Existential Risk / Opportunity Singularity Management

July 2, 2020

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Introducing Adriano Autino

Adriano Vittorio Autino is the president of Space Renaissance International [1] (SRI), a cultural association existing since 2008 and formally incorporated in 2010, with the goal of re-founding the general philosophy of our human future, completing the Copernican revolution, and moving from a closed world to an open world Weltanschauung (personal philosophy). He was formerly an entrepreneur in the field of real-time systems design, development and engineering for industry, infrastructures and aerospace.

A more complete bio is available at the Space Renaissance website.[2]

[1] https://spacerenaissance.space/

[2] https://spacerenaissance.space/media/AVA_BIO.pdf .

Expand or Die

by Adriano V. Autino

I am happy to accept the kind invitation by James Blodgett to send my contribution to the mitigation of global risk, from the point of view of astronautic humanism.

Humanity Needs to Stop Keeping All of Our Eggs in One Basket

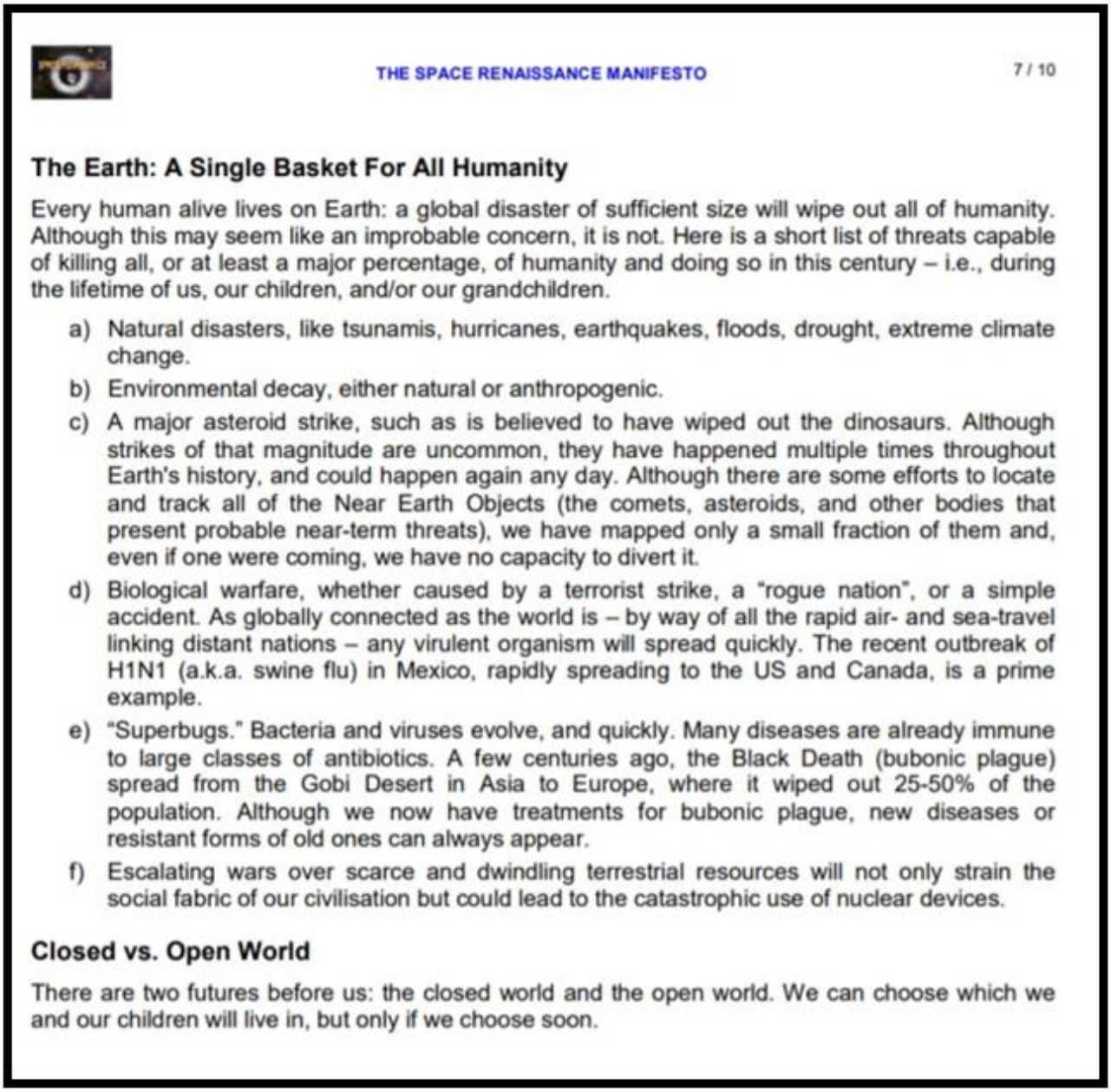
Since the very beginning, as written in SRI's Space Renaissance Manifesto[1], we agreed, together with the world space community at large, that there is only one way to mitigate the global risk of premature extinction for our civilization: to become a space-faring civilization, establishing and settling other celestial bodies and artificial infrastructures, as Gerard K. O'Neill excellently designed 50 years ago.

