Introduction: A Voyage of Knowledge

"As far as the laws of mathematics refer to reality, they are not certain; and as far as they are certain, they do not refer to reality"
- Albert Einstein (1879 - 1955)

The classical Jewish 'Monotheistic Concept of One God', a powerful unifying idea over disparate dark "forces", was an essential precursor to modern science and its methods - Relativity Science Calculator

"We are then quite out of the way, when we think that things contain within themselves the qualities that appear to us in them ... For which, perhaps, to understand them aright, we ought to look not only beyond this our earth and atmosphere, but even beyond the sun or remotest star our eyes have yet discovered. For how much the being and operation of particular substances in this our globe depends on causes utterly beyond our view, is impossible for us to determine. We see and perceive some of the motions and grosser operations of things here about us; but whence the streams come that keep all these curious machines in motion and repair, how conveyed and modified, is beyond our notice and apprehension: and the great parts and wheels, as I may say so, of this stupendous structure of the universe, may, for aught we know, have such a connexion and dependence in their influences and operations one upon another, that perhaps things in this our mansion would put on quite another face, and cease to be what they are, if some one of the stars or great bodies incomprehensibly remote from us, should cease to be or move as it does. This is certain: things, however absolute and entire they seem in themselves, are but retainers to other parts of nature, for that which they are most taken notice of by us. Their observable qualities, actions, and powers are owing to something without them; and there is not so complete and perfect a part that we know of nature, which does not owe the being it has, and the excellences of it, to its neighbours; and we must not confine our thoughts within the surface of any body, but look a great deal further, to comprehend perfectly those qualities that are in it." - John Locke

Source: "An Essay Concerning Human Understanding - Chapter VI - Of Universal Propositions: Their Truth and Certainty", Section 11, by John Locke, 1690.

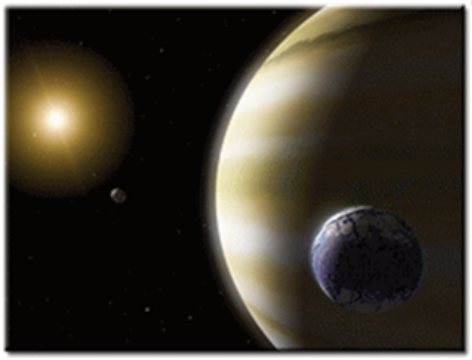
note: What Locke is prompting us to understand in an early "theory of knowing" (epistemology) is to comprehend the dichotomy of "appearance vs. reality" insofar as the inherently severe limitations placed upon the human mind by "naive (appearance) realism" in otherwise knowing the true and verifiable underlying structural reality of the external physical world. It is only by means of mathematical logic and experimentation, much as what Einstein had ultimately accomplished in his mathematical physics for relativity science, that the human mind is thereby able to truly transcend narrow - minded, solipsistic "naive realism" which is based solely upon outward surface appearances.

Relativity Science Calculator is a discursive *mathematical essay* employing common categories of thinking in philosophy, history and mathematical physics in order to better explain obscure and often recondite einstein relativity physics science theory in as simple and straightforward manner as possible.

That is, Relativity Science Calculator contains little original material, except to bring forth certain important mathematical logical connections otherwise missing in the vast body of relativity scientific literature and texts; rather it is entirely pedagogic.

You are therefore about to enter a voyage of knowing and understanding your physical world. It is a voyage built upon the knowledge and understandings handed down to us by ancient Greek philosophers and thinkers, astronomers and mathematicians, right straight down thru to Einstein and other modern men and women of wisdom and insight into nature's ultimate secrets.

How, for instance, was the Earth's circumference determined by simply pacing out steps on the Earth's surface while at the same time thinking about this problem? Or, how was the distance to the Sun and other planets determined with only their light coming into the eyes of those wise enough to understand and interpret its significance? Why, anyways, is it so significant to understand the nature of light and its distant travels? And how, by the way, do we literally count time and distances to far off corners of the cosmos when standing on the Earth's surface? Simply standing on either the Moon or Mars does not alter this basic question because their distances to the galaxies are not significantly different



from that of the Earth to these far off filaments in the universe.

As each of these questions - simple and not so simple - came into the minds of great thinkers past, an arduously built staircase of knowledge of experimental and mathematical lattices came to be constructed. And what questions were heretofore never even imagined by the Ancients such as whether we exist in a multi - verse system of bubbling, interacting and competing universes, are now being asked by modern cosmologists possessing newer and more powerful tools of theoretical mathematics and applied experimentation.

