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CONCEPTS FOR A WORLD SPACE
PROGRAM BASED IN THE SOCIETY

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CONCEPTS FOR A WORLD SPACE PROGRAM BASED IN THE SOCIETY

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<http://www.tdf.it/>

1 ABSTRACT

The document is aimed to bring to the attention of the Congress the basic need of taking the discussion on the World Space Program for the next Century inside the Society; to go over the deep cultural frontiers among the different worlds: the "Space Community", other Research branches, the Industrial world, the Political and Trade-Unions Organizations, the Volunteers Non-Governmental Organizations, the Musicians, Movie Directors, Writers, the Journalists. The document focuses on some social items, and fundamental philosophical themes. This document is aimed to give first answers to the basic questions of the continuation of the human civilization, indicating research paths to deepen the acknowledge of the problem, that is, in the mean time, scientific, social, economic and anthropologic.

The second chapter (being first the generalities) discusses the need, of Humanity, to enter a greater ecological niche. A table gives the numbers of the human growth since the pre-history to our days, showing how the Human Kind, the only sentient species on this planet, had a formidable success. The chapter tries to demonstrate that the different vectors of the Human growth (numerical, cultural, technological, civil) are closely interdependent, and the crisis of one will be the crisis of the whole human civility. Dr. Michael Martin-Smith adds some considerations, reinforcing the demonstration.

The third chapter (Space, Society and Societies) present lines to bring the Space Option in the society and in the different Societies (developed countries and underprivileged countries), asking for the help of everybody, in order to win the challenge, taking the whole Humanity to a greater ecological niche. The document proposes to reverse the economic paradigma: the Space Revolution can't be dealt as any usual business. If a real World Space Economy will begin, it will give raise to an incredible increase of the world economy. The produced richness, therefore, will be of many magnitudes bigger, not comparable to the funds entered at the beginning. The critical first 30 years of the Space Development are also analyzed, pointing out the main (political, economic, social) obstacles and dangers on the road. Finally, the document proposes a biological approach to the space, giving priority to solve the problem of the oxygen and water production, and to experiment small, closed ecosystems, researching the vegetable species more suitable to live in closed environments.

In general terms, the document invites to a "not standard" and not routinary approach to the space development, and to change firstly our culture: if we are to instill in the Society the idea of an open world (opposed to the closed world of some ecological thought), we are to open firstly our cultural world, starting to call many more categories of people and experts to share this discussion.

2 GENERALITIES

2.1 Scope and purpose of the document

Scope of this document is to bring to the attention of the Congress the basic need to take the discussion on the World Space Program for the next Century inside the Society. In fact:

- the Human Society needs Space as a vital growth environment,
- the Space Research and the Space Economy need the support of the Society, in order to rise and surmount present and future difficulties

The document is aimed to give a contribution and a stimulus to overcome the deep cultural frontiers that divide the different communities, even if they all aim to help Humanity:

- the so called "Space Community"
- other Scientific Research branches
- the Industrial Enterprises and Industrial Associations
- the Political and Trade-Unions Organizations
- Volunteers and Non-Governmental Organizations, acting in the underprivileged Countries
- the Artists: Musicians, Movie Directors, Writers, etc...
- the Journalists

In my opinion the Studies of the Space Agencies should be submitted to meaningful samples of the above subjects. In one word: to bring the studies, and the discussion, beyond the "authorized personnel", directly to Society at large.

This document focuses on some social items, that should have, in my opinion, a much higher priority.

If we want to give to the Space Option a chance to win we must aim very high. The whole philosophy should be redesigned, starting from the concept of an Open World, looking forward to a Greater Earth, as a next concrete step for the development of Mankind.

The Space Option will always remain an option among others (and not a demonstrated imperative) if we don't answer to these 2 questions (linked and interdependent on each-other):

- "Shall Humanity, as a Species, continue its growth?"
- "Shall Humanity, as a Species, aim for immortality, or, at least, to survive as long as possible?"

If we don't answer "YES" to both the above philosophical questions, and to other questions which flow from the above, giving solid scientific arguments to the answers, Space will remain the heritage of a very sophisticated club of dreamers, which plays with very expensive toys.

The main purpose of this document is to give, firstly, answers to the above questions, indicating some research paths to deepen our knowledge of the problem; these are, scientific, social, economic and anthropologic.