Such an evolutionary step is essential, in order to stop keeping all of our eggs in one basket. We all know this.

The global crisis of Coronavirus is showing clearly that almost eight billion humans can't continue their development, if they remain confined inside the boundaries of our mother planet. Furthermore, remaining confined on the bottom of Earth's gravitational well makes civilization weak and dramatically exposed to a large number of threats, both endogenous and exogenous. An abstract from the Space Renaissance Manifesto, written in 2009, can be seen in Figure 1. Points d) and e) illustrate the dangerous possibility of both superbugs (pandemics) and bacteriologic warfare in a globalized world. That world has become too small and narrow for the free and democratic development of 8 billion people. And, of course, we are still facing environmental decay, although Coronavirus recently stole the show from climate change and the plague of pollution.

[1] https://spacerenaissance.space/wp-content/uploads/2012/07/The_Space_Renaissance_Manifesto.pdf

Figure 1. An Excerpt from the Space Renaissance Manifesto (2009)



THE SPACE RENAISSANCE MANIFESTO 7 / 10

The Earth: A Single Basket For All Humanity

Every human alive lives on Earth: a global disaster of sufficient size will wipe out all of humanity. Although this may seem like an improbable concern, it is not. Here is a short list of threats capable of killing all, or at least a major percentage, of humanity and doing so in this century – i.e., during the lifetime of us, our children, and/or our grandchildren.

a) Natural disasters, like tsunamis, hurricanes, earthquakes, floods, drought, extreme climate change.
b) Environmental decay, either natural or anthropogenic.
c) A major asteroid strike, such as is believed to have wiped out the dinosaurs. Although strikes of that magnitude are uncommon, they have happened multiple times throughout Earth's history, and could happen again any day. Although there are some efforts to locate and track all of the Near Earth Objects (the comets, asteroids, and other bodies that present probable near-term threats), we have mapped only a small fraction of them and, even if one were coming, we have no capacity to divert it.
d) Biological warfare, whether caused by a terrorist strike, a "rogue nation", or a simple accident. As globally connected as the world is – by way of all the rapid air- and sea-travel linking distant nations – any virulent organism will spread quickly. The recent outbreak of H1N1 (a.k.a. swine flu) in Mexico, rapidly spreading to the US and Canada, is a prime example.
e) "Superbugs." Bacteria and viruses evolve, and quickly. Many diseases are already immune to large classes of antibiotics. A few centuries ago, the Black Death (bubonic plague) spread from the Gobi Desert in Asia to Europe, where it wiped out 25-50% of the population. Although we now have treatments for bubonic plague, new diseases or resistant forms of old ones can always appear.
f) Escalating wars over scarce and dwindling terrestrial resources will not only strain the social fabric of our civilisation but could lead to the catastrophic use of nuclear devices.

Closed vs. Open World

There are two futures before us: the closed world and the open world. We can choose which we and our children will live in, but only if we choose soon.

So, going deeper into the investigation, we are astonished to realize that, after 50 years of space exploration, almost nothing has happened, in terms of space settlement.

During its first World Congress [2], in 2011, SRI reached an understanding that a big change is necessary: from the paradigm of space exploration we need to move to a paradigm of space settlement. Why is such an essential step still dramatically missing, although it is considered key by many in the space community?

