to me probable: from that period to the present day I have steadily pursued the same object. I hope that I may be excused for entering on these personal details, as I give them to show that I have not been hasty in coming to a decision.

Centuries later, America's National Aeronautical and Space Administration (NASA) seeks answers to fundamental questions of science and technology, based ultimately on these same ageless mysteries of the universe. The following questions are listed in NASA's Strategic Plan, and serve as the foundation for its goals:

1. How did the universe, galaxies, stars, and planets form and evolve, and what is their destiny? How can our exploration of the universe and our solar system revolutionize our understanding of physics, chemistry, and biology?
2. Does life in any form, however simple or complex, carbon-based or other, exist elsewhere than on Earth? Are there Earth-like planets beyond our solar system?
3. How can we utilize the latest findings about the Sun, Earth, and other

[2] A provisional anonymous translation of the *Makatib-i Abdu'l-Baha* can be found on the web at http://bahai-library.org/provisionals/universe.html

planetary bodies to develop accurate, predictive environmental, weather, climate, natural disaster, and natural resource models to help ensure sustainable development and improve the quality of life on Earth?

4. What is the fundamental role of gravity and cosmic radiation in vital biological, physical, and chemical systems in space, on other planetary bodies, and on Earth, and how do we apply this fundamental knowledge to foster a permanent human presence in space and to improve life on Earth?
5. How can we enable revolutionary technological advances to provide air and space travel for anyone, anytime, anywhere, more safely, more affordably and with less impact on the environment, and improve business opportunities and global security?
6. What cutting-edge technologies, processes, techniques, and engineering capabilities must be develop to enable our research agenda in the most productive, save, economical, and timely manner? How can we most effectively transfer knowledge from our research and discoveries to benefit both commercial ventures and the quality of human life?

Where NASA and other scientists stop in the enquiry, religion and spirituality can begin studying different facets of the same mysteries. Charles Darwin, who had originally planned to train for the ministry, and whose theory of natural selection as it applies to evolution may at first seem at odds with the existence of a Supreme Being, himself remarked, "I cannot pretend to throw the least light on such abstruse problems. The mystery of the beginning of all things is insoluble by us; and I for one must remain agnostic."[3]

Bahá'u'lláh, in a tablet written during roughly the same time as Darwin's publications, expounded on the mysteries to be addressed by spiritual enquiry[4].

> Verily I say, the human soul is, in its essence, one of the signs of God, a mystery among His mysteries…It is, in itself, a testimony that beareth witness to the existence of a world that is contingent, as well as to the reality of a world that hath neither beginning nor end.

In the same Tablet He continues

> Thou hast, moreover, asked Me concerning the nature of the celestial spheres. To comprehend their nature, it would be necessary to inquire into the meaning of the allusions that have been made in the Books of old to the celestial spheres and the heavens, and to discover the character of their relationship to this physical world, and the influence which they exert upon it. Every heart is filled with wonder at so bewildering a theme, and every mind is perplexed by its mystery. God, alone, can fathom its import. The learned men, that have fixed at several thousand years the life of this earth, have failed, throughout the long period of their observation, to consider either the number or the age of the other planets. Consider, moreover, the manifold divergencies that have resulted from the theories propounded by these men. Know thou that every fixed star hath its own planets, and every planet its own creatures, whose number no man can compute.

[3] As quoted in the biography of Charles Darwin at http://www.blupete.com/Literature/biographies/Science/Darwin.htm

[4] *Gleanings from the Writings of Baha'u'llah*, LXXXII, pp.160-162, trans. Shoghi Effendi, Wilmette, IL: Baha'i Publishing Trust, 1952.

By way of clarifying and expounding on this passage, Shoghi Effendi, authorized Interpreter of Baha'u'llah's Writings, gracefully hands part of the inquiry into this mystery back to science.

> Regarding the passage ……of the 'Gleanings': the creatures which Baha'u'llah states to be found in every planet cannot be considered to be necessarily similar or different from human beings on this earth. Baha'u'llah does not specifically state whether such creatures are like or unlike us. He simply refers to the fact that there are creatures in every planet. It remains for science to discover one day the exact nature of these creatures.[5]

Delving slightly deeper into the Bahá'í Writings and secondary literature, one can find several other intriguing references to life and creation/creatures, which, taken together, paint a picture of a universe possibly teeming with living beings, and cast interesting light on Astrobiological questions.

> Verily I say, the creation of God embraceth worlds besides this world, and creatures apart from these creatures[6].