2.2 About author and contributes to this paper

Adriano Autino is a small entrepreneur, owner of Studio ANDROMEDA and publisher of the online magazine "Technologies of the Frontier" (http://www.canavese.it/autino/home_frf.htm, it will take <http://www.tdf.it/>).

The Studio ANDROMEDA is a Software house, skilled in real time systems and simulators for AeroSpace and Industry.

Technologies of the Frontier is a philosophical and scientific site, aimed to promote a new humanist philosophy and a new development paradigm.

Technologies of the Frontier, together with the Space Age Associates (UK) and the OURS Foundation (CH), forms the Association for a Greater Earth.

Dr. Michael Martin-Smith is the President of the Space Age Associates (UK).

Roberto Delbene, a student in agrarian and forest science, helped the author for some aspects concerning the vegetable life and the biological systems.

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3 HUMANITY NEEDS TO ACCEED A GREATER ECOLOGICAL NICHE

3.1 The Human Growth reaches the limits of a finite Planet or "The Bars of the Cage"

Mankind, the unique Sentient species living on our planet, has had an unprecedented success; this success

has been concentrated in the last 4-5 centuries, with a frantic acceleration in the XX Century. We composed the figures in Table 1. using data from several sources.

Table 1.

Age (beginning)	Year	World population (Millions)	World population (Millions)	Developed countries	Underdeveloped (or underprivileged) countries
		Source: European Encyclopedia			
	2000	6.494 (100%)		1.454 (22,4%)	5.040 (77,6%)
	1970	3.621 (100%)		1.084 (30%)	2.537 (70%)
<i>Space Age</i>	1950	2.506 (100%)		857 (34,2%)	1.649 (65,8%)
	1900	1.650 (100%)		573 (34,7%)	1.077 (65,27%)
	1850	1.262 (100%)		347 (27,5%)	915 (72,5%)
	1800	978 (100%)		248 (25,4%)	730 (74,6%)
	1750	791 (100%)		201 (25,4%)	590 (70%)
		source: Asimov-White	source: WWF		
	1.500		750		
<i>Modern Age</i>	1.250		500		
	1000	26			
<i>Middle Age</i>	37 A.D.		375		
	1 A.D.	170	300		
	1000 B.C.	50			
<i>Iron Age</i>	2000 B.C.	27	200		
<i>Bronze Age</i>	3000 B.C.	14	150		
	4000 B.C.	7			
	5000 B.C.	5			
<i>Neolithic</i>	6000 B.C.	4,6	50		
	7000 B.C.	4,3			
	8000 B.C.	4			
<i>Paleolithic</i>	500.000 B.C.		1		

Leaving out the differences between different sources on Ancient times, we can see that the real growth starts in the Modern Age: an unprecedented success in a very short time, for an animal of our size on this planet, mostly due to the progressive discovery of more and more efficient energetic transformations. The same period that saw the dimensional growth of the Humanity saw also a formidable cultural (i.e technological) growth. If we can't definitely assert a demonstrated relation of cause-effect between the two phenomena (demographic and technological growth) we can observe that they are contemporary, parallel and mutually re-inforcing. Since the neolithic revolution, Man started to leave hunting

and gathering lifestyles behind, and, uniquely among the animals on our planet, took the path of culture. Agriculture brought a different diet, that made women more fertile, giving rise to demographical growth. More children required more technologies, and in the mean time provided an increased number of thinking heads to conceive new technologies. More technologies for food procurement and protection against natural events (and the first concepts of social justice) led to an increased population. The development of commerce, since the dawning of civilization, was based on the idea of increasing markets: nobody starts enterprises expecting a decreasing market. Since the dawn of civilization, men

of good will have tried to get better living conditions and make safer provision for their children, ensuring the first of the Human Rights: the Right to the Future.

But, in the last quarter of the XX century, it has become clear to the public that the resources of our native planet are not infinite, and that they will not suffice forever, nor cater for any conceivable population level of human beings on the surface of this planet. Each year, after the Chernobyl tragedy, Lester Brown and the Watch World Institute have given us a worrying picture of the illness of the planet, and repeat that people must stop polluting the world and wasting resources. They draw a very critical picture, showing the decrease of food resources versus the growth of the population. The recent summit on the Environment, held in Tokyo, confirmed many of the pessimistic predictions of the World Watch Institute, specially focusing on the greenhouse effect. Many currents of thought were born, in '80s and '90s, seeing the limits of our actual world as unpassable, and aiming an idyllic "harmony with Nature". The remedy that they suggest, according to their old and closed vision of the world, is very simple: to stop demographical growth, and to adopt a so-called "sustainable development" model. David Pinhental (Cornell University, New York State) stated that, in 2100 AD, the planet will sustain a population of max. 2 billions people; and that the predicted level of 12 - 15 billions will bring misery to the world. Families should, according to Pinhental, restrict the number of children to 1.5. In my opinion, things are not so simple.