Finally, of what importance is all this knowledge and understanding to human existence? This is not a minor question.

In formal religions there are many competing answers given to this question. This particular branch of human inquiry is known as "Eschatology", the ultimate questions and answers to human meaning and purpose given at the very final end of human time. All of this implies, of course, a concept of an *unknowable* and an *unprovable* "God" whose existence is beyond any human understanding. But just as Copernicus demonstrated in 1453 that indeed the human mind can explore realms of the universe way beyond the tied bounds of earthly existence, so now, as then, it is entirely possible to reach way beyond our present earthly bonds in order to extend and continue human knowledge and existence throughout the universe.

What Relativity Science Calculator precisely has in mind is this: our known universe is approximately 13.73 ≈ 14 billion earth - years (note: closer to 13.8 per latest ESA Planck satellite mission) whereas our Earth has been in existence for some 4.5 billion years, so - called "deep time". Plus or minus on all this stuff. Our Sun has already been around for some 4.57 billion earth - years and has grown about 40% brighter since its initial beginning, and in about another 1.0 billion years will be even 10% brighter than presently and Earth's atmosphere and oceans will begin a long term process of boiling away. In fact, our Sun grows approximately 10% brighter every billion years or so, and as this brightening process continues, Earth's atmosphere will get wetter from evaporation and any remaining hydrogen and oxygen in the atmosphere will escape beyond Earth's gravity bonds into deep space. During the 2nd billion years of this ongoing process, Earth's oceans will have been considerably desiccated and any remaining humans on Earth will by this time have suffocated from lack of atmospheric oxygen, if not already burnt to death.

The Sun will, however, in another 4 - 5 billion earth - years be fully entered into its *red giant* phase where Earth's atmosphere and oceans are completely dissipated while pushing Earth into a farther and more distant orbit approximating Mars's present orbit owing to a lessening of the Sun's mass as it blows off its coronal mass in order to conserve angular momentum. Hence, the Sun's gravity pull upon Earth considerably lessens and Earth will drift into a more distant orbit from the collapsing and dying Sun. During the Sun's initial transition from a hydrogen - burning, main sequence star to the red giant phase, Earth will be engulfed in the Sun's life - destroying gases where gravitational tidal forces will attempt to totally swallow and engulf planet Earth creating a surface bulge on the Sun whose frictional effect upon the Earth will theortetically cause Earth to slow its axial spin and spiral further inwards towards the Sun. Whether Earth survives as a distinct entity during this transitional period is still an open theoretical question. During this apex *red giant* phase the Sun will be approximately 2,700 times as luminous and 250 times as big as is our Sun today. Eventually, however, the Sun's internal helium will undergo a sequence of explosive ignitions, turning helium into carbon and finally iron, whereupon the Sun's oscillating outward expansions and inward collapses, each smaller and more dense than the last, will finally result in one last fiery explosive flash and thereafter the Sun will become a cool *white dwarf* cinder as its remaining shining light will fade away as a life source for any surviving planet Earth. Earth will literally die of intense heat and later die of intense cold, if it survives at all. Planet Earth as a spaceship for human existence is doomed.

Red Giant Suns

The core burns down, creating upward and outward heat pressure arising from the additional compression of the inner energy fusion core by the downward gravity of the outer hydrogen gases, all exerting further upward pressure on the surface hydrogen gases while maintaining angular momentum; finally the entire "sun system" gravitationally collapses inward from its own unsustainable weight in the weakening contest between upward but exhausting helium fuel for fusion energy against the unremitting downward gaseous gravity, whereupon the ensuing outward massive explosion blows off the remaining hydrogen - helium gases and exposes a miniature white dwarf to drift endlessly into the cosmic blackness.

Digressing a bit, the balance between a star's gravity and its internal atomic furnace is what maintains the stability for any star, including our own Sun's. At the point where our Sun devolves down to the size of Earth and becomes therefore a white dwarf where all internal atomic fusion ceases and all compositions and forms of chemical hydrogen are converted to inert iron, the core and hence the surface of this final white dwarf are supported by a force called *electron degeneracy pressure* exerted by fast moving electrons. Where a star is initially otherwise three to five times the mass of our sun, gravity is so enormously strong that the core collapses down to just the essential neutrons, smashing all internal semblance of atomic structure, and the resulting final state is a neutron star whose internal support comes from the pressure of swirling neutrons. The neutron star's diameter eventually settles to barely 10 kilometers across. Beyond even these massive stars which collapse down to either a white dwarf or further to a neutron star at the end of their energy - lives, the remaining accounting for these sorts of grand massive stars can only be in terms of Einstein's General Relativity Theory for gravity where in all probability these collapse into so - called "naked singularities", either visible or not, but nevertheless devoid of event horizons.