> The earth has its inhabitants, the water and the air contain many living beings and all the elements have their nature spirits, then how is it possible to conceive that these stupendous stellar bodies are not inhabited? Verily, they are peopled, but let it be known that the dwellers accord with the elements of their respective spheres. These living beings do not have states of consciousness like unto those who live on the surface of this globe; the power of adaptation and environment moulds their bodies and states of consciousness, just as our bodies and minds are suited to our planet[7]

> ...[W]e cannot say definitely that His Revelation will be inter- planetary in scope. We can only say that such a thing may be possible. What Bahá'u'lláh means by His appearance in 'other worlds' He has not defined, as we could not visualize them in our present state, hence He was indefinite, and we cannot say whether He meant other planets or not... (From a letter written on behalf of Shoghi Effendi to an individual believer, December 24, 1941; *Lights of Guidance*, #1555)

> As to your question whether the power of Bahá'u'lláh extends over our solar system and to higher worlds; while the Revelation of Bahá'u'lláh, it should be noted, is primarily for this planet, yet the spirit animating it is all-embracing, and the scope therefore cannot be restricted or defined. (*Lights of Guidance*, #1594)

> ...['Abdu'l-Baha] had been speaking of the great technological and scientific strides of the age; it would be meet, He said, if ways and means of reaching other planets were now devised. (*'Abdu'l-Bahá* by H.M. Balyuzi, p. 377)

> 'Abdu'l-Baha stated there are other worlds than ours which are inhabited by beings capable of knowing God." (Shoghi Effendi, *Light of Divine Guidance*, Vol. 2, p. 82)

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[5] From a letter written on behalf of Shoghi Effendi to an individual believer, February 9, 1937 (*Lights of Guidance*, #1581, p. 478, rev. edn., New Delhi: Baha'i Publishing Trust, 1988)

[6] "Súriy-i-Vafá, in *Tablets of Bahá'u'lláh*, p. 189, Wilmette, IL: Baha'i Publishing Trust, 1978.

[7] *Divine Philosophy*--a book of statements allegedly made by 'Abdu'l-Bahá and published by Isabel Fraser Chamberlain.

In *The Tablet of the Universe*, ‘Abdu’l-Bahá makes the point that, just as the expressions of the creative hand of God throughout His limitless worlds are themselves limitless, in like manner the worlds of bodily existence the mind of no man can reckon nor the understanding of the learned comprehend. In this tablet and in others, Bahá’u’lláh and he both quote traditions and excerpts of the Qur’an that make reference to creatures inhabiting both the heavens and the earth.

> And one of the signs of (God’s) creation is the (existence) of the heavens and the earth and whatever lieth between them and the creatures inhabiting them.

Again in *The Tablet of the Universe*, ‘Abdu’l-Bahá asserts that physical things are signs and imprints of spiritual things; every lower thing is an image and counterpart of a higher thing. Earthly and heavenly, material and spiritual, accidental and essential, particular and universal, structure and foundation, appearance and reality and the essence of all things, both inward and outward -- all of these are connected one with another and are interrelated in such a manner that you will find that drops are patterned after seas, and that atoms are structured after suns in proportion to their capacities and potentialities. For particulars in relation to what is below them are universals, and what are great universals in the sight of those whose eyes are veiled are in fact particulars in relation to the realities and beings which are superior to them. Universal and particular are in reality incidental and relative considerations. He continues to explain that the all-embracing framework that governs existence includes within its compass every existent being -- particular or universal -- whether outwardly or inwardly, secretly or openly. Just as particulars are infinite in number, so also universals, on the material plane, and the great realities of the universe are without number and beyond computation.

This interrelatedness of all things and all aspects of reality is what binds together the inquiries of science, philosophy, religion and art. The Universal House of Justice appeals to all people to engage in this type of unified exploration of Truth in a letter written May 19, 1995:

> With regard to the harmony of science and religion, the Writings of the Central Figures and the commentaries of the Guardian make abundantly clear that the task of humanity, including the Bahá’í community that serves as the "leaven" within it, is to create a global civilization which embodies both the spiritual and material dimensions of existence. The nature and scope of such a civilization are still beyond anything the present generation can conceive. The prosecution of this vast enterprise will depend on a progressive interaction between the truths and principles of religion and the discoveries and insights of scientific inquiry. This entails living with ambiguities as a natural and inescapable feature of the process of exploring reality. It also requires us not to limit science to any particular school of thought or methodological approach postulated in the course of its development.

