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Humans in Outer Space – Interdisciplinary Perspectives

SpringerWienNewYork

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Prefaces

As a child, as a little boy I always dreamt to fly. I was lucky enough to be born in the century when my dream could come true. I even had an opportunity to fly to space for six months. I believe it is inherent in the human nature to look out into the unknown, to be inspired by the remote horizons, to reach out into the sky. I am sure that many of the European citizens are fit and qualified, and dream to fly to space – by far more than there are flight opportunities today. I am convinced that one day it will change. I am looking forward to that day.

Europe has always been a society of explorers and visionaries. Columbus (whose name is given to the European space laboratory), Magellan, Marco Polo – just to name a few – with their life and work made a profound positive difference in the history of the whole world. I have always been proud of being a European and being connected to this heritage of exploration.

It was a particular honour for me to represent Europe as the first European commander of the International Space Station, today's only exploration outpost in space. It is also an honour and an achievement of the European Astronaut Corps and of the European Space Agency. It clearly shows what we can accomplish together as Europeans. It symbolises the success of the International Space Station in which all partners play an important role. Like Europe, the ISS is a true example of what humans can achieve when they decide to work together for a common goal leaving aside their differences.

Today we continue human exploration of outer space in order to push the frontiers of our knowledge and capability. In the 15th century Columbus travelled to the unknown destinations. While his voyages and discoveries barely had an impact on his contemporaries, they have shaped the world as we know it today. I am convinced that we owe it to the future generation, to the life on Earth to have a vision, which will take us to *Mundus Novus* that today lies outside of the boundaries of our planet.

With the words of Carl Sagan

“In a cosmic perspective, most human concerns look insignificant, even petty. And yet our species is young and curious and brave and show much promise. In the last few millennia we have made the most astonishing and unexpected discoveries about the Cosmos and our place within it, explorations that are exhilarating to consider. They remind us that humans have evolved to wonder, that understanding is a joy, that knowledge is prerequisite to survival. I believe our future depends on how well we know this Cosmos in which we float like a mote of dust in the morning sky.”

I strongly believe that a society that stops exploring is a society that stops progressing. Therefore, I hope that Europe also in the future will continue to explore and take up more and more responsibilities in space exploration. European ships and sailors sailed all the oceans of our planet. I hope to see European manned spaceships travel to the ISS and beyond.

As a child I had dreams and my dreams came true. I hope that tomorrow all children in Europe can have equal opportunities to realise their dreams, whatever they are, including an opportunity to travel to places far away from their continent, into the unknown of the universe. And I still dream of a world society continuing to explore, continuing to progress, by humanity and for humanity. This book gives the perspectives to realise that dream!

Frank De Winne
International Space Station Expedition XXI Commander
European Space Agency Astronaut

Interdisciplinarity, multidisciplinary and transdisciplinarity are key notions in present-day research. It is practically impossible to envisage research that does not penetrate into new disciplines or does not cover more than one domain of science. The volume at hand goes beyond the traditional notions of interdisciplinarity by bringing together worlds which at first glance seem to be aeons apart. The contribution of the humanities and social sciences to space research opens up, without a doubt, new vistas of understanding of the Future, but also of the Present. The Future – in the sense of projecting possible ways of how humans will live in totally different environments than those that we are used to here on Earth. The Present – in the sense that through the process of conceptualising Future life in the universe, we in fact project a “mirror image” of humans and human behaviour on Earth. Both perspectives touch upon a multitude of issues, ranging from ethical to environmental, from aesthetic to scientific, from individual to global and in this case beyond global.

The papers assembled in this volume present a building block for future developments and approaches that the humanities and social sciences will provide for a better and a more thorough understanding of humans in their present context, but also for envisaging humans in their future contexts and environments.

The volume provides a “variation on the theme of dichotomy”, and diversity. It builds upon a conference which was held at sea level and ended “on the Moon”, or almost, i.e. in the isolated environment of the Roque de Los Muchachos astronomical Observatory, above the clouds, and above several layers of various vegetations characteristic of the island of La Palma in Spain.

