

Philosophy and human motivations for space exploration



Moon Village and Beyond. Credits: ESA – P. Carril.

Report of the workshop held on 23 June 2022

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Preamble

This document is the synthesis of a seminar organized on June 23, 2022 by the Academy of Air and Space (AAE), in the framework of the preparation of a symposium on “Space Exploration” planned for May 10-12, 2023 in Turin. With the aim of debating the philosophy and motivations of this exploration, the Academy has gathered 14 participants from different backgrounds:

- **Eric Dautriat**, former Director of Launchers at CNES, author of *L'espace en quelques mots : d'Aventure à Zénith* and of *Le Brisement de la Mer*, AAE Vice-President, moderator of this seminar and author of the present synthesis
- **Jacques Arnould**, in charge of ethical questions at CNES, author of *Oublier la Terre?*, *Le voyage dans l'espace, petites extrapolations sans gravité*, and many other works
- **Philippe Berthe**, Project Coordination Manager, Orion-ESM program, ESA
- **Jean-Pierre Bibring**, astrophysicist at IAS, Orsay, author of *Seuls dans l'Univers ?* (to be published), *Mars, planète bleue ?* and other books, AAE correspondent
- **Christophe Bonnal**, senior expert at CNES Strategy Department, author of *Pollution in space, a state of emergency*, AAE member
- **Roger-Maurice Bonnet**, former Director of Scientific Programs at ESA, Honorary Director of the International Science Institute, Bern, author of *Les Horizons chimériques*, AAE member
- **Jean-François Clervoy**, astronaut, ESA, President of Novespace, author of *Histoire(s) d'espace*, AAE member
- **Christian Clot**, explorer, Director of the Human Adaptation Institute, author of *Au cœur des extrêmes*, et autres récits
- **Giancarlo Genta**, Professor of mechanical engineering, University of Turin, author of *Space, the final frontier?* and numerous science fiction novels
- **Etienne Klein**, physicist, philosopher of sciences, host of the program *La science en questions* on France-Culture, author of numerous books including *Discours sur l'origine de l'Univers*, *Matière à contredire*, *Psychisme ascensionnel*
- **Franco Malerba**, astronaut, former member of the European Parliament, author of *Professione astronauta, la lunga strada per arrivare allo spazio*, AAE member
- **Adrien Normier**, pilot, author of *Des ailes pour la science*, doctoral student in epistemology, with a thesis on Epistemology, moral philosophy and philosophy of action, applied to the question of the expansion of the field of consequences of human decisions, on very large scales of space and time, due to space technologies

- **Xavier Pasco**, Director of the Fondation pour la Recherche Stratégique, author of *Le nouvel âge spatial, de la guerre froide au New Space* and other geostrategic works
- **Julie Patarin-Jossec**, sociologist, associated researcher with Centre Emile-Durkheim, Bordeaux, author of the thesis *Le vol habité dans l'économie symbolique de la construction européenne*
- **Michel Praet**, Head of the ESA office in Brussels, author of *Défis européens*, a series of conferences as Advisor to the President of the EU, member of the EAA
- **Ji Wu**, former Director General of the China Space Science Center, President of the Chinese Academy of Space Research, author of *The Rainy Sea Hotel*

Since this is a synthesis, we have avoided the form of a verbatim where each person's words are attributed to him or her. On the other hand, boxes from place to place allow to quote the words of the different participants, not necessarily expressing an opinion shared by all, by particularly representative of their author's viewpoint, or striking.

Eric Dautriat

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1. Introduction

Space exploration will be considered here under a philosophical and anthropological angle, leaving aside, with necessary exceptions, its scientific and technical aspects, widely explained and debated elsewhere.

We will simply define its perimeter: **physical exploration of the solar system**, by automatic way or by man, beyond the presence in low terrestrial orbit, this one constituting, however, a necessary prelude. We will distinguish the exploration, which is discovery, from the exploitation, which has a perennial economic goal, and *a fortiori* from the colonization; but we will approach both. Some more distant escapes will however be evoked, quite naturally.

Thus defined, it is distinguished from astronomical observation, not by the nature of its scientific objectives but by the means implemented.

What are the deep motivations, in the anthropological and cultural sense, of this exploration?

In its automatic version, it undoubtedly responds first of all to human curiosity, the driving force of science. But it also adds a first form of presence. More complex and more disturbing is the human exploration. It is necessary to note that the voyage of man in space nourishes expectations, ambitions, dreams of a quite particular nature. This leads us to question **the imaginary of human exploration and its symbolic role in the current and future civilization.**

The sending of automated probes, although responding to a specific logic, is often either the prefiguration, or the assistance, or the extension, of manned flight.

It is also necessary to distinguish the motivations of the decision makers who make this exploration possible, those of the men and women who choose to embody it, and those of the citizens who support it (or not).

Why send humans into space, since it costs so much? Why does the eventual return to the Moon and even more so the trip to Mars arouse, in spite of their cost, a form of **desire**, certainly not unanimous but considerably shared? Why do the States grant this value of prestige to such enterprises: since there is prestige, where does it come from?

Is it not the importance still and always given to the **presence of the body**, as opposed to the only (beautiful) images? It would seem that everyone can project oneself into the adventure of a few astronauts, through whom they feel "represented". The strangeness fundamentally associated with this "inhabited" adventure is that of the body of the "fellow man" all at the same time plunged in a totally exotic environment, carrying out an extreme voyage, and endowed with the same senses as any human being.

Is it a **Promethean will of conquest** (with the hope of an eventual exploitation of the resources) or rather a **quest** – or both according to the cases? And if there is a quest, to which worldviews does it respond and what can it bring them? What part of dream, and even of childhood dreams, does it include? Beyond the journey of these few “representatives”, is there (must there be) an anthropological future to a kind of dissemination of the man in the space (which space) and in what the current actions prepare it at least symbolically? And what are its ethical dimensions?

This questioning could not ignore either the **physical limits** known at present, nor the considerable constraints which would weigh on any *installation* and even more any possible *exploitation*.

Moreover, it is fundamental to **question the future of this double desire (of knowledge and presence)**. Is it soluble in the pre-eminence of contemporary environmental questions, centered on the Earth? And moreover, what will become of this concern of “projection of oneself” through the intermediary of the physical presence of another, the day very soon when “virtual reality” will have made such progress that the illusion of walking on Mars will be able to be, for the use of all, perfect and almost free?

These questions are not the prerogative of experts; they concern everyone and everyone can bring their answers. We will see, not surprisingly, in the course of this synthesis, that they are far from having unanimous answers... for example on the following points: the possible horizon of exploration or even human exploitation of space; what is desirable in this field; the search for extra-terrestrial life. The aim of this seminar was not to deepen these contradictions or disagreements nor even to underline them, but each one will be able to perceive them in the course of the pages which follow, and perhaps, to lean on one side or the other.

2. Founding myths

Space exploration is often the object of incomplete and sometimes even superficial justifications, especially when it is about “manned flight”. From its undeniable scientific objectives to the “race for prestige”, passing by sterile polemics about the respective advantages of man and automatic vehicles, it is relatively rare that its anthropological bases are searched for. However, more perhaps than any other human activity, **space exploration conveys deep philosophical and political principles**, which, although not always apparent, are no less essential. Among these, the notion of “delegation” of a collective impulse to a few is omnipresent; nothing is more political than that.

Space provides information about us, about the Earth we live on. Telecommunication, Earth observation, meteorological and other “Earth-related” satellites allow us to better understand how to address the various challenges we face. This is why space will be vital to implement the Green Deal and to position Europe as a major player in the digital economy.