Historical Perspectives

The relative movement of the Sun, moon, and planets is a phenomenon, once a hotly-debated ambiguity, that has been central to our evolving notion of our relative importance among creation. This issue is closely related to the equally controversial mysteries of origin and evolution of life in the universe. ‘Abdu’l-Bahá states in *The Tablet of the Universe* that early ideas of the Earth revolving about the Sun were proposed by Pythagoras in 500 B.C., and then supported specifically in a treatise by Aristarchus in 280 B.C. However, because these theories were based only on presentiment and intuition, and not founded upon clear evidences, convincing arguments (Pythagoras reckoned the Sun must be the center in relation to the Earth because it was fiery), and

positive proofs derived from the laws of geometry and mathematics, the Sun-centric view was replaced by the more appealing Earth-centric view that seemed consistent with casual observation. Ptolemy, the Greek Alexandrian astronomer and historian, cemented this Earth-centric theory in the second century (A.D.). Based on the philosophy of Aristotle, Ptolemy synthesized the first comprehensive model of the universe. His elaborate new mathematical model, using Euclidian geometry and eccentric orbital paths to explain planetary retrograde motion and the periodic dimness of Mars, was founded on observation and rigorously developed. So powerful and enduring was Ptolemy's model, recorded in an almanac and embraced by the Roman Church, that it remained as accepted fact for the next thousand years. In the sixteenth century, Nicolaus Copernicus proposed that a rotating Earth revolving with the other planets about a stationary central Sun could account in a simpler way for the same observations. This time, the theory was supported by more substantive science and recorded in his historic work, *De Revolutionibus*. Being a consummate perfectionist, he circulated his new theories only amongst a limited circle of astronomers for a several decades before publicly announcing the now famous system of laws that were the fruit of his studies. He died in 1543, so soon after the publication of his work that he was never to know the impact it would have on the world. Wolfgang Goethe[8] in 1808 described it thus:

> Of all discoveries and opinions, none may have exerted a greater effect on the human spirit than the doctrine of Copernicus. The world had scarcely become known as round and complete in itself when it was asked to waive the tremendous privilege of being the center of the universe. Never, perhaps, was a greater demand made on mankind -- for by this admission so many things vanished in mist and smoke! What became of our Eden, our world of innocence, piety and poetry; the testimony of the senses; the conviction of a poetic -- religious faith? No wonder his contemporaries did not wish to let all this go and offered every possible resistance to a doctrine which in its converts authorized and demanded a freedom of view and greatness of thought so far unknown, indeed not even dreamed of.

Fearing the implication that this new theory reduced the significance of man and robbed him of his premier position in the universe, the powerful clergy of the time vehemently punished any supporters. Giordano Bruno, an Italian scientist who had postulated that space was boundless and audaciously suggested that there might be other inhabited worlds, was burned at the stake in 1600 for blasphemy by the Inquisition. The two contemporary astronomers, German Johannes Kepler and Italian Galileo Galilei were the first strong supporters of Copernicus to provide elegant mathematical theory and incontrovertible observational evidence for the heliocentric theory, superceding the Ptolemaic model. The strongly religious Kepler had intended to become a clergyman and was always guided by spiritual ideals based on the concept of beauty and harmony in geometric figures, numbers, music, and the structure of the universe. Although he didn't find astronomy particularly appealing, the idea of a Sun-centered system had mystical appeal. Just before completing his theology exams, however, he accepted a post as professor of astronomy and mathematics in Austria. It was there that he discovered and published his three laws of planetary motion in his *Harmonices mundi* (*Harmonies of the World*, 1619), in relentless pursuit of solving what he called the "Cosmic Mystery" of non-circular orbital paths. These three laws laid the foundation for Newton's theory of gravitation and were a turning point in the history of science. To Kepler they satisfied his longing to reconcile the emerging vision of a Sun-centered planetary

[8] Goethe, Johann Wolfgang von. 1808-1810. *Materialien zur Geschichte der Farbenlehre*, *Zur Farbenlehre*, 2 vols. (Tübingen: Cotta). English translation by Charles Lock Eastlake, Goethe's theory of colours (London: Murray, 1840). American edition arranged by Rupprecht Matthaei and translated by Herb Aach, Goethe's color theory (New York: Van Nostrand Reinhold, 1971).

system with the ancient Pythagoran[9] concept of universal harmony. Kepler also described a

[9] Source: *Johannes Kepler and the Music of the Spheres*, by David Plant. Plant says: “Pythagoras discovered that the pitch of a musical note depends upon the length of the string which produces it. This allowed him to correlate the intervals of musical scale with simple numerical ratios. When a musician plays a string stopped exactly half-way along its length an octave is produced. The octave has the same quality of sound as the note produced by the unstopped string but, as it vibrates at twice the frequency, it is heard at a higher pitch. The mathematical relationship between the keynote and its octave is expressed as a 'frequency ratio' of 1:2. In every type of musical scale, the notes progress in a series of intervals from a keynote to the octave above or below. Notes separated by intervals of a perfect fifth (ratio 2:3) and a perfect fourth (3:4) have always been the most important 'consonances' in western music. In recognising these ratios, Pythagoras had discovered the mathematical basis of musical harmony.