[2] https://spacerenaissance.space/congress/sric-2011/

A 50 Year Delay in the Kick-Off of Civilization's Expansion into Space

There is no doubt that we are late in developing the main enabling technologies for expansion into space. Only the advent of reusable rockets, developed by Elon Musk's Space X since 2015, gave us hope, after a long wait for space tourism to become a reality. In several papers and articles, Patrick Q. Collins, another co-founder of SRI, analyzed the deep causes of such a delay.[3] Considering that the X-15 aircraft made 200 flights at sub-orbital altitude in 1969, it is perfectly reasonable to question why we didn't have a fully reusable orbital vehicle very quickly, during the 1980's to be conservative. Collins argues that the main space agencies, operating like big bureaucracies, were not interested in developing civilian space travel and allowing private industry to enter the game, because they received a budget of about 25 billion per year of public money; this without any obligation to give back a return of investment to taxpayers. The expendable rockets industry, as well, strongly opposed the development of a fully reusable orbital machine; instead, for the sake of their business, that developed over the course of 40 years, they launched thousands of satellites for communication and research. They threw away hundreds of millions for each launch, and filled the orbits, from LEO to GEO, with tons of unattended space debris. This continued until Elon Musk came; writing the word END to that milking cow, which was mainly financed by public money. Another important stakeholder of the expendable rocket's persistence, well after its ontological technology justification, is the governmental/military domination of space: as long as access to outer space was only affordable for governmental agencies there was no danger of a private industry intrusion into that unchallenged realm.

The Birth of Commercial Space: How Far Are We from Geo-Lunar Space Industrialization?

In 2016, during the 2nd SRI world congress, [4] Jeff Greason made an important contribution. Jeff told us that there are currently some space activities that could be done better and more profitably by human technicians than by robots. He advocates industrial potentiality which is represented by satellite assembly in orbit. This would bring several savings: less need for automated devices to be launched to orbit (e.g. to deploy solar panels and antennas.) Orbital workshops could reuse materials obtained by processing space debris, thereby producing satellites components in orbit. Quite a spark on a possible orbital industrialization!

We started asking ourselves, and asking others: how far are we from Jeff Greason's promising scenario?

Jeff put it simply: that scenario will come to reality when it will be possible to move one person to orbit by spending less than $1 million. Nowadays, NASA will likely

[3] https://spacerenaissance.space/wp-content/uploads/2020/04/The_Growth_of_a_Space_Tourism_Industry.pdf

[4] https://spacerenaissance.space/congress/sri-2nd-world-congress-from-space-exploration-to-space-settlement/

pay about $90 million for each astronaut who flies aboard Boeing's CST-100 Starliner capsule on International Space Station (ISS) missions. The per-seat cost for SpaceX's Crew Dragon capsule will be around $55 million. Therefore, we are still one order of magnitude away from space industrialization, in terms of financial assessment.

But, during the last four years we understood that our quest is not just a matter of money, although the financial issue is still the most relevant in our world dominated by banks and stock exchanges -- at least until the current Coronavirus crisis. We studied the possible scenario of a Geo-lunar space industrialization, and asked: "Which industrial activities could bring a return of investment during the next thirty years?" There are many. Let's reflect on the resources already existing in orbit, such as the space debris and wreckages, which are a repository of materials that could be reused to build space infrastructures. These materials cost a lot of money to be launched into orbit. Now those materials are there, and can be considered orbital in situ resources, provided that we develop the needed infrastructures to grab, smash and process them to obtain powders for 3D printing. Moving satellites to proper orbit is another important logistic activity. Maintaining satellites will lengthen their life cycle. Fueling stations, yards for space-craft assembly, and orbital and lunar hotels will also be useful. Bio-medical and orbital hospitals are another big and quite promising segment. Last, but not least, lunar and asteroids mining can provide us with raw materials for building space infrastructures. Of course industrial activities in space, when exceeding a certain degree of complexity, need humans (thank God…).

Space Travelers Shouldn't Be Astronauts

In general terms, we understood that the problem we are facing is the following: space settlement will begin when it will be possible to move civilian people to space and accommodate them for long periods of time, eventually as resident space citizen**s**.

Just as airline passengers don't need to be pilots, nor hostesses, nor stewards, space travelers shouldn't need to be astronauts.

Reusing the first stage of a Two Stages To Orbit vehicle, currently available from Space X and Blue Origin, is just the first step. It is clear, from the point of view of human rights and interest**s**, that civilians have mission requirements that are different from military astronauts. However, military people, (sad to say for a humanist,) don't have civil rights, by definition, and their life is "expendable." Civilian passengers and settlers need softer traveling conditions and protection against the austerities of living in space, such as low gravity and cosmic radiation, and they need green environments in the habitats, and there are also legal constraints, as any airline company knows well.

The few tourists who have flown so far to the International Space Station paid a $30 million ticket, and signed a release letter, in which they renounced any warrants about their life and health, relieving the involved space agencies from any damage or harm they could incur during their travel and stay onboard the station.