We can see that the three successes of our Species - cultural, technological, and numerical - are indissolubly linked in a very critical way, and if we stop any of the three vectors we will get a deep, probably irreversible, crisis of the whole system. That's why we think that the supporters of the "Closed-world" option deal too superficially with concepts like the demographical steady state or even reversal of the demographic vector. Moreover, to refuse birth of children is a very egoistic solution: it will mean denying the future, thus condemning our species to a sure extinction, in a more or less quick euthanasia of our species.

If we observe the natural species, we can see that steady species don't exist. Each species grows, or it becomes extinct. Maybe some predators, like the shark, at the top of the food chain, can survive for millions of years without much variation in population; but our cultural behaviour, or at least our cultural model, is very different, and nobody until now has had the cheek to put forward the shark as our model. Anyway the shark will be subject to the natural cycles of this planet: there will come a day, following a climatic change or some other accident, when it will become extinct.

In many other cases we can see that Nature does not seem to tolerate the growth of an animal species beyond a certain limit. The planetary clock, sooner or later, will sound the hour of all species. A very popular example is the extinction of the big sauria, 65 millions years ago. In another part of this document we propose the hypothesis, agreed by many scientists, that they became extinct because of a big asteroid impact on Earth's surface. And this is perfectly plausible. But there is also another possibility. They were very big animals, eating mostly leafy branches of trees. If we think that the termites of the tropical forests consume 6.7 tons of organic materials per year, per hectare of ground, and that the fermentation of cellulose in their organism produces 27 Megatons of methane per year, with over a total of 76 Megatons per year coming from animal source, just think what was the methane production of

the big sauria, when their numbers became critical for the planet! And what could have been the resulting greenhouse effect. Their extinction could also have been due to an asteroid impact (representing a no less dangerous menace), but, really, Mother Nature had also other means to erase the big sauria when they became cumbersome!

Nor an intelligent species will be an exception, if it will be late using its intelligence to enter new ecological niches. Though we can discover new ways to optimize the resources of a closed ecological system, the curve of the innovation will tend one day (maybe not so far away) to its maximum. According to Gunter Pauli¹ the introduction of the Biotechnologies in the Agriculture will not lead to an increase of the product comparable to the one attained with the first green revolution: the introduction of the Pesticides led to a 10 factor increase, while Biotechnologies are foreseen to bring a 2 or 3 factor increase only.

A cultural species, when it starts to play hard with its technology, cannot avoid an early meeting with the bars of its planetary cage - and thus a simple dilemma: to go over the limits or to die. This is exactly the present situation for our Species. A time window is open, on this planet, favourable to the development of an oxygen breathing species. This species was born, has grown, and now is near to saturation of its first ecological niche. As a chick, this species now has to decide whether to break the egg-shell and to be born into a greater niche or to die because of the exhaustion of its amniotic liquid. A wrong decision could cause closure of the window. But, being a species equipped with intelligence and opposable thumbs, this species has the means to start reproducing its favourable oxygen-rich environment outside its birth environment. This is our challenge and our commitment: to take our destiny in our hands, building the new, greater, world that we need, keeping the window open, using our Thought and our Technology.

To rise to the challenge, we have excellent assets: 6 billion intelligent beings, an enormous heritage, the greatest riches that Man has ever had. But we are not culturally equipped; for this we need to define our requirements more clearly: money is only an accounting tool. Millions of \$ are quickly burned up in one day, by the Stock Exchange. The real wealth is human work potential and technology. It is not the money that creates wealth: it is enthusiasm linked with human work, when new horizons of development are opened up. To win the challenge we need the help of everybody: 6 billions people. And everybody will be happy to fight for his right to the future, helping the World Space Program, if we can to take it all over the world, humbly asking for the help of all Humanity.