But space is also, and I would even say that space is first of all information about ourselves. About who we are.

On our way of approaching the universe through our psychology, our philosophy. In short, through our personality.

To put the foot, a human foot, on the Moon was certainly a great leap forward in research and technology. But it was especially “a giant leap for humanity” as Neil Armstrong rightly expressed it. Because since July 21, 1969, the most eminent, but also the poorest, person knows that by observing the Moon, he has gone there. Because he is, in essence, a human being and can identify with the astronauts who made his human dream a reality.

This factual perception has enormous repercussions on our society, our economy, our way of life but also our way of thinking.

This perception creates an open mind. And it is mainly to space exploration that we owe the fact that being “open-minded” is something more than a simple concept.

Michel Praet

One frequently speaks about “conquest of space”. This term is inappropriate: man has not conquered space, or if he has done so, it is a question of tiny fragments of space, but this word “conquest” places space exploration in the implicit line of previous explorations and conquests, notably that of the New World by the Europeans. In any case, this “push” towards elsewhere, towards the open sea, towards enlargement, has its first roots in **the myth of Prometheus**: the acquisition of fire, and thus of the ability to make tools and to develop its industry. **Through his ingenuity, man becomes the most powerful of creatures and subdues the world.**

California, March 2018: Elon Musk speaks at a roundtable dedicated to the conquest of space and repeats the phrase of the father of Soviet astronautics Konstantin Tsiolkovsky: “Earth is the cradle of humanity, but humanity cannot remain in its cradle forever.” He continues: “It is time to conquer the stars, to expand the spectrum of human consciousness. I find that incredibly exciting and it

makes me happy to be alive, I hope you do too. In quoting this maxim, Musk places his space project in a definite philosophical tradition. If we need to grow up, to leave our earthly cradle, to emancipate ourselves from our natural limitations in order to become adults, it is because man, unlike animals, defines himself by his self-surpassing.

We know the myth of Prometheus. Endowed with fire, it is only by his technical ingenuity and his work of transformation of his environment that man becomes the most powerful of creatures, subduing the beasts and nature. He discovers his own nature by denaturing himself, by exceeding the limits that his initial conditions imposed to him. Far from submitting to some external authority, divine or superhuman, it is he who sets the rules and establishes the limits, the better to exceed them by his infinite ingenuity. Elon Musk recognizes himself perfectly in this Promethean project.

Etienne Klein

This myth is similar to the one in Genesis: "God created man and woman. [...] And said to them: Be fruitful and multiply, and fill the earth and subdue it." Pico della Mirandola, much later, wrote in *On the Dignity of Man*: "Let a kind of sacred ambition invade our minds and make us dissatisfied with mediocrity, aspire to the heights and work with all our strength to reach them." **On the conquest of space as an extension of the subjugation of the Earth...** and from this "conquest" we already see deriving, as common sense, a notion of colonization. An thrilling prospect, summit, at least at its beginnings, and even before its beginnings as we shall see later, and remained so for many.

However, the mass has not been said. The thrill of space flight hides perhaps an alienation – as **Anna Harendt** affirmed it after the beginnings of the "space conquest", of which she takes the meaning extremely seriously, connecting it to the advances of the physics of the XXth century which also left the Earth by reproducing phenomena which were until then the property of the stars. Is the space exploration really the continuation of the humanism, or its questioning, even its end? For us, says Husserl, "the Earth does not move", it is our only and unique anchorage, and **humans are Earthlings before being human**. And Etienne Klein adds: **man is not a being whose nature would be invariant by translation in space...** Wouldn't humans who would be installed on a planet so far away (and Mars is enough for that) that the Earth would no longer be visible, or almost no longer, become *other*?

There's a little chatter going on. If things get too bad here on earth, some people dream that we could always go elsewhere and settle on other planets. Is this really reasonable?

*(...) In a 1934 text entitled *The Earth does not move*, the German philosopher Husserl defends the idea that the Earth is not for us a planet like any other: it is the original and irreplaceable ground of our bodily anchorage, so that, for us, it is not in movement, and it is illusory to hope to emancipate ourselves from its attractive and nourishing presence.*

***We would be, in short, earthlings before being humans.** So much so that if we camped far away from the Earth to the point of not even seeing it, we would certainly lose our psychic balance and*

our way of being in the world. To change planet would be to become other (...) This is the paradox of our situation: at the very moment when we discover the astrophysical banality of our planet, we become aware of its uniqueness relative to us.

Etienne Klein

This is a valid question for the perspectives, or dreams, of space colonization. On the other hand, as soon as he leaves to come back, as far as he goes, doesn't the astronaut, and with him all those who symbolically accompany him, keep all his humanity, giving him on the contrary an additional meaning?

Space is a place where the *oceanic feeling* described by Romain Rolland can blossom (as long as the astronaut has the time... but that's another subject), a kind of spiritual fusion with the universe, the infinite and even eternity. It is not necessarily religion. It is perhaps a physiological inebriation, which is similar to the high-altitude euphoria... But it is not difficult to understand how, immersed in the starry sky, alone or almost, especially if he floats in his spacesuit during an extra-vehicular activity or if he walks on the Moon, can feel this dimension, and in a way "go out of himself. This does not make him a non-human. As long as he comes back... or at least wants to come back.

On the other hand, it is common to affirm, perhaps by taste of the provocation, that the exploration kills the mystery of its subject, as the mountains once climbed lose their height. The Moon lost its mystery when it gained its capital letter, when it went from a celestial silhouette, divinized, the moon, to a telluric satellite of a planet. It is however there a paradox hardly tenable.

Certainly, **the beauty of the cosmos** is perceptible by all. It is enough to enjoy a starry night, even on Earth. But this perception **has gained enormously in intensity** through space exploration – and also through astronomical observatories, both terrestrial and orbital. Everyone has apprehended, thanks to the images and also thanks to his projection in another self (the astronaut, more difficult the automaton), the beauty of space freed from the filter of the atmosphere, as well as the arid beauty, monotonous sometimes, inhuman but all the more impressive of the surface of planets. The attraction of beauty is not often cited in the arsenal of human motivations for exploration, but it is certainly present in the public infatuation, when it occurs, towards the Martian robots, and in the feelings of the astronauts. It is however interesting to note that most of them, when asked about beauty, answer by speaking with emotion and sincerity about... the beauty of the Earth, seen from space.

In the order of myths, we must also consider that of Noah's Ark. The transposition to astronautics is obvious, and we will come back to this in Chapter 8 concerning the desire of some people to escape in the future from a planet that has been destroyed (by them!), at the end of its resources. However, as in the Ark of the

myth, not all the inhabitants of the planet would be entitled to this curious 'rescue'. And everyone knows that. It is not impossible that the risk of disaffection towards space adventure, mentioned in chapter 7, has a link with the situation in which people project themselves: passengers on the Ark – or condemned.

3. Ideological sources

In the debate on space travel, I hear from time to time statements such as “humanity’s destiny in space is written in its DNA”, as if we were born with this imprint. This is certainly a phrase with a strong communicative impact, but nobody has yet found the “exploration gene” in our DNA. Perhaps we don’t yet know all the manifestations of DNA, but reference to DNA does not seem to be the most convincing evidence of humanity’s destiny in space.

I find more convincing an “anthropological” approach to understanding humanity’s desire to explore a dimension that I would tentatively call “culture”.