The Damages to Human Health Caused by Long Unprotected Stays in Space

Astronaut Scott Kelly spent a year in the International Space Station. He was exposed to microgravity and radiation, which had detrimental effects on his health. His book, "Endurance," describes some of those detrimental effects.[5] We will need to mitigate those effects to make space travel safe enough for civilians. Mitigation is possible. Microgravity can be solved by providing rotational gravity. Radiation can be solved by shielding. It seems likely that providing adequate shielding will make space ships and habitats more difficult to build than we had expected, but at least it is doable.

The Challenges We Shall Overcome, to Kick-Off Civilian Space Development

Expansion into space may turn out to be difficult. But, do we really have other choices? No, we don't. Any possible alternative includes the possibility of a horrible holocaust, very much worse than facing the problems of developing good living conditions in space. Therefore, our real priority is to develop other models of space settlement that allow for optimal human habitation. Artificial gravity is key, and so is protection against cosmic radiation. But these are not the only challenges we should tackle. If we want the average person, without astronautic training, to be able to travel to and from orbit, we also need vehicles as comfortable as normal airliners, with horizontal takeoff and landing, low acceleration, and safe reentry into the atmosphere.

Last, but not least, for the sake of our physical and mental health, we also need a green environment in space habitats: flowers, trees, grass, flowing waters and, yes, animals with us.

Summarizing, what we need is a substantial advance in a series of enabling technologies for civilian space development. For example:

Passenger Transportation Systems:

- low cost, fully reusable
- comfortable
- low acceleration, in both directions
- safe reentry into the atmosphere
- horizontal take-off and landing
- protection from solar & cosmic radiation

Space Habitats:

- protection from solar & cosmic radiation
- artificial gravity
- green environment onboard

All of the above was conceived as the result of the humanist philosophic setup of our Space Renaissance International association. When developing our concepts we always start with humans: their rights, their health, their life, and their hopes for a better future. We work to allow people's lives to become better, not worse! There is no doubt

[5] Scott Kelly, Endurance: A Year in Space, a Lifetime of Discovery, Pub: Alfred Knopf, 2017.

that traveling and living in space like astronauts would be quite a poor life. An astronautic experience could be exciting, of course, if it is for a short duration. That's the point where space tourism comes in.

Space tourism is an intermediate stage, between astronautics and resident space citizenship. Space tourists will stay short periods in space, perhaps a week, or at most a month. Therefore their physiology will not be dramatically endangered by low gravity, though cosmic radiation could be an issue even for short periods. However, when flying with vehicles conceived for astronauts, tourists will need to be trained, in order to tolerate 4–5 G acceleration, vertical launch vibrations, and the hard onboard conditions. Elder people couldn't go, just to mention one important limitation, considering that retired people are the most keen to travel for tourism.

Figure 2 and Figure 3 show the progressive mission requirements for a transition from space exploration to space settlement.