3.2 Some remarks by Dr. Michael Martin-Smith

In advocating a strict limit of population to family sizes of 1.5 children, Growth Limiters have to face two major problems, both of which make Adriano's warning of eventual cultural and biological suicide stronger still. Firstly, there is the obvious need for coercion and oppression to enforce this policy. We have seen some evidence for this in China and India in recent decades. In India, enforced sterilization lasted 18 months, and did much to bring about the end of Indira and Sanjay Gandhi's political pre-eminence, while in China, it is a

¹ Gunter Pauli "Breakthroughs - What Business Can Offer Society" - 1996 Gunter Pauli

source of endless corruption among Party officials seeking to evade the restrictions. There is also the well-admitted problem of a generation of complete egoists - always a risk with only children in indulgent families! It is likely that this policy, if enforced in China over the long term, will contribute to the eventual collapse of the regime there, with incalculable results. Secondly, a world birth rate of 1.5 children per family will cause a situation never before seen in History - namely a society in which senescence is normal, and in which there are more pensioners than workers. Even allowing for improved health for many of this "army of the Aged", the impoverishment of culture, and loss of any long term vision for the future, is likely to be very damaging for our future civilization; in any event it is clear that Human civilization faces a great loss of vitality if Grey Power grows to its logical conclusion. The ferment of Youth, sometimes uncomfortable, is essential for any progressive civilization. Thirdly, a restricted population will mean a reduction in the ability of our species to attain its full potential. Out of one million people, there is usually one exceptional person- be he a Mozart, Einstein, Buddha, or whatever. Statistically, bigger populations should throw up, over time, more geniuses, provided they are not crushed by dictatorial regimes. Widespread expansion into New Frontiers, even if individual colonies are quite small, would result in a solar system (at first) capable of supporting many hundred billions of people. From these a quantum leap in creativity and genetic variety should occur, leading to fuller realization of the promise of the human Genome. To foreclose this possibility by confining an aging population to one small planet is a crime against Life and Mind. In summary, we should accept the continuing growth of human populations as healthy and natural - provided that it does not all occur on one small planet!

An example of limited Growth without a New Frontier as safety valve is provided at Easter Island, where many strange ideas have been put forward to account for the spectacular statues and civilization built by a people, whose construction their descendants could not explain. The truth has been unveiled by archaeologist Dr Paul Bahn, and palaeobotanist John Flenley, in their Book "Easter Island, Earth Island". Put simply, in 400 AD Polynesian islanders landed on a fertile and wooded island, and then built a prosperous Stone Age civilization, supporting as many as 50,000 people; for 1,000 years, they prospered, and built the famous statues in celebration of their ancestors. But about 1700, the trees were in short supply, owing to the needs of the statue builders, and boats for fishing become harder to produce. Wind erosion wrecked the agriculture, but, notwithstanding the signs before them, at some time in the 18th century, the last tree was felled. Warfare (on a hitherto peaceful island), disease and hunger set in, so that, over a generation the population crashed to one third of its previous value. The gods were thrown down, and, in an almost Jungian realization of their true predicament, worship of the Frigate Bird replaced ancestor worship - almost as if the Frigate Bird - being the only creature capable of leaving the island, by flight - was understood to have the answer! However, materials and skills for building boats had been lost, leading to catastrophe. Only the advent of Europeans in the late 18th century has reversed the decline, and restored some active life there Earth differs from Easter Island only in size, and our "frigate birds" will need rocket power, if we are to learn from the tragedy of this mysterious culture. Apart from the fact that they believed themselves to be alone in a limitless and desolate Ocean, it is easier for us to reach the Moon than it was for the stranded islanders to make landfall, 4,000 kilometres away.

4 SPACE, SOCIETY AND SOCIETIES

4.1 Space and Developing Countries

The return from space activity, for humanity, is not only the revenues of the investments, but also the great economic-employment-behaviours-human-relationships (in one word let say anthropologic) revolution that will arise, with the advent of a global space economy.

The opening of the High Frontier will produce effects even in the poorest underprivileged countries, stimulating great hope. It will be responsibility of the industrialized countries not to discourage this hope. If we will be able to keep alive this hope for the poorer nations, they will quickly learn how to help us and how to help themselves, finding a new dignity. I would not be surprised if many lessons of deep human importance will come from the underprivileged peoples, when they see the new opportunities.

The Countries that already work in space could greatly, drawing on the deep and ancient humanist traditions of their societies, by holding space symposia in the Universities of India, South America, Bangladesh, Africa, and so on, looking for partners, soliciting new cooperation, to work on the high frontier, and inviting enterprises to start partnerships with those countries. This behaviour will win, eventually: a new, concrete, hope, rising in the poor countries, which is the first condition for gaining the support of the people, and the

needed funds for investments. It is enough to think of the hundreds of millions collected by humanitarian initiatives: like "Do they know it's Christmas time...", the Telethons for the medical research, or the "Lady D" collection of funds.