Of course it's far, far more probable that human life on Planet Earth will have extinguished itself by its own makings of over - population and warfare well before another 1000 years, never mind the passage of these extra 4 - 5 billion years.

On the other hand, maybe human existence is not so much doomed as is Planet Earth. How so? How can this ultimate existential fate be avoided?

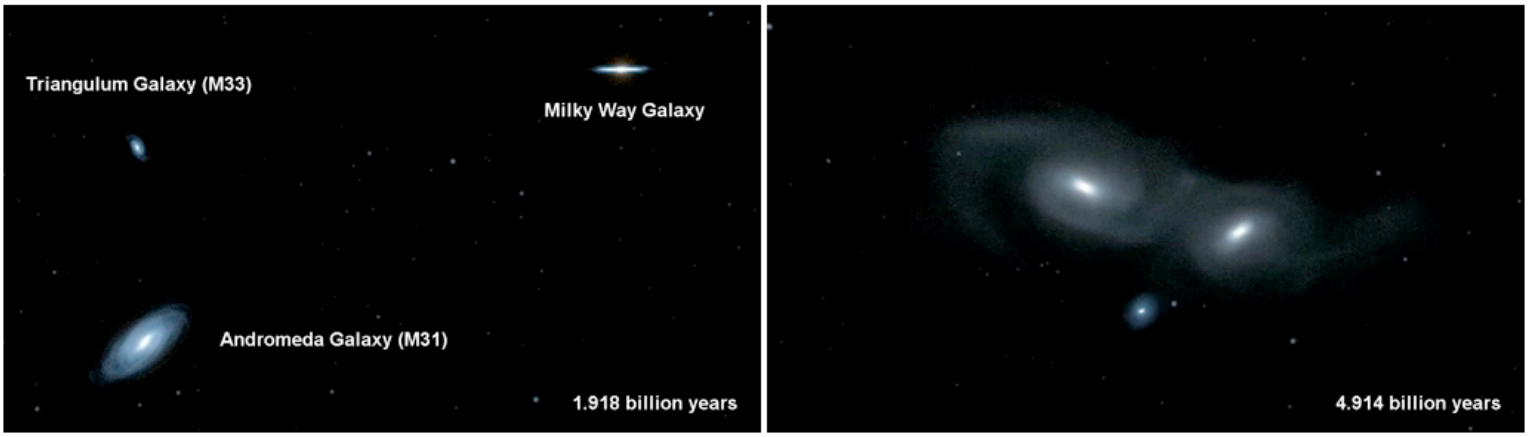
Well, people could travel to other planets or even to other galaxies. For example, travel to Mars takes about 10 months to over a year of travel depending on orbital transits. Much further away is Jupiter's moon Europa at about 8 to 11 years, also depending upon relative Earth, Jupiter and Europa orbital transits. Why Europa? Because aside from Mars, Europa presumably has oceans of sub - glacial water for sustaining presumed life already. But who wants to live on or under icy, watery Europa? And going there will require extraordinary advances in human biology.

We here on Earth could in the interim begin employing some of the latest technologies for "telepresence" whereby micro robots (micro - bots) could in every practical sense, be flung into deep intergalactic space, way beyond Milky Way and approaching say one - tenth the speed of light, to send back "virtual presence" of sight, sound and, yes, even touch to earth observers of far, far distant suns and planets. Why not? But this aspect of human exploration should begin sooner rather than later in order to reap this sort of virtual experience by the middle of the next 22nd century.

However for our part, Relativity Science Calculator loves Planet Earth! There is hardly anything else like it in the known solar system. You really want to live on gaseous and ringed Saturn or just gaseous Jupiter with their turbulent gas storms of methane and ammonia air? Not Relativity Science Calculator. Rather Relativity Science Calculator loves Earth's air and water! You want to live on some bleak, planet outpost without blue sky, stuck out among the stars against an unknowing and uncaring blackness? Not for you nor us either! Relativity Science Calculator loves Earth's mountains, oceans and sky!! So what then?

It must be admitted by scientists and mathematicians that religious dogmas are half right: namely that intelligent human life is both precious and rare. This derives from present knowledge of both our solar system and the vast remains of the universe. But it is also an *unproven faith* of scientists and cosmologists that *intelligent life is not absolutely unique* nor does human life possess some sort of teleology - ultimate meaning and purpose - in the untold boundaries of the universe. In this latter regard religious dogma is wholly incorrect.