Figure 2. Space Transport Vehicle and Space Habitats Requirements

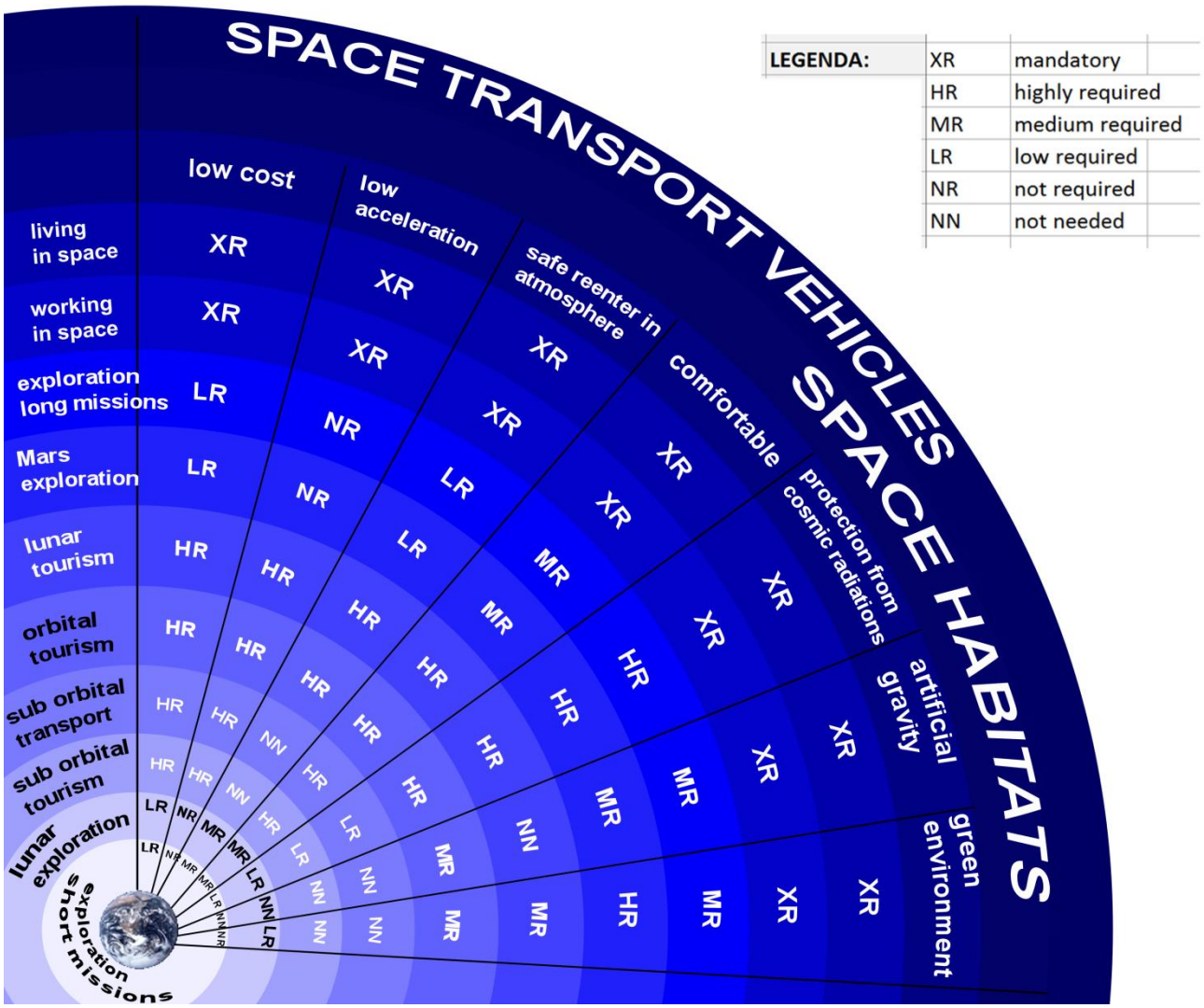


Figure 3. Space Transport Vehicle and Space Habitats Requirements Legends Expanded

flight levels	requirements	low cost	low acceleration	safe re-enter in atmosphere	comfortable flight	cosmic radiation protection	artificial gravity	green
sub-orbital tourism		HR	HR	NN	HR	LR	NN	NN
sub-orbital transport		HR	HR	NN	HR	LR	NN	NN
orbital tourism		HR	HR	HR	HR	HR	MR	MR
lunar tourism		HR	HR	HR	HR	HR	NN	MR
space exploration	short missions	LR	NR	MR	LR	LR	NN	NR
	lunar	LR	NR	MR	LR	LR	NN	LR
	Mars	LR	NR	LR	MR	HR	MR	HR
	long missions	LR	NR	LR	MR	HR	MR	MR
working in space		XR	XR	XR	XR	XR	XR	XR
living in space		XR	XR	XR	XR	XR	XR	XR
	LEGENDA:	XR	mandatory					
		HR	highly required					
		MR	medium required					
		LR	low required					
		NR	not required					
		NN	not needed					
CONSIDERATIONS:		1)	exploration is made by public money, so far; didn't need to be low cost…					
		2)	trained astronauts can tolerate high accelerations					
		3)	trained astronauts so far absorbed radiations: nothing prevents them to be more protected in the future					
		4)	trained astronauts so far faced very unsafe and uncomfortable re-entry conditions: nothing prevent them to have better conditions in the future					

Expansion into Space Grows as an Expanding Sphere Centered on Earth

The concept we would like to be understood and adopted by the decision makers of Planet Earth is "expansion," i.e. our expansion into space.

Expansion is quite different from exploration. Expansion should logically come after a good period of exploration. So far we have had 60 years of space exploration. We are sending automated probes to the orbits of Jupiter, Uranus and Neptune, and even out of the solar system. Of course there is still very much to be explored in the inner solar system, on Mars, on the Moon, and on Asteroids. We are not saying we should stop exploring space.

But we know that, in the space community, there are many supporters of the "exploring forever" doctrine, often sitting on relevant chairs. Such people firmly oppose space settlement, and they make any efforts to reduce manned space flight, in favor of automated exploration. Their arguments are strong, and range from financial convenience to safety, i.e. "protecting" humans from the dangers of space… But, who will protect us against the dangers of our own planet, and against cosmic threats coming from outside? And, how much will it cost humanity to renounce expanding into outer space? Very much more, indeed.