The wish of the occidental people to help the poor people in their countries (and the fear that the poor people will all come to Europe and USA) is really a powerful rationale, comparable only to the fear of environmental crisis. What we need, to win the game, is a certain number of good speakers, able to go around the world and spread the "good news" of the opening of the space frontier, making agreements for cultural exchanges on space subjects. It will really be a great thing if we will integrate into the space program the result of a series of discussions around the world, based on two simple questions: "What do you expect from the world space program?" and "What could be your engagement to help the world space program?" It will also mean to organizing a world-wide school. Such a program will not be too long: in 30 years we could have several generations, in the developing countries, graduated in New Space Sciences.

This strategic line is supported not only by the need to get the support of the public opinion of the developed countries. Humanity has never been as rich as today: our technology is ready to take us to space, an heritage that we (cultural and technological avanguard of the

world) must be able to turn to account. To win the challenge, we need the help of everybody, six billion intelligences: the biggest resource that Humanity has ever had.

4.2 An unbelievable season of economic development

About the priorities of a World Space Program. An urgent task for Humanity is to gain access to a new, greater, ecological niche, and since this new environment is not ready for use (as the New World was 500 years ago) it must be developed. Thus we should give priority to learning how artificial ecosystems can maintain themselves in closed, extraterrestrial environments. The outcome of this game will probably decide the survival of our species, and surely that of human civilization. Around this main task the entrepreneurs will learn how to be productive and to make profits. We should not do all the work for them: why not involve a certain number of entrepreneurs in the formulation of the space program? We will give the guide-lines and the priorities, their creative ingenuity (they are entrepreneurs because they know how to make money) will do the rest. It is obvious that the agriculture, the biological sciences, and the food industry will take on a new importance, if we are to face the growth of the world population. How space can help the food industry, and how we can bring the food industry into space will be a very interesting set of problems. Building a first orbital agricultural platform or small town could be a realistic goal, as a follow-on from the ISS experience. In addition, a first settlement on the Moon might be directed to develop an artificial ecosystem in a close protected environment.

The economic logic of the space program should be completely reversed. The space program should not be treated as a usual business problem, where one is to calculate the costs and the benefits very precisely. In fact, it is very difficult to model a revolution: if a space economy really takes root, we will move forward to an unbelievable period of development and growth in the world economy. The economy, in fact, doesn't depend on the costs-benefits calculations, but mainly it is based on variables like enthusiasm, mass-psychology, hope and depression. While the stock-exchanges can burn billions of dollars in few days, during a crisis of confidence, the opening of a new horizon will start to create wealth even as some people just start to take it seriously.

4.3 The Criticism of the Space Economy at its Beginning

4.3.1 The Space Research and the Commercial Space

It seems to be universally recognized that, in speaking about implementing the Space Option, the starting period of a Space Economy is the main problem, from many quarters, as we saw at the 48th IAF Congress in Torino, options are emerging for a more concrete approach to Space. At the IAF Congress this sounded like "+ commerce, - research", or a changed emphasis from research_issues to commercial ones. It means, moreover, that the Space Agencies need to open up Space activities to the real economy, otherwise in few years the tap of the governmental funds will be dry, and they will find themselves at... the bottom of the heap! This new approach mainly refers, by now, to the communication satellite technologies; it looks forward to

the Space Tourism, and timidly starts to speak about Energy from Space.

It is my opinion that the above commercial activities will be useful to cover the very beginning of a political discussion in Society at large about the Space Option, but it will not be enough to give rise to the veritable start of a new Space Economy:

- Communication Satellite Technology doesn't need human settlement in space (except perhaps to sweep up the trash)
- Space Tourism, on its own, is not sufficient to justify human activities in Orbit
- Energy from Space is a first real economically significant item, but it has to compete against the petroleum lobbies; thus we can't hope that an EFS program could start very early.

Furthermore, moving the accent onto commercial, feasible, space activities (although useful for the goal of opening a discussion in the Society) presents some risks: mainly that of letting research go, "as it will go", without a political direction and without priority criteria.

Instead we need to have a very clear vision of our goals (economical, social and developmental) and of the steps to reach them.