As indicated, this book clearly illustrates that human space exploration is far more than simply technologies and (pure) science. The headings of the three parts encompass the very broad variety of topics that made the La Palma meeting lively and intellectually interesting: education, ethics, religion, history, aesthetics, governance, security even clothing and music, just to name a few, are subjects that scientists or engineers would not necessarily think of when considering manned spaceflight. Through our joint efforts, we paved the way for mutual assessment and analysis: interdisciplinarity, multidisciplinary and transdisciplinary at its best, and beyond traditional notions.

Milena Zic-Fuchs
Chair of the Standing Committee for the Humanities
European Science Foundation

Jean-Pierre Swings
Chairman European Space Science Committee of the European Science Foundation

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Introduction: from “odysseys” to “perspectives” – towards new interdisciplinary approaches to humans in outer space

Ulrike Landfester, Nina-Louisa Remuss, Kai-Uwe Schrogl
and Jean-Claude Worms

This book is being published at a time when the subject of human space exploration appears to become very popular again. Most space-faring countries seem to agree on targets to reach (with robotic missions) in the solar system and in May 2007, 14 space agencies even agreed to a “Global Exploration Strategy” document,¹ delineating various options for the exploration of the solar system. In the USA, even though currently there is some uncertainty regarding the fate of the “Moon option”, President Obama has committed his administration to continued exploration of the solar system with the goal of sending humans to Mars in the longer-term, and ambitious robotic missions to be implemented in the years to come through reinforced international cooperation. In Europe, most scientists believe that the – limited means of the continent should be directed towards strong participation in an international endeavour to explore the planet Mars, even though no one rules out the possibility of, or the interest in, returning to the Moon with strategic contributions from Europe’s industrial base. European nations do not agree in full on the first steps (i.e. Moon or Mars) but there seems to be consensus that, beyond the application programmes Galileo and GMES, space exploration of targets that can ultimately be reached by humans could become one of Europe’s next “Grand Challenges”. What then of the human factor? Should it be a mere cog in the intricate gears of future missions or does it possess an intrinsic value? Should we leave the exploration of the solar system to robots or can *homo sapiens planetaris* bring added value to the adventure? This is what the European Science Foundation (ESF) and the European Space Policy Institute (ESPI) decided to explore through a series of events that culminated in a conference held on 2–3 April 2009 in La Palma, Canary Islands. This book is the result of the discussions that stemmed from this conference.

Humans in outer space – interdisciplinary odysseys

In 2006 the European Science Foundation (ESF) set out to organise the first trans-disciplinary comprehensive dialogue on humans in outer space. This dialogue goes further than regarding humans as better-than-robot tools for exploration. It investigates the human quest for odysseys beyond Earth’s atmosphere and reflects on the implications of possibly finding extraterrestrial life. The inherent human curiosity for exploring the unknown is at the heart of this dialogue, which was addressed through collaboration between the ESF Standing Committee for the Humanities (SCH) and the ESF European Space Sciences Committee (ESSC), in cooperation with the European Space Agency (ESA) and the European Space Policy Institute in Vienna. From the ESF’s perspective, the idea of involving humanities and social sciences in that debate was strengthened after completing the “Athens Declaration”² in May 2007, which was commissioned by ESA to ESF to establish a scientific framework for defining Europe’s exploration programme.