“In one sense Pythagoras had also invented western science. By associating measurements of length with musical tones he made the first known reduction of a quality (sound) into a quantity (length and ratio). The understanding of nature through mathematics remains a primary objective of science today. But Pythagoras also recognised that the musical octave is the simplest and most profound expression of the relationship between spirit and matter. The 'miracle of the octave' is that it divides wholeness into two audibly distinguishable parts, yet remains recognisable as the same musical note — a tangible manifestation of the hermetic maxim 'as above, so below'. The short-lived but profoundly influential Pythagorean Brotherhood sought to unite "religion and science, mathematics and music, medicine and cosmology, body, mind and spirit in an inspired and luminous synthesis".

“The Pythagoreans used music to heal the body and to elevate the soul, yet they believed that earthly music was no more than a faint echo of the universal 'harmony of the spheres'. In ancient cosmology, the planetary spheres ascended from Earth to Heaven like the rungs of a ladder. Each sphere was said to correspond to a different note of a grand musical scale. The particular tones emitted by the planets depended upon the ratios of their respective orbits, just as the tone of a lyre-string depended upon its length. Another type of celestial scale related the planetary tones to their apparent rates of rotation around the Earth. The music of the spheres was never a fixed system of correspondences. Many variant schemes existed because each philosopher would necessarily approach it from a slightly different perspective. The musicologist Joscelyn Godwin comments, ‘...the celestial harmony of the solar system... is of a scope and harmonic complexity that no single approach can exhaust. The nearest one can come to understanding it as a whole is to consider some great musical work and think of the variety of analytical approaches that could be made to it, none of them embracing anything like the whole.’

“Plato, Pliny, Cicero and Ptolemy are amongst the philosophers of the ancient world who contemplated the music of the spheres. The doctrine was transmitted to medieval Europe where it found its most glorious expression in the architecture of great abbeys and cathedrals consciously designed to conform to the proportions of musical and geometric harmony. The English hermeticist Robert Fludd (1574-1637) visualised grand celestial scales spanning three octaves and linking levels of existence from the sub-planetary elemental worlds to exultant choirs of angelic intelligences beyond the stars. The beautiful engravings which illustrate Fludd's encyclopaedic works are amongst the most comprehensive descriptions of pre-Copernican cosmology ever devised.

“The ideals of Pythagorean harmony inspired Copernicus himself. Nicholas Copernicus (1473-1543) spent most of his life in the fortified city of Frauenburg in Prussia fulfilling administrative duties as a canon of the cathedral chapter and devoting the rest of his time to contemplation of the cosmic harmonies. The cumbersome mathematics of the Ptolemaic system, with its maze of epicycles grafted on to reconcile various observational discrepancies, offended his Pythagorean sense of proportion. He realised that a Sun-centred planetary system not only gave better predictions of celestial motion but could also he expressed through more elegant geometry — to the greater glory of God the Creator.

“Kepler's early enthusiasm for the Copernican system was inspired by the same sense of idealism. He could readily accept the Sun as the centre of the planetary system, but the necessity of rejecting circular orbits came as something of a shock. The circle is an archetypal symbol of harmony and perfection; Kepler recoiled with disgust when an unsightly bulge began to emerge from his analysis of the orbit of Mars. Yet the elliptical orbits eventually revealed a scheme of celestial harmony more subtle and profound than any that had gone before.

“Kepler's, First Law states that the planets move in ellipses and that the Sun is not at the exact centre of their orbits. Each planet moves between a 'perihelion' point nearest the Sun and an 'aphelion' point furthest away. The Second Law states that the planets move faster at perihelion than at aphelion. Kepler measured their angular velocities at these extremes (i.e. how far they travel in 24 hours in minutes and seconds of arc as viewed from the Sun) and expressed this ratio as a musical interval. Saturn, for instance, moves at a rate of 106" per day at aphelion and l35" at perihelion. Cancelled down, the ratio 106:135 differs by only two seconds

journey to the Moon and discussed the existence of possible lunar inhabitants. Although his ideas were controversial and he was a public defender of Copernicanism, he did not suffer the fate of Galileo, who was brought before the Inquisition in 1633 for his *Dialogue Concerning the Two Chief World Systems.* This work upheld the Copernican system rather than the Ptolematic system and, together with his other scientific and astronomical inventions and discoveries, marked a turning point in scientific methods and philosophical thought. He was made to renounce all his beliefs and writings supporting the Copernican theory.