Maybe the very first engagement, in designing a Space Program, should be, at least as far as research is concerned, to give a lower priority to all those activities which are not essential for the practicable goals of the next 30 years.

In Private Enterprise we can't prevent anyone risking his own money, but in any case a serious approach should be:

- to select, among the projects, the ones which most accord with chosen priorities;
- to indicate a strategy and some feasible goals.

For instance, a strategical point should be one involving the petroleum lobby in the development of a "Solar Energy from Space" project. Why couldn't a Petrol Company start to think to itself as an energy provider, instead of a petrol supplier?

4.3.2 The Trigger Threshold of a new Space Economy

A new Space Economy will really start only when:

- the interest of the people in the space activities will be ignited in a clear and unquestionable way, and, meanwhile,
- the commonsense opposition question " Why waste money in the space, while we have many problems on the Earth?" will be countered, by means of clear and unquestionable facts.

Thus all the efforts of politics, research and economics should be directed to the above goals, with solid arguments.

The discussion on the need of new Philosophies to support the continuation of Human Development can (and must) gain the support of the intellectual avanguard of the world. But we would be incurable romantic idealists, if we hope to get widespread support only by means of the correct philosophic ideas. The majority of the people (needed in the democracies to carry out strategical tasks) will be on our side only if the Space Option will demonstrate its high profitability by results.

This means that the main physical obstacles to the human use of Space must be removed as soon as possible.

Among the main obstacles to the free development of human life in the space we observe: the oxygen scarcity, the water (important for all the functions of our metabolism) scarcity, the absence of gravity, or, anyway gravity lesser than the one we are accustomed. Will we rush into space commerce only to discover, when we get there, that we can't keep the shop open for more than 15 minutes per day, due to the cost of breathable air?

Our biology is still based on oxygen respiration, and will continue thus: it's not nice to imagine our grandchildren as mutated methane breathers!

Therefore we should address our efforts to solve the following, simple, problems:

- How to find, or extract, abundant oxygen in space
- How to find, or manufacture, abundant water in the space
- How to reproduce gravity conditions similar to the ones we are biologically linked to.

And so we are back to research. The above, in fact, are research problems, rather than commercial ones. We can't really expect that a Space Economy can take off before they are solved.

4.3.3 The economical, political and social conditions

I think we are wasting precious years. Even if the catastrophist visions of Lester Brown were too pessimistic, we should take them as significant, at least as a trend. The World Watch Institute scenario points out some key factors:

- The human population will double in the next 50 years (more or less 12 billions people)
- Clean, drinkable, water is already scarce, especially in China, where enormous regions are now desert
- In many parts of the world desert areas are increasing and fertile land areas is decreasing
- The annual global catch from fisheries is decreasing; for the first time in the history of the fishing, this is not due to reduced human capacity, but to an absolute reduction in global fish stocks.
- The global amount of food resources in the world is decreasing

If the above trend will continue, we can foresee very difficult scenarios, in the next 30 years, due to increasing needs, against an increasing shortage of resources. Brown imagines rising conflict among nations, for control of food resources.

What should be the path for the Space Option, in such a scenario? I propose that the Space Program must show its viability, with even a few, but concrete results, before such scenarios arise. If Humanity makes the terrible choice of self-centred confinement within a closed world, with all the consequences that we can now imagine (wars, famine, epidemics, decline of science and culture, and a return to the Middle Ages or barbarism) it will be very difficult to find the money, the energy and even the spirit, to develop the Space Option.

In such a scenario several authoritarian regimes will probably emerge, aiming to manage the scarcity of resources. When people feel fear, they start to follow all sorts of loonies. People are ready to believe the most absurd promises and illusions, in order not to face reality. It has often happened in world history. And our cosmopolitan, internationalist, antiracist,

XX_century_culture is still so fragile; it is just an option, among others, valiantly competing to rule the world.

Thus I propose: the Space Option shall demonstrate its feasibility in the next 30 years, or it will never be developed! This is our urgent Imperative.

4.3.4 The Need of Priority Criteria for the Space Research

While we must look enthusiastically to commercial dynamism, we should give due attention to research, starting with a major discussion on the priorities of the Space Research. Priority should be given to all those researches aimed at solving the oxygen and the water problems.