Expansion is a progressive advance in the cosmic realm. It begins by starting on the ground, then colonizing Earth orbit, from LEO to GEO, then the Moon and the Near Earth Asteroids, building infrastructures in the whole geo-lunar system. Such a process should be designed as a step by step procedure. Each step needs proper scientific and technological advances.

What will help us in defining the mission requirements of each step? A number of conditions need to be addressed, as follows:

- Infrastructures inside the Van Allen belt will require lower protection against cosmic radiation
- Suborbital passengers transportation vehicles should comply with low acceleration, safe reentry and a mild protection against cosmic radiation
- Orbital passenger transportation vehicles should comply with low acceleration, safe reentry and a better protection against cosmic radiation
- Lunar passenger transportation vehicles and infrastructures should comply with a higher protection against cosmic radiation
- Any infrastructure, from LEO to Moon orbit and Lagrange Points should be endowed by artificial gravity
- And so on . . .

The expansion paradigm requires a new methodology to be conceived and adopted, including a long-term roadmap which defines for each step the required technologies, the scientific milestones to be reached, the prototypes, the experiments, and the proposals. A great collaboration is necessary, by all the governments of Planet Earth, in order to create the proper program management of the greatest human enterprise of all time in human history.

As a final statement, I would like to reassure the supporters of exploration that exploration will always be necessary. Expansion will never eradicate exploration. The opposite is true: expansion will require more advanced exploration.

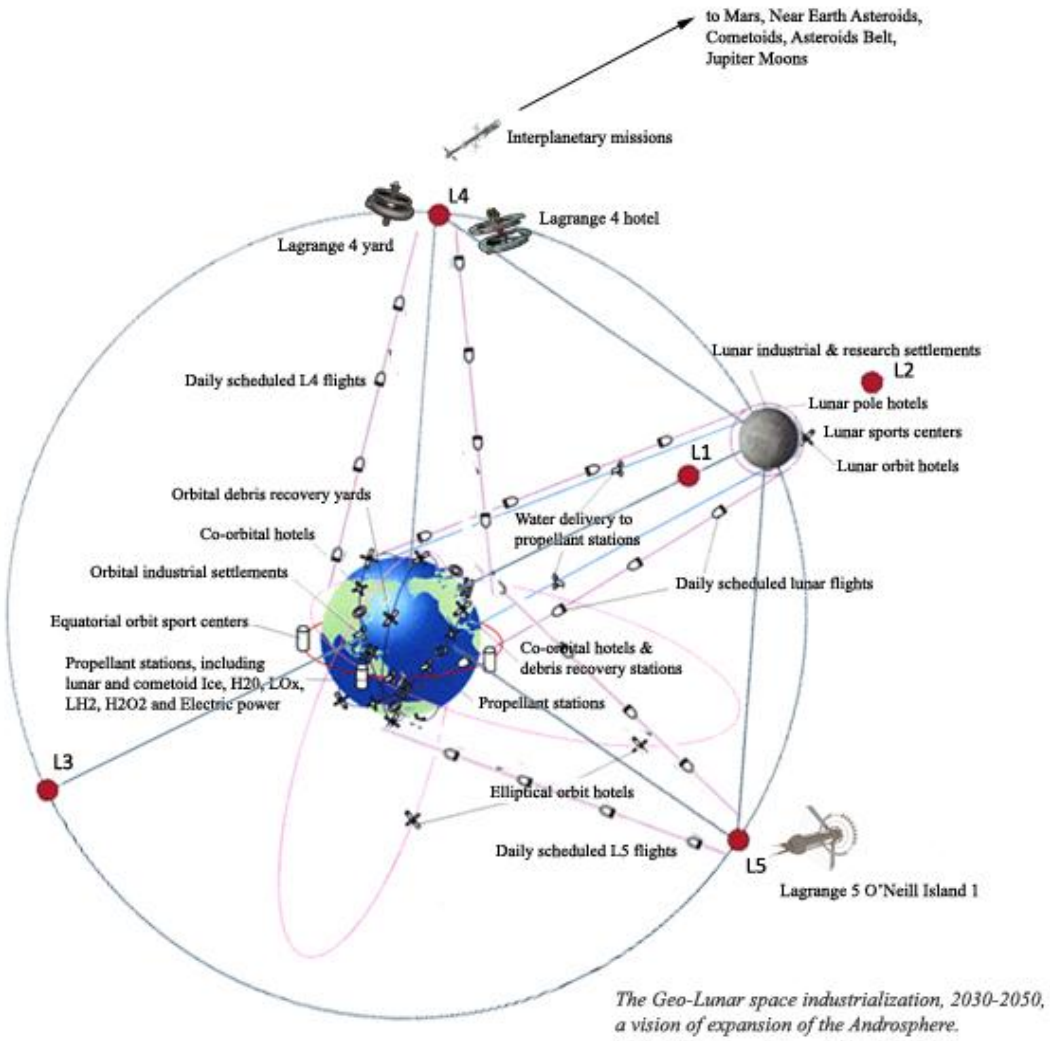
Unfortunately, exploration can exist for a long time without expansion. But I have to raise a warning here: should the civilian space development not kick-off before 2030, the global economy will fall into an endemic crisis, and it is likely that political leaders – more and more oriented by financial concerns – will decide that we don’t have enough money to continue space exploration. Therefore, I would suggest that exploration supporters stop opposing space settlement. Space settlement is in their interest too, since only in a realm of rapid economic growth will space exploration be sustainable.