Following the lead of Kepler, Sir Isaac Newton (1642-1727) laid the foundation for modern physics. He was an English mathematician and physicist who solved some of the mysteries of light and optics and invented calculus[10]. He is best known for his three laws of motion (published in his *Principia*), from which he derived the law of universal gravitation. These laws govern all non-relativistic interactions of force, matter, and motion. Of Newton, it is written in *Science in History* (Bernal)[11]

> Newton's theory of gravitation and his contribution to astronomy mark the final stage of the transformation of the Aristotelian world-picture begun by Copernicus. For a vision of spheres, operated by a first mover or by angels on God's order, Newton had effectively substituted that of a mechanism operating according to a simple natural law, requiring no continuous application of force, and only needing divine intervention to create it and set it in motion.

Indeed the mystery of the nature of Gravity so perplexed Newton that he died unsatisfied that he had achieved his ultimate goal, which was to unite knowledge and belief, to reconcile the Book of Nature with the Book of Scripture. Newton had a passionate interest in alchemy that drove all of his scientific research. In addition, he pursued research in theology and history with the same vigor as alchemy and science.[12] He wrote,

> I have not yet been able to discover the cause of these properties of gravity from

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from 4:5 — equivalent to the interval of a major third. Kepler found that the angular velocities of all the planets closely correspond to musical intervals. When he compared the extremes for combined pairs of planets the results were even more marvellous, yielding the intervals of a complete scale. Thus, the ratio between Jupiter's maximum and Mars' minimum speed corresponds, to a minor third; the interval between Earth and Venus to a minor sixth. Rather than the fixed-tone planetary scales of earlier schemes, Kepler's measurements revealed ever-changing polyphonic chords and harmonies as the planets move between perihelion and aphelion. Furthermore, he had shifted the focus of celestial harmony from the Earth to the Sun: 'Henceforth it is no longer a harmony made for the benefit of our planet, but the song which the cosmos sings to its lord and centre, the Solar Logos'. (Joscelyn Godwin: Harmonies of Heaven and Earth (Thames and Hudson 1987))

"Scientific materialists have tended to dismiss the spiritual dimension to Kepler's work as either the remnants of a deeply-ingrained 'medievalism' which he was unable to shake off or, even less charitably, as the fantasies of an over-worked mind. His vision of the music of the spheres, however, is based upon the hard facts of astronomical measurement. The astronomer Fred Hoyle agrees that the correspondence between musical ratios and planetary velocities as described by Kepler is "frighteningly good".7 The Kepler scholar Francis Warrain extended Kepler's researches and found that the angular velocities of Uranus, Neptune and Pluto, which were unknown during Kepler's lifetime, also correspond to harmonic ratios. The music of the spheres is more than a beautiful poetic intuition. The dynamics of the solar system, first laid bare by Kepler's mathematical genius, are directly analogous to the laws of musical harmony."

[10] Leibnitz invented calculus at the same time and the notation in use today is that of Leibnitz.

[11] Bernal, *Science in History* (1954), Cambridge, Mass.; M.T.P. Press, 1985

[12] Robert A. Hatch of the University of Florida says of Newton: "Newton's final gesture before death was to refuse the sacrament, a decision of some consequence in the 18th century. Although Newton was dutifully raised in the Protestant tradition his mature views on theology were neither Protestant, traditional, nor orthodox. In the privacy of his thoughts and writings, Newton rejected a host of doctrines he considered mystical, irrational, or superstitious. In a word, he was a Unitarian."

> phenomena and I frame no hypotheses. It is enough that gravity does really exist and acts according to the laws I have explained, and that it abundantly serves to account for all the motions of celestial bodies. That one body may act upon another at a distance through a vacuum without the mediation of anything else, by and through which their action and force may be conveyed from one another, is to me so great an absurdity that, I believe, no man who has in philosophic matters a competent faculty of thinking could ever fall into it. [13]

Newton died two centuries before 'Abdu'l-Bahá's intriguing answer to his question.