The first terrestrial environment was entirely devoid of oxygen. Life came out from the water in a completely hostile environment: neither a skin to protect itself from the sun radiation, nothing to eat, but the naked rock². The first vegetable life was able to create the oxygen by means of the photosynthesis. Of course there was plenty of water, on the planet, at that time. Nature had some millions of years to try, make errors, and try again. We do not have that much time. We should try to condense Nature's work of millions of years into a few years of computer simulations. The problem is to find a way to transform solar energy (abundant in the Earth's Magnetosphere) into oxygen and water. The key is vegetable life, helped by some mechanisms: it was just the vegetable life that started the transformation of Planet Earth, and some millions years later we found it inhabitable! We could provide plenty of carbon dioxide and other waste products of our biologic functions: something that was lacking for the first phototropes! Once suitable plants are developed and engineered they should be tested in the real target environment: Orbiting Facilities and Moon Settlements.

We should reflect anew on the miracle of vegetable life: millions of plants can grow from one only seed, and by photosynthesis, consume CO₂ and produce Oxygen. Could we "teach" to some plants to do something else? Could some lichen, for instance, be selectively bred to break down rocks in a shorter time? Vegetable, Bacterial and fungal processes are interesting, because they consume rocks and produce fertile ground. If we opt, in the long term, to extract oxygen from the rocks, on the Moon, only by mining, it will not be the same thing: we will extract oxygen from the rocks, giving back... iron and cement, in the meantime consuming the ground under our feet. Of course, oxygen could at first be extracted from the rocks (as Dr. Ehricke so clearly described in his paper "Industrializing the Moon"), but we should focus our mind on the fact that, when live on the Moon, the nearest farm, and cultivable abundant resources, will be some four hundred thousand km away (on the Earth)! Imagine ourselves on the Moon, looking up at the full, white and blue, Earth in the sky: we have mineral rich regolith under our feet, abundant and unobstructed solar light and energy, many bags of seeds and the requirement to build one or more transparent domes. What should we do? Looking at the Earth in the sky we should realize that:

- our Mother World is wonderful, and we feel a little homesick...
- our World is finite (not infinite); that's why we came to the Moon! (interesting philosophical concept)

² Krafft A. Ehricke "The extraterrestrial imperative: Why Mankind Must Colonize Space"

- our World is a closed ecosystem, inside which everything is recycled by living organisms (interesting biological concept)
- if we want to continue our growth, we need to find (or create) living resources outside our World; if the resources of our World were enough, we probably would not have decided to come here to settle, only maybe to explore.

In our bags we should have selected and genetically engineered plants, able to feed off rocks, and convert inorganic materials into organic products). We should also have in our bag some plants, i.e. the *Pennisetum*, able to very quickly transform the inorganic CO₂ in organic molecules and able to live in environment of water scarcity³. I'm sure that, if we start to consider the problems while living there, on site, both our scientific and philosophical ideas will be greatly enhanced; we will find solutions, as we Humans have always done in our History.

If we reflect, all previous great revolutions started with vegetable "industrialization": it was so when Life left the sea and created the first phototopes, and it was so when the Mankind started the neolithic revolution. The space revolution is an event comparable to the above two: why shouldn't it begin with the same steps?

There are no doubts: absolute priority should be given to research on the biological and life aspects. If the given problem is, after a first contribution of oxygen by lunar mining, how to maintain a closed life system, several problems should be solved: selection and design of organisms to maintain the atmosphere; calculation of the required amounts to feed the organisms, the leaf surface needed to produce the needed oxygen quantity, etc... We should also consider that, if we are to expand into the Solar System, during coming centuries, we will have continuously increasing requirements for oxygen and water. Thus we should spend much more time and resources on understanding how to get these two elements, synthesizing them, separating them from other components, using vegetables to produce them; we should explore and verify all the ways our ingenuity can suggest. A big effort of computer simulation, but also repeated trial and error, are needed. When shall we start? I want to be part of it.

4.3.5 The Need of a "Not Standard" Approach to the Space

The space philosophers designed visions of great works. Ehrlicke's paper on Lunar industrialization, for instance, is a wonderful, epic poem of future engineering. O'Neill's book on orbiting cities is a really inspired work. They probably took for granted that public money would be available for space, or maybe a mix of public and private funds. This kind of vision, although very scientific, was affected by the "Cold War" political syndrome. The economic way to space is not so simple, as we noticed after the end of the "Cold War": the space economy has to make its way, to a certain degree, like all other businesses.