In this context, the “culture” is not a “knowledge” or a “erudition” in the classic sense of the term; it is a set of rules, of knowledge and of manners to behave which allow the men to survive in a given environment. In this sense, each man has a “culture”, that is to say that he possesses the set of notions that allow him to live and act practically everywhere on the planet Earth, like the Eskimos in the polar regions or the Tuaregs in the Sahara desert.

Franco Malerba

The USSR and the United States are of course the two “conquerors” of space in the 20th century. It is very interesting to observe that this shared role is not linked to their only economic power of the moment nor to their only rivalry for the world domination, **but concretizes, on both sides, a philosophy or better, a culture, well before the beginning of the space era** but having prepared it more or less explicitly.

Very explicitly on the Russian (then Soviet) side. **Cosmism** is an intellectual movement, carrying out a syncretism between spirituality, philosophy and science, in forms varying according to the times and the authors, but always with a will to make man the conscious and active center of the cosmic evolution. Through this mastery, man will attain immortality. We are not far from the contemporary transhumanists, however American... It is an understatement to say that cosmism is anthropocentric. **Its influence was strong at the advent of the communist regime in 1917. The latter will seize it**, at least in part, and make it one of the implicit foundations of its will to conquer space.

Cosmism was based on two ideas: on the one hand, human action can modify the cosmos (Nature); on the other hand, cosmos has an influence on human activity. It follows that the domination of cosmos is a condition of human freedom. The conquest of space is one axis; another is to create immortality through science. Cosmism is a mixture of religion and science. It touches on the “nature” of humanity. Its motto could be: dominate the cosmos and colonize the planets.

Constantin Tsiolkovski, considered the founder of Soviet astronautics, was a cosmist. He was the originator of the famous sentence according to which “the Earth is the cradle of mankind, but one does not spend one’s whole life in its cradle”.

This was a very powerful ideology at the time. Dostoyevsky himself was a cosmist, and one of the Karamazov brothers expresses himself on the subject.

Xavier Pasco

The mysticism associated with cosmism is profound, so much that it is surprising, at first sight, that cosmism has “percolated” into the Leninist doctrine. Needless to say, it persists all the more easily in today’s Russia, where the theoretical contradiction with Marxist materialism no longer exists. (On cosmism, see *Lénine a marché sur la Lune*, by Michel Eltchaninof, 2022).

Quite different (... really?) is the concept, due to John O’Sullivan, of “**manifest destiny**” which impregnates the American ideology, just about contemporary with cosmism and promised to the same longevity, with the addition of global publicity. The United States is a predestined nation, called to create a new world, with foundations just as mystical as cosmism. To this is added another thesis, that of “**Frontier**”, built a little later by Frederic Jackson Turner: it is obviously, at the beginning, the conquest of the West, but not only. The West represents, beyond a territory to be won and populated with white Americans, a vital force, physical and mental qualities, **a model of interaction between Man and Nature**. Thomas Jefferson would refer to the biological necessity of growth, like a plant in its pot, then out of its pot. The combination of manifest destiny and frontier, then, is a natural one. These two ingredients are necessary to create the identity that the United States, so new, needs. Together they become a leitmotiv. All North American children learn this in school. It is quite natural that at the time of the “conquest” of space, so loaded from the start, as we said above, with ideology, manifest destiny has manifested itself and that the new frontier has been inscribed in space, upwards. A couple of space probes will be called “Lewis and Clark”, like the two famous explorers.

As we can see, the parallel between cosmism and manifest destiny is striking.

On the American side (but what about the Russian side?) space is seen as an island of “moral health” (Thomas Paine, NASA administrator, 1968). Elon Musk, nowadays, says the same thing about Mars, whose colonizing society would be free of the social ills of Earth (Elon Musk being a libertarian, states are surely part of those ills for him).

With such ideological sponsorships, space adventure, exploration are robust enterprises. As long as the financing follows. These can certainly experience very sharp ups and downs. But what American President could bring them down to zero without being accused of undermining the very destiny of the United States?

Today in the United States, **there are three distinct, concrete approaches to this destiny: that of NASA, that of Elon Musk and that of Jeff Bezos**. NASA intends to continue along the path it has always traced, taking up the installation on the Moon where it left off, but this time with a wish for international cooperation – naturally under its leadership. Elon Musk is pursuing his dream of planetary colonization, wanting to make humanity a “multi-planetary species”. As for Jeff Bezos, taking up the ideas that O’Neill (1976) had expressed under the very

significant title “The High Frontier”, he intends to develop orbital infrastructures, outside the gravity wells represented by the planets and their main satellites. Needless to say, the visions of the two billionaires do not have the same technical basis as NASA’s. But they certainly make people dream more. We will see later that investors who follow Elon Musk, for example, do not necessarily care about the technical credibility of his statements of intent.

What about Europe? What are the founding myths, or the contemporary philosophical foundations, to which a place, a role in space exploration can be associated? This essential question will be the object of our last chapter.

4. The literary translation of the desire for space

It is not an exaggeration to say that in the field of space exploration, of space “conquest”, fiction has largely preceded reality and has, in a certain way, more symbolic than technical obviously, opened the way. It has reinforced, even created, the “**desire for space**”.

The literature of the journey, as old as it is, announces perhaps itself certain tendencies of the SF and not the least. **The Space Odyssey is explicitly the daughter of Homer.** One makes worse filiation.

The journey has its icon: Ulysses. For discovery, it may be Christopher Columbus; for conquest, Alexander; for achievement and extremes, Hillary and Norgay. (Everyone is free to install other icons than these on such altars). Neil Armstrong, on the other hand, represents all this at once. With a big difference: the totally collective character of this adventure, which mobilized hundreds of thousands of participants and, “live”, hundreds of millions of companions.

For Christopher Columbus, the only one in the above list to have seriously dealt with the economic question, it was finally a rather unhardy bet (on the part of his financiers): very moderate investment, colossal possible gains. In the case of space exploration, it is more or less the opposite. The “Return on Investment” is more than hazardous. But it is not the return on investment that mobilizes people and politicians (in that order, or the other way around). It is human imagination.

Eric Dautriat

After the great precursors that were Cyrano de Bergerac, H.G. Wells and Jules Verne, came during the XXth century the authors of “**hard science-fiction**”, which endeavours to make its scenarios relatively credible, to take advance on the available technologies but in a plausible way, without violating, at least consciously, or by violating the least possible, the laws of physics. It goes without saying that science fiction is not limited to the conquest of space. But this one holds an absolutely major place there. It is the case of authors like Isaac Asimov or Arthur C. Clarke, or still, later, Kim Stanley Robinson. Many actors of the space industry, whether astronauts, engineers or scientists, do not hide that this vocation came to them, among other things, by reading books or watching science fiction movies. (Of course, later on, **Gagarin and the Apollo program came to renew and concretize the dream**, mythologizing both the notion of national hero and that of collective effort, which complement each other). Science fiction literature, more than cinema, has accompanied the rise of exploration at its beginning, as if it was taking care to take the field but not too much. Once again, the case of 2001, A Space Odyssey (1968) is the most emblematic. We remember the half-joke, tinged with emotion, of the crew of Apollo VIII who, flying over the dark side of the Moon first, had considered sending a message to Houston to make people believe that they saw the famous monolith of the novel, or rather of the film.

In this regard, it is obvious that the existence of aliens is widely postulated by science fiction of all categories, and has played an absolutely major role in the formation of successive young generations.

We must not neglect comic books, American cartoons or others. In Europe, Tintin played this role of symbolic precursor in the 50s. A poster, realized in 1985 by the Wallonie-Bruxelles center of Paris, showed Tintin, Snowy, Captain Haddock and Professor Calculus welcoming on the lunar surface the crew of Apollo XI by a sound "Welcome"!