> Love is the secret of God's holy Dispensation, the manifestation of the All-Merciful, the fountain of spiritual outpourings. Love is heaven's kindly light, the Holy Spirit's eternal breath that vivifieth the human soul. Love is the cause of God's revelation unto man, the vital bond inherent, in accordance with the divine creation, in the realities of things. Love is the one means that ensureth true felicity both in this world and the next. Love is the light that guideth in darkness, the living link that uniteth God with man, that assureth the progress of every illumined soul. Love is the most great law that ruleth this mighty and heavenly cycle, the unique power that bindeth together the divers elements of this material world, the supreme magnetic force that directeth the movements of the spheres in the celestial realms. Love revealeth with unfailing and limitless power the mysteries latent in the universe.[14]

The statement that "Love is the most great law" poses an interesting challenge to scientists seeking to discover the ever-elusive 'Theory of Everything' in science that will elegantly explain all forces of nature. Until the end of his life, Albert Einstein sought and finally formulated the beginnings of a unified field theory, whereby the phenomena of gravitation and electromagnetism could be derived from one set of equations. Einstein revolutionized all of science and modern thought through his theories of general and special relativity. His theories were tested and proven by applying them to explain the advance of the planet Mercury's perihelion, which Newton's laws had failed to predict. After 1920, however, while retaining relativity as a fundamental concept, theoretical physicists focused more attention on the theory of quantum mechanics, as elaborated by Max Planck, Niels Bohr, Werner Heisenberg, and others, and Einstein's later thoughts went somewhat neglected for decades. This picture has changed in more recent years. Physicists are now striving to combine Einstein's general relativity theory with quantum theory in a 'theory of everything', by means of such highly advanced mathematical models as superstring theories.

These are just some of the historic advances in philosophy and science impacted directly by individuals in space science and astronomy. Through the process of continuous discovery of scientific and mathematical theories to explain mysteries previously attributable only to God's influence, there occurred a dramatic shift from convictions of humanity as the God-created centerpiece of the Universe towards the view of humans as an insignificants and accidental bi-product of natural processes.

Attention now turns to space projects within the last 50 years that have impacted upon humanity in no less profound ways. NASA's Apollo Program of the 60's and early 70's offered a glimpse into the future of a unified humanity. The first photographs of the earth as a whole and complete sphere, hanging in the blackness of space, has given people a concrete image to associate with the idea of the Earth as the home of one People. In the photograph of the Earth rising over

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[13] As quoted by Professor Morris Kline, in his book, *Mathematics and the Search for Knowledge* (Oxford University Press, 1985)

[14] *Selections from the Writings of 'Abdu'l-Bahá*, No. 12 (p. 27)

the lunar horizon, no borders were evident. As the first steps were taken on the Moon, an unprecedented number of people around the world watched and listened together and for a moment felt the inspiration of an act taken on behalf of the whole human race. The words spoken were "That's one small step for man, one giant leap for Mankind." The inscription on the plaque mounted on the lander was:

HERE MEN FROM THE PLANET EARTH FIRST SET FOOT UPON THE MOON
JULY 1969 A.D.
WE CAME IN PEACE FOR ALL MANKIND

Ironically, it was not peace, but war (the Cold War between the U.S. and the U.S.S.R.) that fueled the race to the Moon and provided justification for the huge financial expenditures and sacrifices made on both sides during the race. Most people were aware of this, yet they were nevertheless inspired by the mere act or idea of such an achievement dedicated even if only at the end to peace and unity. In addition to the psychological impact of the Apollo program, the super-human pace of technology development required for success spawned countless new inventions that advanced civilization. It was during those years that the beginnings of the Internet were developed, closely linked with the same space race and Cold War. The first satellites were launched, and the potential for global communications became plainly evident.

In the years following Apollo, the question of life on other planets was a key science driver for a series of robotic Russian and American missions through the Solar System. Probes traveled to Mercury, Venus, Mars, Jupiter, Saturn, Asteroids, Comets, and the Moon, and one even passed by the outer planets and exited the Solar System entirely. Mars was discovered to hold the most promise for life, but even in the case of Mars, the attitude towards life has oscillated wildly. In the early 20th century, astronomer Percival Lowell interpreted telescopic observation of linear features on Mars to be canals built by Martians. He introduced the idea of little green men into the popular literature, and defended his canals in his scientific literature. Other features on Mars were thought to be vegetation or oceans, before the American Mariner 4 mission returned the first photographs of a barren, cratered surface, much like the Moon. Still, a lander was necessary to test for the presence of microbial life on Mars, since all the necessary elements for such life (carbon, oxygen, water, sunlight) appeared to be present on the planet. The Viking landers in the mid 70's returned no conclusive evidence for life, and this effectively delayed the active search for life on Mars for several decades.