Exploration is a military concept, while expansion is a civilian one, although it doesn’t prevent military activity in space. Exploration doesn’t require industrialization nor infrastructure construction, while expansion requires both. Furthermore, as civilian space development grows, more and more human presence will be required and this is the true key condition: only by enabling growing numbers of people to become space

citizens can our civilization really grow, both in size and in culture. In fact, while exploration can be accomplished by robots endowed with artificial intelligence, expansion requires a coherent enlargement of human settlement, from Earth to near space, and progressively beyond.

Last, but not least, exploration is financed by public money, and tends to keep launch costs high. Expansion requires private enterprise, and this stimulates human ingenuity to invent suitable technologies and methodologies, to step to the stars.

Figure 4. Geo-Lunar Space Industrialization, 2030-2050



The Geo-Lunar space industrialization, 2030-2050,
a vision of expansion of the Androsphere.
© 2015 Adriano Autino & Patrick Collins

Introduction to the Following Article

by James Blodgett

If you have been reading past issues of this publication, the article below will seem familiar. I am summarizing much that has been said here before. I am repeating myself and condensing our message because that message should go beyond readers of this publication. A lot of people do care about our human future, but most people don't care enough to vote for and help finance enough worthwhile initiatives. If we are going to make an adequate impact, we need a larger audience. I have been trying to write a book that might help. I may get it written, but it is a hard book to write. A book is not as important as reaching a large audience if only with a condensed version, and I should try to do that first because of the small chance that I will die before I can get a book written, a hopefully unlikely outcome that both my age and the Coronavirus makes plausible. I will send this article to other publications to see if they will reprint it, and also as a writing sample for similar articles I might write if they want an exclusive version.

SIG members and readers of this publication can also help to get the message out. If you know of a publication that might be interested in our message, you can suggest it to them, or you can suggest them to me. You can talk up our quest to friends, and perhaps suggest the URL of EROSM. (The list of back issues from which they can be downloaded is at: http://www.global-risk-sig.org/pub.htm .) You can also write and publish your own writing and make similar, or better, points in your own style.

The Hobby of Improving Our Human Future

by James Blodgett

Hello readers. I am writing to suggest a hobby that is more than a hobby. The hobby consists of improving humanity's future, a perhaps impossible task but not completely impossible, and at least an interesting topic and an interesting hobby, at most a big contribution. The top end of what we might achieve was suggested by Nick Bostrom [1] when he made a rough calculation of the number of human and human equivalent lives that could be hosted given the resources of the reachable universe. His estimate was 10^{58} lives, or in normal numbers:

10,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000 lives.

If human lives are valuable, this is extremely valuable.

A quest on this level suggests delusions of grandeur. However, if our thinking about it is appropriate it will not be a delusion. Settling the universe will be very difficult, and may never be accomplished. The stars are very far away. However, there are existence proofs that something like that might be done. The existence proofs start

[1] Bostrom, "Superintelligence," 2014, Location 2449 of 8770 in the Kindle version.

with what I call a seed ship. A seed ship is very small, perhaps the size of a large natural seed. It can grow a whole biosphere. Trillions might be fired at the stars. They contain artificial intelligence, nanotech, cell templates, and the DNA of many species. Nanotech consists of molecular machines that can reproduce and build larger things. When arriving at an appropriate source of materials and energy, the artificial intelligence directs the nanotech to reproduce and to build infrastructure, then the DNA of many plants, animals, and finally humans are inserted into cell templates, grown in infrastructure incubators, and then raised and (in the case of humans) educated by infrastructure robots. Voila, we are there! (Armstrong and Sandberg suggest something like this.[2]) Some seeded settlements might be able to build and launch more seed ships and make the process exponential.