But coming back to the first question, namely how can the ultimate fate of human existence - rare, precious, but not absolutely unique - be avoided given that Planet Earth itself disappears in 4 - 5 billion years, more or less? And, further, how can humans ever, ever travel to the farthest reaches of the cosmos when distances are so entirely vast that human lifetimes would expire before ever reaching the next nearest galaxy, Andromeda (also known as M31), only some 2.5 million light - years away? Not possible! Of course, because Andromeda Galaxy is speeding towards our own Milky Way Galaxy and merging into it, approaching our Sun with velocity approx. 110 km/sec (68 miles/sec), with its crashing arrival expected in some 3.5+ billion earth - years forming Milkomeda or Milkdromeda, a gigantic dispersed elliptical unlike other more normally compacted ellipticals, then maybe we're not talking exactly about 2.5 million light - years, but only some 3.5 million light - years away? Big deal. Still not possible.



source: NASA animation

But!

Suppose that either thru contacting extraterrestrial intelligence or by means of our own intellectual discoveries, that all of human intellectual discoveries and all of Planet Earth's biota (DNAs, RNAs, etc.) (who wants to leave Planet Earth without their most precious loved ones?) could be broken down into an *informational signal code* which could then be broadcast ("teleportation") into the cosmos at the speed of light. And suppose further that coded into this signal would be information to pick and choose where amongst the galaxies, stars and exoplanets those most suitable to replicate Earth's former unique and hospitable conditions for advanced human life to continue onwards. Just suppose the sort of intellectual knowledge first developed on Planet Earth during its habitable period which could make all this possible!

In other words, the only solution to "The Tragedy of the Human Condition", if there will be one, will be DNA - biologic insofar as transforming the human genome into some sort of an "informational code", including a "detecting code" for seeking out other earth - like, carbon - oxygen environments, to be transmitted at the speed of light into the cosmos to spawn in multiple places throughout the universe.

What this further means is that the rest of humankind will remain back on planet earth to perish in its own waste

material and self - created, ideologically religious wars.

However at least human knowledge, hopefully way beyond Newton and Einstein, will survive if not totally thrive in some other, far - off reaches of the cosmos.

Just suppose!!

[note: special allowance should be made to separate out those humans who prefer Allah's black hole to go straight into it.]

Impossible, you say? If we humans can get past the next 1,000+ years we have a good enough chance to make it to the next billion earth - years of knowledge and discovery. It's like if you personally make it healthily to, say, age 70, then you'll likely make it to 90+.

There is, moreover, one other peril for "intelligent life" to survive the cosmos and that is The Great Freeze for the eventual freezing of the entire known universe as it inexorably expands outwards in all directions while dissipating all heat energy. The only escape for this, perhaps, would be to discover some sort of worm - hole through which "intelligent life" could move parallel into another, yet still extant, membrane universe.

We, therefore, will still need The Philosopher to continue to inspire physicists and medical biologists to overcome the inexorable "Tragedy of the Human Condition".

So what in a nutshell is Special Relativity and what does it tell us about nature's reality? Well, because light possesses finite speed all sorts of other realities become apparent. Among these other realities are that nothing in nature travels faster than the speed of light but that at speeds approaching the speed of light, time slows down appreciably; physical bodies actually contract and get smaller - truly that mass itself is a variable quantity; light itself acts like matter and therefore reacts to the gravitational forces of other bodies of mass; black holes exist and either completely trap light or bend nearby traveling light; and that huge amounts of energy are contained in bodies of all masses. In fact, energy and mass are interchangeable qualities of nature such as what The Big Bang itself demonstrates - it all depends upon the speed of light! Other little tidbits of consequence arising from Special and General Relativity are that gravity and acceleration are the same phenomenon. And because of Special and General Relativity much is understood - *and much is yet to be understood* - of the cosmos!

In these circumstance therefore, we humans - precious and rare, but not absolutely unique - could truly reach out and touch not the face of some unknown, mythical heavenly "God" to which supplicating prayers of nescience are made in some churches or synagogues, but to rather reach out and literally touch another Friendly Earth among the stars. And not to get too flowery or teary here, we humans will truly be standing on the shoulders of the ancient Greek philosophers, mathematicians and astronomers. Hence, let us now begin *as simply as possible* a voyage of understanding *Relativity Science Cosmology*.