The photographs from orbit showed geomorphological signs of water on Mars -- canyons, valley networks, apparent lake beds -- and this was compelling enough to keep a small number of scientists interested in the possibility of life. Then, in 1996, the astonishing discovery of possible evidence for life inside a Martian meteorite catapulted the search for life on Mars back into priority science. Mars and Earth are thought to be sister planets, having very similar climates and appearance throughout much of their early history around the time when life was first appearing on Earth (~3.5 billion years ago). Figure 1 (see Appendix) shows a comparative timeline of the evolution of the two planets with some important milestones indicated (McKay, 2001)[15]. This particular meteorite on Mars was the oldest of the more than 15 meteorites from Mars known. If life evolved on Mars as it was evolving on Earth, it was thought that this meteorite could contain clues to that life. The arguments "for life" were energetically challenged, but enough ambiguity remained to stir excitement again.

The next mission following this discovery, called Pathfinder, had already been built without the search for life as its goal. It was a relatively tiny mission compared to Apollo or Viking, serving primarily as technology demonstration, and yet the public's interest in the project was extraordinary.

[15] McKay, C.P., personal communication, first published in MacKay, C.P. & Stoker, C.R., The early environment and its evolution on Mars: Implications for life, *Rev Geophysics, 27*, 189-214, 1989.

Many factors contributed to the unprecedented public involvement. This was the first spacecraft to land on Mars in two decades, and the first to be immediately accessible by the Internet. Excitement about the possibility of life was at a high despite the great controversy surrounding the meteorite findings. During the mission, the Pathfinder web pages were getting over a million hits a day. Schoolchildren were involved. People identified with the little Sojourner rover as if it were an animal. Some even expressed sorrow when the battery on the main lander station ran out, leaving the solar-powered rover to roam blindly with no way to communicate home. The phenomenon of Pathfinder demonstrated again humanity's thirst for inspiration, purpose, and progress.

The search for life on Mars and in other places in the Solar System remains a high priority in NASA's program. Higher resolution images from orbit have produced in recent years compelling evidence for the presence of liquid water on or near the surface of Mars. It is generally accepted that "where there is water, there is likely to be life", so the focus of exploration today is on the search for water. Even in this arena, the Bahá'í Writings illuminate.

> …for without water no worldly creature can live—mineral, vegetable, animal, and man, one and all depend upon water for their very being. Yes, the latest scientific discoveries prove to us that even mineral has some form of life, and that it also needs water for existence.[16]

Launched on 2 March 1972, Pioneer 10 was the first spacecraft to travel through the Asteroid belt, and the first spacecraft to make direct observations and obtain close-up images of Jupiter. Pioneer 10 is over 6.6 billion miles away, making it the furthest extension of human craftsmanship. This mission made valuable scientific investigations beyond the outer regions of our solar system even after the end of mission on 31 March, 1997. Pioneer 10 is headed towards the constellation of Taurus (The Bull). It will take Pioneer over 2 million years to pass by one of the stars in the constellation. The Pioneer 10 spacecraft bears a gold plaque (Figure 2) designed by Carl Sagan containing mathematical and graphical information about who and where we Earthly humans are in the Universe. The plaque shows simple one-line drawings of the Pioneer spacecraft, representation of a man and a woman, with the man's hand raised in a gesture of good will. Spheres and binary numbers representing our Sun and planets, vector diagrams of the position of our Solar System in the Milky Way galaxy, calibrated using intrinsic radiation of the hydrogen atom, give our precise location. In the event that it is ever discovered by other sentient beings, it will give them some basic information about the creatures that built the craft.[17]

Space and the Unity of Mankind

In conclusion, the odyssey of the study and exploration of Space shows great potential for playing a role in the unification of mankind. Efforts of international cooperation in space have to date proven challenging and have been only moderately successful. The International Space Station has gone through countless major re-designs and has suffered through major economic turmoil during the collapse of the Soviet Union and frequent changes in national priorities. Nevertheless, the examples of Apollo, Pathfinder, and Pioneer 10 stand as reminders of the thirst for unity and peaceful cooperation in historic undertakings. If a war-time endeavor to send a human to the Moon and back could produce such inspiration, it is worth considering how much more a truly global mission to send humans to Mars might inspire. Of course, there are numerous examples of other glimpses into the potential unifying impact of international cooperation. Scientific missions

[16] 'Abdu'l-Bahá, *Paris Talks*, 82

[17] See Figure 1: Pioneer 10 plaque

such as Cassini and the Mir ('Peace') Space Station, as well as popular science fiction such as Star Trek demonstrate this.