This outpouring of dreams into real life, as Gérard de Nerval would have said, **can be a source of energy but can also be demobilizing** if the gap between the two becomes too great, if the "invented" technical references are too out of sync, erasing the immense difficulties of the real world. For those who are used to travelling through wormholes in the cinema, the return to the Moon may seem laborious, and the real astronauts, dabblers. However, these last decades have seen the expansion of space opera more than hard SF, itself often overshadowed by heroic fantasy (the whole facilitated, perhaps, by the propensity of cinema to the spectacular more than to the intellectual deepening?). But this one, most often, does not look towards the future, even if it is chosen as a pretext, but towards the past, a past generally violent, warlike, with strong hierarchical structures: a reactionary vision if ever there was one. By the way, the future of these literatures cannot be separated from the rise of the "virtual"; we will come back to this later.

Elon Musk and Jeff Bezos make no secret of their literary "sources", of their adolescent taste (which they may still be) for science fiction, of their desire to make it come true. At least the "not unrealizable" part of it.

Is it to say that the literature and the cinema of science fiction, in the broad sense of this word, have a role to play in the society, in order to contribute to give a positive, avant-gardist image, not only of space but more generally of science and technology, at a time when too many young people turn away from it? Undoubtedly, as long as one does not deduce that the authors should be subjected to pressure so that their writings "go in the right direction"! **The place of the imagination and its "role" is undoubtedly a subject for reflection and necessary action. Doesn't the Air and Space Academy have a "History, Letters and Arts" section?**

The importance of science fiction is not limited to motivating young people to undertake scientific and technical studies and to embark on scientific careers. Science fiction is also a symptom of an interest in the future and a willingness to look to the future with a positive attitude. At a recent conference, a media expert said that one of Italy's problems (or rather, one of the symptoms of Italy's problems) is the fact that Italy does not produce science fiction (and I would add the difficulties faced by the few who try to do so). This clearly shows that Italian society is looking more to the past than to the future and is giving up the role of propellant that it had in the past.

Giancarlo Genta

5. The Earth is unique

This theme is not absent from science fiction, but it is not at all a leitmotiv; it would perhaps be demobilizing, too... But a major lesson of the exploration of the solar system (and of astrophysics) since its beginnings is that “the Earth is unique”, the Earth as a source of intelligent life in any case. At the beginning of this exploration, this was not the commonly accepted paradigm. On the contrary, the past centuries, with in particular the end of geocentrism, Copernicus, Giordano Bruno, Galileo, etc., had (very gradually) given way to the idea that the Earth was quite commonplace, that life, not only biological but also intelligent, existed in many other “worlds”, thus feeding, as we have seen above, many works of science fiction and many legends. This way of seeing, of course, was built against the previous doxa, that of the monotheisms in particular, for which Man and thus the Earth were unique, placed at the center of creation.

At the beginning of the space age 60 years ago, we were still in the idea of validating the dogma of the “plurality of worlds” and the “banality” of the Earth. The goal of the first exploration missions was to scientifically validate this dogma; in particular, there should be life elsewhere than on Earth and we should find it. The Viking missions in 1976 did not aim to find out if there was life on Mars, but to determine the metabolic rate at which it developed (...)

Now we know that there is nothing generic about the Earth, we have returned to uniqueness. Not in the pre-Copernican way, where the Earth alone would be unique; in fact each planet is unique in its own way, and the same is true for the other planetary systems, which are all different from each other and from what we would expect. (...)

There is no origin of life as such, life emerges following a series of contingent bifurcations. I even dispute the word exobiology, which involves a misunderstanding. What we call life is entirely related to the Earth and the processes it has undergone.

Jean-Pierre Bibring

Now, the more it advanced, the more the exploration demonstrated, not only the absence of life on other planetary surfaces (while leaving open the possibility of fossil traces or even of current oases), but also **the extraordinary conjunction of circumstances** which had allowed, on Earth, the blossoming of life, circumstances which were not found elsewhere, in the infinite diversity of possibilities. It was much more than the presence of an atmosphere. It was certainly the distance to the Sun (and thus to other stars for the exoplanets), but also the role played, with respect to this one, by the migrations of the giant planets, the Moon, the impacts, the magnetosphere, etc. A weak variation of each of these numerous parameters leads, in the models, to the failure of life. Of course, the laws of physics are universal, but evolution is not only mechanically guided by these laws, it is also guided by the physical context, partly constructed by a succession of random events.

Let's quote Jacques Blamont: “Whatever science fiction authors invent, escape is impossible. No planet in the solar system can offer us hospitality: we only have

our own. Venus is much too hot and the atmosphere of Mars too thin. As for the stars, located anyway at an inaccessible distance, the hundred or so of them known to have planets do not seem to tolerate around them the presence of a globe of our size, capable of generating and maintaining a habitable biosphere. Finally, we do not have access to the space-time loops, known only to poets.” (*Introduction au siècle des menaces*, Ed. Odile Jacob).

We must consider this result as the fruit, on the one hand of astrophysical observation, on the other hand of the exploration of the solar system – and of course of biology itself.

Thus, starting from the notion of its uniqueness, humanity has, in the opinion of some, returned to it, even if it is no longer on the same philosophical basis. **We are thus Earthlings before being human, not only for the philosophical reasons mentioned above but also for reasons of physical “feasibility”.**

However, **it is impossible to demonstrate anything in this field about the possibility of intelligent life at “great distances”.** We can approach the question from another angle. The search for life has different scales. Beyond the solar system, it is not a question of physical interaction but of the search for information (“intelligent signals”) – to which it is not at all clear that we could respond within the time frame of the life and death of civilizations, a time frame about which we know nothing.

In the expanding universe, the speed of light defines fundamental physical limits. Three concentric circles, centred on our Earth, are thus of particular importance. From the largest to the smallest: the sphere of observation, defined by the particle horizon, beyond which it is impossible for us to acquire information; the sphere of action, beyond which we cannot be the cause of any effect; finally the sphere of interaction, beyond which no feedback is possible. If our cosmological representation is valid, 97% of the 2000 billion or so galaxies that we can observe (older the further away we go) will remain forever out of reach. And with 99.7% of them, no exchange of information will ever be possible. We can only be confronted with the consequences of our decisions, with feedback, from a small fraction of the space (itself very limited) that we have the capacity to impact.

It is hard to resist, here, a little quote from Michel Audiard: “Sometimes I think that the most obvious sign of an extraterrestrial intelligence in the universe is that they haven’t tried to contact us.”

Even at these scales, it is quite possible **that the “quest” to which the exploration answers is in fine the search of ourselves, of our origins, of our destiny,** or more exactly of what we can and cannot direct our destiny towards, being understood that we see correctly a thing (the Earth) and a being (humanity) only from the outside. **An existential quest.**

6. An expansion in space of human species?

As mentioned above, humanity, or an important part of it, expresses a “desire for space”. This desire is strongly expressed during the great automatic exploration missions, such as Perseverance or, for Europe, Rosetta; and even more strongly – also in Europe – when a “national” astronaut flies to the ISS and stays there; cf. the craze shown recently in France by the missions of Thomas Pesquet. Of course, the peak of this craze, worldwide this time, was reached during the race to the Moon and the first steps of man on our satellite. For a long time (is it still the case?) this event was considered the most important of the 20th century.

It is essential to note that **this exploration is perceived as part of the vast paradigm of progress**. In particular in the sixties, where this last one is omnipresent in the facts and in the minds. But it is not only a question of perception: it is necessary to consider that progress is part of the very definition of exploration, and not only spatial. Progress of knowledge and progress of know-how.