What the Space Economy needs to rise and develop is that many terrestrial enterprises take their activities into space, on Orbiting Facilities and on the Moon: in other words, the industrialization of space; the creation of a new market dimension. After the rise of the instrumental

³ Ludlow e Wilson - 1971 Photosynthesis of tropical pasture plants. I. Illuminance, carbon dioxide concentration, leaf temperature, and leaf air-vapour pressure difference. AUSTR. Journal Biologic Sciences 24, 449-470 1971

goods market segment (in the last 30 years), now it's time for the space industry. But there are substantial differences: the rise of the instrumental goods market was a logical consequence (anthropologically speaking) of the standardization of components and of the coming of the automation. We could say that nobody really "projected" the rise of the instrumental goods market: it was a process, an industrial revolution.

The case of the space revolution is many times more complex. Before an anthropological evolutionary process can take place, we have to build the suitable biological environment. And this is something that has never been done before. Man is used to analyzing evolutionary processes when they have been developed and have already caused a lot of social problems, not to scientifically programming them in advance. This is the first time that we can identify a road, recognize it as the only way to survive and continue our development, and then have to program and build everything, including the biological environment! Should we not forget our "routine researches" and put in place a radical, new research effort? Do we not need the help of everybody available to apply his intelligence to solve the problem?

The opening of the biological way to space is, firstly, a research problem, and it will remain so for many years. Thus Space Research must open the way for Industrial Pioneers. Of course, the Industrial Pioneers will apply on large scale the solutions developed by the Research effort. Even in the first stages, Private Enterprises can be invited to take part in the research tasks. But maybe nobody has considered until now that, among the pioneers, the Food Industries and the Farmers should be considered, together with the "traditional" High Tech Enterprises. The Israeli Water Research Institute should be considered among the Pioneers, and all the Research Institutes (or private, like Biosphere 2) which are exploring and investigating the functioning of vegetable life in hostile environments.

The human space settlements should be quickly biologically self-maintaining, and the Space Economy self-generating. The perspective (at least) of both these two facts must be evident already in the first decades of the Space Program, if we are to hope for a harmonious and safe development of the Space Option.

4.4 The Criticism of the Anthropological Aspects

The space revolution shouldn't be left completely to Space Scientists and Bureaucrats. There are many aspects to be studied and analyzed scientifically. The danger is to rely too much on the past experience, in facing an event without precedents. Sociologists and Anthropologists should be involved in the analysis. Space Research should be the Project Manager of the Space Program, but open minded and able to involve all the necessary competences and skills.

The risk is real: it would be very easy to go ahead with confidence in our past experience, and to discover, when we are there, that we neglected a small, stupid detail that will invalidate an important phase of the project, wasting resources and causing a loss of public credibility.

Before today, new areas for development were maybe difficult to conquer, thus man developed many competitive means and weapons, to be used against other humans or an hostile environment. However, air to breath and fresh water to drink were always granted. Man has little experience, as yet, in overcoming his own fear of an empty, completely unknown, environment.

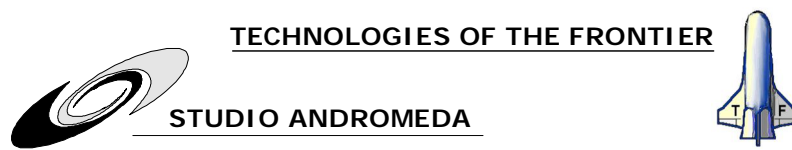
How will the fact that Man will completely depend on his technology, 24 hours a day, work psychologically, in the long term? This has been studied in a limited fashion, on MIR and shuttle missions. But the people, in these cases, didn't conceive of the ship as home. Will a Moon farmer, living in Luna City with his family, be able to relax?

Failure to secure the basic life elements (low cost air to breath and water to drink) could represent the "banana skin" on which the Space Option could fall. If it is true that Mankind has still a 30 years window to prepare for the jump to the stars, such an error could be irrevocable. The terrestrial ecological niche gave us millennia to make our mistakes, to verify and correct (?) them. But the new, greater, niche will not give us plenty of time. We presently are like a soloist on the First Night of a

concert: the whole orchestra, and the public too, are waiting for our performance; we have no more time, we must not fail.

Our life is so conditioned by the city environment that we forget that we depend on the countryside, until when we see the farmers protesting in the streets with their tractors. We look at them with incredulous eyes, and only after reflection do we remember that we are alive only thanks to those gentlemen, which produce our food. Are we sure we aren't forgetting something very important, in designing the Space Program?

Teams of experts in the biological and anthropological aspects should work night and day, to find out all the possible "banana skins".



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