A challenge was to bring together scholars who usually have few reasons to meet in scientific forums, and exchange views in a non-traditional fashion. Non-traditional because, beyond the technical aspects linked to human presence in space that have been studied by space scientists and engineers for the last five decades, humans in space pose challenges that go much further than the ability to survive. In March 2007, an ESF strategic workshop was therefore organised at the University of Genoa entitled “Humans in Space”, addressing some of the issues identified above. The central theme was the role and situation of humans in orbit around the Earth, their place in exploration, and the search for life in the universe. Should humans explore space? Do the (cultural and economic) drivers for exploration require human participation? What are the human abilities and reasons to adapt to such extreme conditions as presented by the space environment beyond Earth? Are there scientific grounds that should lead humans to be prepared for the ethical and societal consequences of a possible encounter with extraterrestrial life? The interaction resulting from this workshop paved the way for a conference on Humans in Outer Space (HIOS), held on 11–12 October 2007 in Vienna, locally organised by ESPI with support from the Austrian Ministry for Transport, Innovation and Technology (BMVIT) and the financial support of the European Space Agency (ESA). Scholars from various disciplines and backgrounds, including history, cultural and religious studies, the arts, anthropology, policy, law, ethics and economics, but also space sciences and technology, presented their views. This conference resulted in a continued and further strengthening of the interdisciplinary European dialogue about human exploration of the Moon and ultimately Mars, with a particular emphasis on the human element.



Fig. 1. *Speakers at the conference on Humans in Outer Space (HIOS), held on 11–12 October 2007 in Vienna (source: ESPI).*

The presentations and discussions were structured around three “Odysseys” of humans leaving the Earth. The first odyssey dealt with humans in Earth’s orbit and their effects on mankind. It addressed (i) the need to protect the Earth from natural and man-made threats and the role that humans in space can play in this context as “citizens of the planet Earth”; (ii) human space flight as a major source of scientific and technological innovation and improved international cooperation; (iii) the relationship between humans and machines, and the subsequent potential readjustment of our notion of “humanity”; (iv) the legal framework for peaceful space activities. The second odyssey tackled the effects that humans exploring the solar system will have on our societies and culture, starting with the rationale for sending humans out there, pursuing global cooperative endeavours in science, technology, search for resources, and cultural curiosity. The specific European cultural approach towards both scientific and moral issues was felt to be important in that endeavour. A key issue here is planetary protection that needs to be elaborated with international partners. Finally, the third odyssey discussed the last step: humans migrating off the Earth and the impact that this will have on human thought and culture. More exotic topics were thus discussed, such as: the search for settlements outside our planet and the first children to be born in space; the idea of possible encounters with other forms of life in outer space, either through the discovery of life in the solar system (extinct or extant) or through the reception of

extraterrestrial radio signals, and whether this would cause the development of a new collective identity for humanity; how people’s beliefs could change in the context of new living environments and in contact with other forms of life and societies, thus increasing the importance of the humanities and the social sciences; and finally, the adaptability of humans to new encounters was examined in the light of past encounters that took place on Earth, showing that human beings did eventually adapt to unforeseeable realities, although often at very great costs. While the first effects of an encounter between humans and extraterrestrial life are unpredictable, humans need to be aware that they will be held morally, economically and politically accountable for their choices.

The conference thus provided a unique European perspective by identifying various needs and interests of the humanities and social sciences that are linked with space exploration. The conference, which yielded the so-called “Vienna Vision on Humans in Outer Space”, was a success not only on a scholarly level through discussions with colleagues in other disciplines with whom regular interaction is indeed not obvious, but also in demonstrating the necessity of productive contribution of humanities and social science disciplines in understanding the universe in which we live, or will live in the future. The proceedings from this conference were published by Springer in 2009³ and led the ESF to publish a science position paper to guide future prospective reflexion and activities.⁴

Humans in outer space – from odysseys to perspectives

While the Genoa workshop and Vienna conference attendants were invited by ESF through its SCH and ESSC committees, the large interest in various communities triggered by these events led the ESF to launch in March 2008 a Call for Expressions of Interest open to researchers and scholars based in Europe, in order to identify key challenging topics from any discipline in this area and investigate the best ways to explore them. This consultation process was meant to provide ESF with the views of the European scientific community on these issues, to be synthesised in order to identify key topics of interest to be developed at the European level.