Exploration is fundamentally justified by progress, allowing to leave a known domain, to acquire new information, to go beyond a limit.

This progress can be brought collectively or individually. Collectively, it can be, for example, the landing of a rover on a distant planet by a team; this feat can be felt as an exceptional personal success, shared with the team, depending on the level of involvement.

But individually, when the action of one or a few people can bring about the improvement of a knowledge useful to the community, the personal motivation and feeling are different. This is the case, for example, of an astronaut who conducts scientific experiments in a space station, or of an individual explorer who explores his or her own limits in extreme conditions in order to improve knowledge about the brain, for example.

Christophe Bonnal

The interest shown towards “manned” missions is clearly a projection of each person into “another self”; **a kind of delegation of exploration**. This delegation is obviously more difficult with respect to a robot (but not completely non-existent: cf. the anthropomorphic feelings aroused by the Chouri lander and its misadventures, or the Martian selfie of the Chinese rover Zhurong).

Given the symbolic importance of manned missions, it is important to reflect on their sociology, based on the data available for historical missions and for the presence in low earth orbit, especially within the ISS.

Why do people want to become astronauts, where do the “lucky ones” come from? (The number of astronaut candidates, for example in Europe, remains extremely high). We have already mentioned the attraction exerted by the founding missions, and by science fiction; we must add to this the hope placed in a resumption of exploration towards the Moon and Mars. The professional environment thus constructed is marked, more and more, by a great diversity of

expertise, while remaining extremely demanding in terms of physical and mental capacities, and work capacity in all circumstances.

Manned spaceflight is an excellent field for the study of the relations between science and politics, showing an entanglement that has reached a state of paroxysm: as the exploration of "outer space" progresses, scientific production and political motivation come to take part in a very tight division of labor. Because if the scientific use justifies the use of a space station on the long term, no scientific program is worth the financing engaged in the construction of such an artefact. The scientific use is never the driving force of manned space programs – diplomacy and international relations are. Politics and science thus share the work of legitimizing the programs, according to their stage of development. Insofar as the space stations are presented as "laboratories", it seems aberrant that this entanglement between science and political exercise has hardly produced any publications. This is not the only unanswered question in a literature which, if it is of a rare extent and diversity in the only field of manned flights, remains silent on the numerous sociological questions that this object of study raises.

Julie Patarin-Jossec

The space agencies have played a central, even exclusive, role not only in the selection but also in the political impulse. The ISS is a political object. It is the highest and most famous symbol of international cooperation and follows another station, Soviet, whose name, Mir, meant both "Peace" and "World". **Astronauts are today the bearers of this ideal**, after having been the instruments and the actors, on the contrary, of the prolongation of the cold war by other means during the race to the Moon.

Moreover, space activity, in particular exploration but also the great astronomy projects play an **essential role in the education of the young generations, an essential point insufficiently put forward.**

To what extent does knowledge and discovery trigger popular support? Why spend so much money on a giant telescope at the L1 Lagrange point (James Webb) when the streets around our houses or buildings are full of beggars and drug dealers? The answer is: education! Bring discovery and knowledge to the level of teachers and invite them to make space an accessible and compelling answer to the question.

Roger-Maurice Bonnet

The notion of cooperation, which has become very present in exploration projects, does not prevent them, far from it, from being used to **reinforce the national identity**. We have seen above the strong link existing between these and the great American narrative; or with Russian cosmism.

This powerful political role comes certainly from the "delegation" of the adventure to another, a "neighbor", but also, without any doubt, from the fact that the space "hero" is also the product of an enormous collective effort; in the preparation of a mission as in its realization. Without the support on the ground, he is nothing. It is the difference between the space explorer and the explorer of the terrestrial confines. **Gagarin is at the same time hero of the Soviet Union and success of a system and a community.** The relations between astronauts and ground support

constitute a complex network, rich, and carrying lessons on what could be lunar or Martian bases, connected to the Earth but with a more tenuous umbilical cord (especially in the Martian case) than the one existing with the ISS.

But things are changing. On the one hand, **private initiatives** are taking away the exclusivity of the Agencies, without disrupting the social relations mentioned above as long as it is still about sending professional astronauts into space. Even more, **space tourism**, already outlined twenty years ago, is getting back to life with these private initiatives. (It takes a bit of complacency to consider Jeff Bezos' and Richard Branson's clients, who make suborbital flights, as space tourists). What look to have to space tourism?

The first obvious fact is that it is an extremely selective leisure activity, given its cost, which could undoubtedly decrease if an effect of scale occurs, but which will remain, intrinsically, very high. As such **it is doubtful that it contributes, in its current form, to "raise" the image of space in the mind of the general public.** These tourists are even blamed for contributing to... global warming. But this very selectivity is one of its reasons for being: the incessant search for "distinction".

A second interesting point concerns the motivations of these tourists. A survey has shown to what extent these are, if one may say so, "down to earth": "Excitement", "futurism", "uniqueness", "luxury"... We are obviously far from the equation exploration = progress, advanced above. It is not surprising, moreover, since this suborbital tourism, objectively, has nothing to do with exploration, and is perhaps not even the prefiguration of it.

It would be sad if the builders of cathedrals that are the real explorers of space (automatic probes and humans) could be confused – or even replaced! – by these Luna Parks for rich people, who have nothing to offer to humanity.

But one can also conceive space tourism in a different way, with another ambition. So do those who imagine the creation of "tourist" lunar bases, **based on a totally private infrastructure of space transport and lunar logistics**, and allowing to spread to a clientele (certainly wealthy and therefore limited, but as large as possible) the change of paradigm already lived by proxy when the Apollo astronauts watched the first sunrises on the Moon. The human mind does not live by knowledge alone, it also lives by physical perceptions, and that a number of men and women, well beyond the small community of astronauts, could experience this would constitute, for some, a collective spiritual enrichment. My "projection" into the experience of others is fine, but my own experience is even better! In other words, it is not only about entertainment but about something more "noble".

Beyond these motivations, if the limitations of public finances postpone the installation of lunar and a fortiori Martian "state" bases to the infinite plus a day, one could imagine that, in a world evolving in this direction, private initiative –

billionaires or not – is the only one capable of “pursuing the adventure” of exploration... We will come back to the future of the “installation” in paragraph 8.

Within the New Space framework, the most promising market is space tourism. This includes the first stage launch vehicle engine, the LEO hotel and then the lunar hotel, high-speed space-to-ground real-time communication, in situ use of space resources, and so on. This is called the space-to-space economy, rather than the space-to-earth economy (which is the responsibility of the government in most cases). Once all of these activities become real and grow rapidly, the total investment in space will be much larger than the total government acceleration. There will be hundreds, thousands or even more people going to and from space every year!

It is interesting to discuss the impact of this. How will it change human beings on the ground? Will it change the way we look at things, like in the 60s-70s of the last century, when the Apollo astronauts took the “earthrise” photo from lunar orbit?

Ji Wu

The difficulties to overcome to become an astronaut are considerable. They come from the extreme mechanical energies, the thermal vacuum, the radiation (the most serious in the long term), the weightlessness in case of a long flight, or the psyche (distance to the Earth, life in community, etc). Associated with the need for an astronaut to be operational, as we have seen above, they lead to long and arduous selection and training procedures. But for a tourist it is different; he is only asked, basically, to survive. In this respect, the question remains of what would happen in case of an accident suffered by space tourists; what would be the reaction of the following “customers”? Would the materialization of the space risk be likely to put a stop to tourism? Probably not, because other examples exist on Earth, of dangerous “leisure” activities, with their share of victims and yet continued – in spite of the aversion to risk that marks our current societies (probably more in Europe than elsewhere).