Unfortunately, few places are the shackles of National sovereignty more limiting than in this arena of International Cooperation in Space. This can be readily discerned in the vision of NASA, written in 1999:

> NASA is an investment in America's future. As explorers, pioneers, and innovators, we boldly expand frontiers in air and space to inspire and serve America and to benefit the quality of life on Earth

A vision serving only America ultimately will not be conducive to achieving the goal of benefiting "the quality of life on Earth". The national priorities quoted in NASA's mission are:

1. To increase the understanding of science and technology
2. To protect Earth's fragile environment
3. To foster educational excellence
4. To foster peaceful exploration and discovery
5. To foster economic grown and security

And NASA's Mission is

1. To advance and communicate scientific knowledge and understanding of the Earth, the solar system, and the universe
2. To advance human exploration, use, and development of space
3. To research, develop, verify, and transfer advanced aeronautics and space technologies

The lofty, Earth-encompassing goals of NASA will continue to be hampered by its very nature as an agency of the US government, because it must serve the interests of the American taxpayer and it is subject to the volatility of partisan politics. Hints of the potential role that Space science and exploration could play in the next leap forward in civilization can be spotted in NASA's plan. But the key to success, namely the recognition of the Oneness of Mankind, is not yet fully embraced or reflected.

Bahá'ís have the opportunity and responsibility to change existing modes of thought, to carry mankind to the next level of unity. As the new World Order begins to take hold, and especially when the political and economic systems of the nations become unified under a global system of governance, the limitations of the current Nationalistic visions will dissolve. In this process will emerge the possibility a global space program, comprising all nations and cultures, striving to answer the same questions and solve the same mysteries of the universe as have been discussed here, but this time, truly, for the benefit of all and the prosperity of humankind.

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Appendix

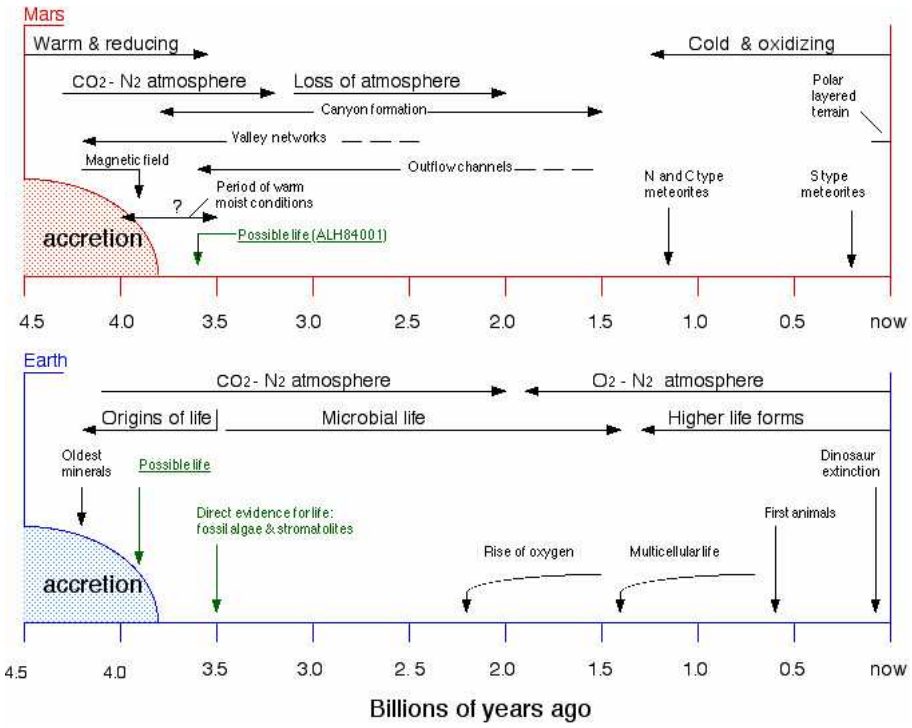

Figure 1. Comparative timeline of the biological and geological evolution of Earth and Mars (McKay and Stoker, 2001)

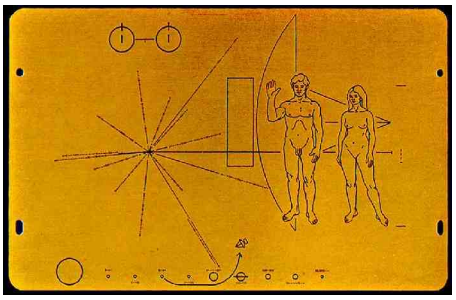

Figure 2. Pioneer 10 plaque—a message