An existence proof for seed ships is a natural seed. An existence proof for artificial intelligence is the intelligence in our own heads, and machines like Google and Watson are getting closer. Existence proofs for nanotech are the many molecular machines (proteins) in each of our cells, machines that would be called nanotech if they had been designed instead of having evolved. Cells can reproduce, and can build larger things, i.e. our bodies. People used to think that flying machines were impossible. That seems strange because birds were an existence proof that something like that is indeed possible. Existence proofs do not prove that all implications of a proposed device will work as promised, but they do prove that something like the proposed device is plausible. Even if seed ships do not do everything we would like, and even if we accomplish a small subset of the goal of using the universe, it will still be a big thing. Even if we never get to the stars, O'Neill estimates that there is enough material in our own solar system to build O'Neill habitats that have 3,000 times the land area of Earth.[3]

The worst case is that we go extinct. We should also work on preventing this. If we reduce the probability of human extinction, that could enable the lives of billions of additional humans. People have done such things. Gorbachev and Reagan tweaked the odds in that direction by ending the cold war. We could use more of that today.

Indeed many heroes of history have accomplished big things. While I grant that it may be improbable that you or I will personally accomplish big things, there is some small probability that we might, and that probability is not always small. A standard metric of decision theory is what is called "expected value." If you win a dollar if a coin toss comes up heads, the expected value of that flip is the probability of getting a head on a single flip, which is 50%, times the value if you win, i.e. a dollar. If you play this game 100 times, it is highly probable that you will win an amount that is close to $50.

[2] Stuart Armstrong and Anders Sandberg, "Eternity in six hours: Intergalactic spreading of intelligent life and sharpening the Fermi paradox," Acta Astronautica, Vol 89,Aug-Sep 2013, pgs 1-13.

[3] Gerard O'Neill, "The High Frontier: Human Colonies in Space," 1977, Location 264 of 4985 in the Kindle version.

Therefore if it costs more than fifty cents to flip a coin in this game, it is most likely that you will lose money, but if it costs less than fifty cents, it is a good idea to take that bet. Now consider the expected value of enabling 10^{58} lives by settling the reachable universe. Even if the probability of personal effectuality in tweaking the odds in that direction is minuscule, it has to be incredibly minuscule for the expected value of that tweak to be less that something like the current population of Earth. Expected value does have problems at the extremes, especially when utilitarianism conflicts with deontology. Nevertheless, something like this expected value result is still true even for a small subset of 10^{58} lives. For example, John Lewis estimates that the asteroid belt in our own solar system has enough iron to build a habitat for 10,000,000,000,000,000 people,[4] and Gerard O'Neill,[5] Philip Metzger,[6] and Adriano Autino [7] have fairly reasonable plans that might result in many habitats that might collectively support this number. Exponential growth can produce amazing results, and has already done so via the industrial and scientific revolutions. So there is value in working on these issues, there is a reasonable probability that we might succeed, and that probability increases if we work hard and intelligently. When big things are at stake, the "right stuff" imperative is to "fly the airplane" rather than scream in terror even if the airplane seems about to crash. "Fly the airplane" includes bailing out if optimal. With luck and skill you can save the airplane and its crew, or at least divert it from populated areas.

[4] John Lewis, Mining the Sky: Untold Riches from the Asteroids, Comets, and Planets, Perseus Publishing, 1997, p. 194.

[5] Op.Cit. Footnote 3.

[6] Philip Metzger et al, "Affordable, Rapid Bootstrapping of Space Industry and Solar System Civilization," Journal of Aerospace Engineering, April 2012. A preprint was available, and is now available on the Internet Archive. Go to http://web.archive.org and you will reach a search page with a rectangle that contains the words " Enter a URL or words related to a site's home page ". Enter into that rectangle, or copy and paste in, without the quote marks: " data.spaceappschallenge.org/aerospace.pdf ". Then press "enter". It will search for a bit, then bring you to a timeline with years and vertical bars indicating captures. Click on a year with one or more bars, then scan the calendar below for a blue high-lighted date indicating a capture. Run the cursor over that date, and a box will pop up with the time of capture in blue. Left click on that time, and the paper will appear. You can read the paper on the screen. You can also print or download the paper, but the way to do that depends on your operating system.

[7] Adriano Autino, "Expand or Die," Existential Risk/Opportunity Singularity Management, July 2020, p.2. You don't have to run to the library to look this one up.

Even if we don't succeed in our quest, working on these issues is still an interesting hobby. It may be unlikely for one person to accomplish big things, but big things are more likely if many people participate. There are already quite a few people working on relevant projects, and right here in this article I am trying to recruit more. For example, you.