The very strong physiological requirements for astronaut candidates will become even more pronounced if they are recruited for a trip to Mars.

(Let’s not dwell on the declared candidates for a one-way trip to Mars. We’re in the virtual realm here. If they really believed in it, if they were about to embark, they would undoubtedly be much less numerous. However, this strange “appetite” describes a “malaise on Earth”, individual or collective, as much, if not more, than a desire for adventure...)

So much so that these requirements could, according to the ideological context of the moment, evolve towards a certain genetic selection. This leads to **the question of the “augmented man”** dear to transhumanism. In a certain way, the astronaut in extra-vehicular activity, in his spacesuit, is already, typically, an “augmented man”, but this augmentation is reversible and “external”. It remains that space is a domain favourable to the expression of these tendencies. **It is propitious, naturally, to transhumanism (whose relationship with cosmism is indisputable).** We know the dreams of infinite expansion carried by transhumanists. Their

“intention” of immortality goes hand in hand with this expansion. Here again, space exploration, in the broadest sense of the term, the most “unbridled”, touches on fundamental philosophical questions. The image of exploration among the general public and politicians could be modified in the long run.

Beyond the technical aspect, there is also a psychological unknown. To this day, it has never happened that a human has not seen the Earth for months and months. The only people who did not see the Earth for a while were the Apollo astronauts, who did not see the Earth for about 20 minutes as they passed behind the moon. But they knew that they would see it again immediately above the lunar horizon. (...) But when we go to Mars or beyond, for the first time in the history of mankind, humans will no longer see the earth. They will not be able to locate it in their field of vision. They will no longer be able to have a live conversation with earth, and they will not be able to return in case of emergency. They will be condemned to wait months, even years, before considering a possible return. As far as augmented man in space is concerned, the limit, for me, is only psychological.

Jean-François Clervoy

There are **a certain number of technical projects**, all at a low level of technological maturity but present in peer-reviewed journals, which imagine the very distant travel (well beyond the solar system) of automatic vehicles, of (very) small size, capable of reaching a speed equal to a non-negligible fraction of the speed of light (beyond 1%) – a speed itself phenomenal which would make it possible to reach nearby stars in relatively few years, and to render this type of exploration commensurable with the duration of human life. Beyond that, very long “galactic” voyages are imagined. Among these technical means, of which it is obviously necessary to exclude the use of any form of “classic” chemical propulsion (which would require unattainable masses of propellants), we can mention the often evoked solar sail, or the propulsion by terrestrial laser rays; some have received a beginning of financing (still very modest). Some imagine, by this type of means, to spread life (not human life but elementary “biological” life) in the cosmos, starting from the principle that life, on earth, is the most completed creation of cosmic evolution and that in some way, it is a duty for humanity to spread it widely... One could consider that this dream goes hand in hand with the increased perception of the fact that life is, to say the least, not omnipresent in the universe, and that the Earth is *the*, or *a*, singular source of it.

From these trends, which are certainly still marginal (much more so than space tourism or the colonization of Mars), we can deduce that today's decisions taken by humanity will have repercussions on a scale of time and space that has never been seen before, and that it would be appropriate to set up a very long-term ethical reflection, at the international level, a priori that of COSPAR. We can see the enormous ethical questions raised, for example, by the idea of seeding, which many would consider unacceptable. However, not only are these projects not very mature, but their very feasibility is controversial.

The expansion of our spatial capacities is equivalent to an enlargement of our 'playground'. In this expanding environment, we can be responsible for the best and the worst, to an extent not previously known. We could seed, or interact with, entire biospheres, perhaps even destroy some.

This is not science fiction. And it is already happening. Since the 1970s we have been sending 'acceptable biological loads' on our probes to places chosen for their similarity to habitable places on Earth. Since the 1970s, small groups have been sending signals to space on behalf of humanity. And since we have located exoplanets, it is to those in the 'habitable' zone of their star, only a few light years from Earth, that these signals are sent on behalf of us all.

A variety of technologies are being explored at different levels of technological maturity that would greatly enhance the impact capacity we already have, on a scale we have not yet manipulated.

Although potentially equipped to deal with the issue, we may not have taken the opportunity as a species to consider our responsibilities at large scales of space and time. This question is one of global responsibility, towards our biosphere and those that exist, or will exist, beyond our own; it is one of our footprint, or lack thereof, up to cosmological scales. We do not want to collectively seed, destroy or even connect to other biospheres inadvertently, or by accident.

How do we manage the large-scale implications of our growing space power? I propose that the 2023 AAE conference formally launch the global discussion on this issue.

Adrien Normier

7. ... Or concerns narrowed to planet Earth?

The attraction for the physical exploration of space can be confronted, tomorrow, with two tendencies independent of each other but calling into question its foundations. **One is the progression of the “virtual” in our lives, the other is the universal importance, at least in Europe, of environmental issues.**

“Virtual reality” (a fine oxymoron, if you think about it) is constantly expanding. The metaverses are gradually becoming... a reality, that is to say, they are replacing an increasing part of social interactions to transpose them “on the Net” by imitating life, while giving it more attractive contours and circumstances. Advertising agencies are thinking about how to influence consumers whose avatars will be the main, if not the only, representatives. Even with the still limited means compared to the promises of simulation, many young people already spend most of their time in this virtual world. **What becomes then the interest for the projection in a space explorer “other myself”, if the 3D simulation can offer to the brain the conviction to be himself, directly, the actor of the exploration,** in sceneries coming or not from real images, with a strong dose, undoubtedly, of game and simulated adventures? What becomes, in a word, **the desire of physical presence?** Our senses can easily be deceived.

“The only way out open to our children is to put on a suit equipped with all the biosensors that Moore’s Law will provide them with, in order to feel, see and touch virtually, swallow a good dose of euphoriant and leave every weekend for the land of dreams with the favorite star, there on a beach before the sixth extinction, eyes riveted to the screens of the helmet, shutters closed, without past and without future”, Jacques Blamont happily writes in *Introduction au siècle des menaces* (op. cit).

This is a strong statement, but it is risky to make such predictions on a general level. We can note that television documentaries have not killed the journey, quite the contrary. The frustration felt during the confinements following the Covid pandemic goes in the same direction. Why would the offer of the metaverse kill the desire for physical experience? Probably, there will always be humans magnetized by it. The beauty and wonder felt not only by the eye but by the five senses and the whole body are not soluble on the surface of a screen or in the thickness of a hologram. Today, it is estimated that in human decisions, emotion plays the first role before reason intervenes.

Even more immediate is the concern that one can have about a **narrowing of human preoccupations on the navel of the Earth.**

A recent evolution, relatively insidious, but perhaps very heavy of future consequences, seems to occur: the emphasis on the “planet Earth” considered as

not only the cradle of humanity, not only as the only livable environment within reach of man, but also, **as the only one worthy of our care and even of our interest.**

The planet, a notion that has entered into the common language to the point of overdose, is obviously a concept that owes everything to space exploration. The vision of the Earth by the Apollo VIII astronauts, as mentioned above, created a new paradigm. But what is striking, and what did not happen immediately, is that the very legitimate concern for this planet, which is too badly treated, sometimes seems to develop to the detriment of the interest for "everything else". That is, the cosmos.

Today, it seems that even in the field of knowledge, of which exploration is a part, criticisms are raised as soon as one does not demonstrate in a quasi-accountable way to what extent each activity will "serve the planet". Research projects are greatly weighed against this yardstick.

One can only agree with the absolute necessity of environmental action. But many more young people who are engaged in scientific studies already want to work in decarbonation technologies than in space "adventures", which fifty years ago were the height of the dream. **A certain feeling of collective guilt surrounds these choices;** and the space adventure does not enter very easily into the silent injunctions of this one.

These attitudes also convey a growing distrust of "technoscience" itself (it is a word with a negative connotation). Technological feats, reaching for the stars, no thank you, it's too far from my garden...? **Is there not a risk of a progressive narrowing of the field of vision?**

Tomorrow, America – which still seems quite far away from it – may well define as a "new frontier" or "manifest destiny" the reforestation of deserts. There would be nothing foolish about that. But then the dream of infinite travel would be gone...

This is a pessimistic vision, of course. The enthusiasm of young people towards space exploration is still there and well there. The success of recent missions has been mentioned above. Nevertheless the reserved attitude towards the rich tourists of the sub-orbital space has already something to do with this "priority to the planet" (whereas there are many other reasons not to be fascinated by them).

The cosmos is part of Nature, of course. The proximity with it, sought after (sometimes from afar) by the young generations, has no reason to exclude it, if we stick to logic. The cosmos acts on the Earth and on its environment, it cannot be dissociated from it... starting with the solar radiations which are responsible for the greenhouse effect. It remains to be seen what weight these considerations will have in relation to environmental priorities; these are not just budgetary priorities but cultural and ethical ones. On the other hand, it is necessary to consider that **space exploration is an extraordinary means of education, in support of science and technology.** The mistrust towards "technoscience", quoted above, has no real

reason to accompany the environmental concern as it seems to do it more and more, in an amalgam not very thoughtful. This is a crucial stake, which has always existed consciously but whose importance is greater than ever, of space exploration, the most mobilizing point of the space activity and perhaps, of the whole of science and technology. The reflection on this point – on what can be done beyond what already exists – would be to amplify.

Science has a double face: it is thanks to the separation that we have installed between nature and culture that our science has become so efficient and so conquering; but it is because of this same separation that nature, finally treated as if it were at our sole disposal, has gradually been damaged. We have marked it with an irreversible imprint, forgetting that it is porous, reactive, not infinite, fragile. Therefore, should we "liquidate the spirit of science for the sole reason of a bad use of the world", as more and more voices ask? (...) Rather than abandoning the idea of rationality, it seems more judicious to re-found it so that it can no longer be used as an alibi for all sorts of dominations.

For such is the paradox of the human being: if he alone is capable, through science, of discovering the laws known as "of nature", he is not for all that a being of antinature.

Etienne Klein

8. Political choices: exploration, exploitation, colonization

Mountaineering is exploration, but not exploitation. There are no plans to install settlers on the summit of Everest (despite the trivialization of expeditions, supervised, artificial, a sort of earthly premise to suborbital tourism!) Conversely, the history of the great explorations, of the great discoveries, shows that exploration is always followed by settlement... It would be interesting to study the differences between Magellan and the conquerors of Everest in greater depth, but that is not our purpose here.

This succession of exploration, exploitation, colonization, for space, is not self-evident. There is no absolute determinism in this announced evolution. The space exploration, with objectives above all, even only, scientific, could be limited to these, without for without withering away.

We have done neuroscience studies that conclude that 10% of the population has a brain that is more oriented towards exploration, 40% more towards exploitation, the pioneer character, and that the remaining 50% are more followers.

It is astonishing to see that when Magellan undertook his voyage (and even when his ship returned), everyone thought that it was a hopeless undertaking, that no one would do it again... And less than 50 years later, and then 200 years later, attempts were made to build human settlements in the Strait of Magellan. They were destroyed, and they finally succeeded only 300 years after the first expedition. The same thing is said today about the Moon: too far, too expensive, too hard... But the idea is never abandoned. You always have people, after an exploration, to attempt an installation.

Christian Clot

Implicitly, the vulgate of the “space conquest” conveys the idea of a continuum to come between exploration, exploitation and colonization. Literature is the first promoter of this idea. The general public communication of the space actors does not fight this idea, and even reinforces it. NASA's major Artemis program, for a return to the Moon, includes a strong logistical component that prepares for permanent settlement. This is one of the explicit objectives of the program (it is true that this does not prove anything).

As for private projects like Elon Musk's, the whole Space X enterprise is based on a narrative repeated over and over again, the climax of which consists of the colonization of Mars. However, this objective has no credibility in the time frame in which it is announced, neither technical nor economic. The same is true of many announcements and initiatives by start-ups largely financed by venture capital. It seems that investors do not believe in these distant projects (far away in space, supposedly close in time); but it does not matter because most of these investments are not aimed at a Martian “ROI” but, in a much more prosaic way, from a governmental origin, with Space X benefiting largely from public contracts

with a much shorter range. Thus, this narrative serves as a backdrop, which suits **everyone**. But it would be unfair and narrow to leave it at that. This form of hypocrisy is indeed accompanied by a **capacity to make people dream and act according to their dreams**, which, if it does not move Everest, is nevertheless capable of lifting a few mountains.

There is the SpaceX/Elon Musk vision, which is summed up by the motto "Making man a multi-planetary species."

This vision can easily be dismissed. It sounds like something out of a 1970s science fiction novel. Its components extend over centuries, their costs are unparalleled in human history, their feasibility is far from proven, but they have the advantage of providing a framework in which smaller projects can find their initial justification.

For example, the Starship (if you can call it a smaller-scale project), which is the backbone of the Mars vision, is under development; the launch facilities and activities in Boca Chica strike the imagination. Polar solar satellites, which could be the first step in a ground-based orbital industrial plan for the future, are receiving renewed interest in China and the United States and also with the SOLARIS initiative of ESA.

Philippe Berthe

In the discourse of Elon Musk and some transhumanists (note that Musk does not accept to be classified as a transhumanist), the idea that our planet, almost divinized by others, will soon be uninhabitable because of the bad treatment that man will have given it. **It is therefore vital to try to escape from it**. The proponents of this spectacular escape do not indicate how many humans could be saved in this way.

It is quite plausible to think that in a century we will have established colonies on Mars. What is less plausible is to think that this is a solution to the difficulties we face today on Earth. We can send a few dozen or a few hundred people to Mars, but this will not save the billions of people living on our planet. If, moreover, we want to preserve the genetic and cultural richness of humanity, a hundred individuals is not enough. This also raises ethical problems: who will be the chosen ones who will leave? What rules will be established in this type of colony? But let us not forget that escape is not a solution. In this sense, I agree with what was said at COP 21 by the Secretary of the United Nations and the President of CNES: there is no Planet B. We have to deal with the Earth, this planet A, and feel directly responsible for it, without neglecting space exploration. Humanity has the means to do both in a reasonable way.

Jacques Arnould, La tête dans les étoiles

In any case, it is a **headlong rush that should be denounced** as delirious and above all dangerous, in that it diverts the action from the only "solution" that is worthwhile, to conserve the earth's environment as well as possible and to adapt to its evolutions. Earthlings before being human... This remark does not imply in any way to give reason to those who, as it was evoked above, would like to turn away from the starry sky to look only at the Earth; the man must be able to do both. But to **dream of taking refuge on Mars when he will have finished trashing the Earth, is both a chimera and a fault**. By the way, in their mind, the resettlement on another planet of a fraction of humanity is also a social utopia, allowing to start

again from scratch, rid of the tares of a too worn-out terrestrial society; let's note that transhumanists and Musk are generally libertarians, fundamentally hostile to the intervention, even to the existence, of States (and of the notion of solidarity). Another subject where space exploration touches the foundations of our civilizations.

Moreover, the astronauts returning from the ISS all insist on the beauty and fragility of the Earth. They don't preach to get away from it. It is likely that tourists who would one day go to a lunar hotel would have the same conclusion.

In any case, **these utopias, or dystopias, largely forget the realities.** Space, including the planets and satellites of the solar system, is a very hostile environment. Life on Mars, imaginable for stays of limited duration, would be nightmarish if it were to be permanent and without return. To undertake a "geo-formation" of Mars to make it habitable, endowed with an atmosphere, etc., would be an absolutely titanic undertaking: Prometheus comes back to mind, with the hubris denounced by Greek wisdom. **Any Martian enterprise aiming at a permanent installation would require funding totally out of proportion** with what is spent today in space budgets. It is hard to see a political leader announcing that from now on, the installation of colonies on Mars will become the first budget item of the country. One hardly sees "the billionaires", despite their wealth and the "generosity" of their investments, capable of making one hundredth of it.

It is fundamental to keep present in all our reflections what it is possible to envisage and what is impossible to carry out, so much the decisions to be taken today in 2022 to envisage them seriously, for many, will be able to reach their objective only in several centuries at the most.

Let's take a particular example: making the planet Mars habitable.

- The global surface temperature would have to be increased by at least 60°.

- The mass of the atmosphere would have to be increased by at least a factor of 100.

- The ultraviolet radiation from the Sun on the surface as well as the flux of X-rays of cosmic origin, should be substantially reduced.

To implement such a desire in a time frame that would correspond to the completion of this work reasonably foreseeable in several centuries, it would be necessary to convince the governments of the various interested countries to introduce today in their budget considerable sums (that the current political priorities seem impossible to release) to be able to engage work that one estimates to see succeeding only in the shortest time in several centuries...

Roger-Maurice Bonnet

But the inanity of these projects does not negate the question of the **exploitation of extra-terrestrial resources** (such as asteroid ores, solar energy capture, etc.), either for space purposes (to install infrastructures), or, despite the currently prohibitive cost, to import them on Earth. Exploration thus becomes exploitation. Today, we note a profusion of these projects in the sometimes chimerical – but not always and not definitively – domain of New Space. It is impossible to predict today what will happen by the end of the 21st century in this field (as in the

others!). But the conceptual bases of the various possible ways exist today and are, by essence, of long duration. Between “Frontier”, avatars of cosmism, European values, Chinese and Indian self-affirmation, venture capitalists, transhumanism, but also environmental withdrawal, “virtualization”, global crises, etc., the parameters are not lacking. **It should be possible to clarify these ideas by attempting to map them. This would be an interesting action to undertake.** We can see that this mapping would not be universalist but country by country (or group of countries).

The exploration/exploitation/colonization triptych (which reflects the range of possible modes of interaction of humanity with its space environment) inevitably results in geopolitical spirals that can give rise to a diversity of scenarios:

Depending on the “targets” considered:

o The installation on the Moon can give rise to competition scenarios (competition for the choices of implantation – control of strategic points, lighting of zones, water resources, etc. – and logistics, competition on the exploitation models to be applied on the Moon) or of cooperation (possible tendency to unify the projects under the leadership of large organizing space powers with similar capacities).

o Mars is probably another case with different constraints (difficulties/constraints of the voyage, types of installation) and a greater importance given to the exploration phase, possibly leading to a symbolic competition but with perhaps less direct competition but the objective of being a pioneer

o Asteroids in relation to Martian facilities to access them in the very long term with economic objectives?

Depending on the actors considered:

o With states, which remain at the heart of the activity and lead to a form of transposition of the terrestrial geopolitical competition.

o With private actors who are asserting themselves, founding the hope of a real economic activity and leading to the introduction of the new variable of economic competition with, in the long run, a possible evolution of the law (legal nature of the establishments and companies created) and of the interest of the States.

Xavier Pasco

9. For a European way

In Europe, as elsewhere, exploration, especially manned exploration, arouses imagination and enthusiasm. We have seen how popular Thomas Pesquet's missions were. What would happen then with a European astronaut to the Moon!

Europe does not have, in its ideological material, either cosmism or manifest destiny (the latter, less than ever) **but it has its own values, from which it should build its strategy of space exploration**, since this one is linked, as we have seen many times in what precedes, to the ideological foundations of a civilization.

These values are those of the Charter of Fundamental Rights: dignity, freedom, equality, solidarity, citizenship and justice; it is our mythology, linked to humanism; **the European space quest is therefore necessarily a humanism** (which is not strictly the case for the others) ... what remains is to build a "narrative", or to use a less "communicative" word, to draw a perspective. We must ask the questions in order: **Who are we? Where do we want to go?**

The ethics of exploration, by definition, is not only European, the questions it raises concern all humanity. In any case, it leads us **to distinguish destinations and goals**. Going to the Moon is just a destination.

Now Europe, with the return of exploration to the forefront of the world strategic scene, is at a crossroads; it must choose what it wants: either a role as an occasional supplier, or that of a partner with a certain autonomy (such as that of sending its own astronauts, using its own system of access to space), or to remain outside... and if it is also a question of means, these choices are above all a matter of the idea that Europe makes, will make, of itself. "Let's cultivate a certain idea of Space as a decentering look at the world and the human condition," said Emmanuel Macron at the Space Summit in Toulouse in February 2022.

Staying "outside" of exploration, that is, "inside" planet Earth? One could indeed imagine that while others are exploring space, Europe, as it were, keeps the house and devotes itself to the protection of the planet, an action to which it is most sensitive. This brings us back to our previous considerations on the possible loss of interest in "what is not the Earth", a risk that is certainly more evident in Europe than elsewhere, but which one could imagine that Europe assumes in order to make it, on the contrary, a reason for being. However... We wondered above about the hypothesis of a leader who would declare the general colonization of Mars as a priority national cause; we can now wonder, conversely, what would be the future of a group of nations (and their leaders) **giving up on going beyond the "crystal sphere"** which, to use the Aristotelian image, envelops us; living, therefore, in another "sphere" than the other great nations of the world. Europe, stay-at-home mum on planet Earth, while Americans, Chinese and Indians roam the vast world? Who could live with that?

More likely and more positively, Europe can play its own part in exploration by developing its own capacities (to a certain extent in a context of cooperation) to put forward the values mentioned above, after having developed a vision that corresponds to it. The indispensable **concern to preserve the “territories” that we will explore, starting with the Moon**, by avoiding that its orbital space and its soil become garbage cans, or that possible remote biospheres be impacted by us, fits perfectly with the European approach, without of course summarizing it. Conversely, it is not difficult to establish that subsidizing in one way or another the sending of billionaires to the near-earth space cannot be a European perspective. This does not prevent others from doing it..

A quite “noble” action to undertake for an Academy would be to contribute to the reflection on this European vocation to write.

10. Conclusion

There is no conclusion to this tour d'horizon (of *chimerical horizons*, to quote the title of a book by Roger-Maurice Bonnet?). That would be too artificial and conventional. Let us simply reread, to finish, Saint-Exupéry in *Vol de nuit*:

“He thought of the small towns of the past that heard about the “Islands” and built themselves a ship. To load it with their hope. So that men could see their hope open its sails on the sea. All grown, all drawn out of themselves by a ship.”

What more beautiful existential roots for space exploration than the maritime adventure of yesteryear, via the pioneers of the Aéropostale?