Twenty-one replies were selected out of 51 by the HIOS Steering Committee chaired by Luca Codignola, and their authors were invited to the April 2009 La Palma conference chaired by Ulrike Landfester. One topic recognised by ESF and ESA as interesting for further cross-disciplinary collaboration is the human impact

of human spaceflight. Human spaceflight is a major endeavour that brings together many scientific and technical disciplines. Up to now, the emphasis in this context has mostly been on engineering, and physical and life sciences aspects, where major achievements have been made. However, with Europe preparing itself to make a decision on its ambition for future human spaceflight to further destinations other than a low orbit around the Earth, it becomes timely to also address the human and social aspects of having “some of us out there”. The Vienna Vision on Humans in Outer Space already clearly indicated that this was a very interesting field to explore. Europe could take the lead in bringing this a step closer and provide a social sciences and humanities-based framework for decisions and events that are expected to happen in the next decades in such areas as:

- Psychology of isolation
- Ethical aspects of human spaceflight
- Socio-economic costs and benefits
- Space law
- Religious implications of leaving Earth
- Administrative and social structures in Lunar or Martian settlements
- Finding non-terrestrial life forms: social, psychological, religious implications
- Artistic expression as a means to share the human exploration experience



Fig. 2. *Speakers at the La Palma Conference (source: ESF).*

The programme of the La Palma conference was structured around the selected expressions of interest under five main themes: enlarging the horizon (cognitive sciences, culture and media); Philosophy, ethics and religious beliefs; Culture and society (arts, fashion, aesthetics); Space and education (school curricula, education, communication and outreach); and, Defining a legal, ethical, political and social framework (rights, governance, law, peaceful use of outer space, human impact on planetary bodies). The presentations at the conference attempted to go from the descriptive odysseys featured at the Vienna conference to a more perspective-based approach, defining aims, enabling science and stepping-stones. The broad discussion that ensued was summarised in a conclusion session, during which participants agreed to have proceedings published as a second “Humans in Outer Space” book.

Humans in outer space – interdisciplinary perspectives

The present book provides “Perspectives” related to governance, management of space exploration, space settlements, the role of astronauts in the future as well as possible encounters with extraterrestrial life. It is a source of insights and arguments for all who have a stake in human space activities. It is structured in three parts, covering the three main interdisciplinary perspectives dealt with in this volume.

The first section, Part I: Politics and Society, discusses the political context of human space exploration, trying to answer questions of ownership and governance as well as management and organisation as elaborated upon by Kai-Uwe Schrogl, Kurt Mills and Martin Parker, respectively. Nina-Louisa Remuss enumerates three scenarios for the potential role of astronauts in space security considerations and Adrian Belu highlights the search for habitable exo-planets as a global task. This section also deals with space-settlements and the encounter with extraterrestrial life. Alan D. Britton sketches out a school curriculum for the children of space settlers, who have never known life on Earth, while Charles Cockell answers ethical questions related to microscopic extraterrestrial life. Michael T. Schetsche provides some exo-sociological considerations in encountering extraterrestrial life while Philippe Ailleris discusses encounters of extraterrestrial life on Earth in the form of UFOs and exogenous intelligence.

The second part, Part II: History and Religion, considers human space exploration from an historic or religious point of view. David Dunér outlines his concept of Astrocognition while the Jesuit Gustav Schörghofer describes his

intentions behind the “Jesuitenkosmos” (“Cosmos of the Jesuits” in English), a reproduction of a International Space Station (ISS) photograph, which was spanned all over the nave of the Jesuit Church in Vienna. Thomas Brandstetter in turn discusses the history of terrestrial biology.

The third and final part of this volume, Part III: Culture and Psychology, deals with the influence of aesthetics on Earth and the shaping of an outer space aesthetics, discussing music as a means of communication in outer space, highlighting the question of clothing and fashion in the context of space travellers and space tourism, outlining the expectations of the next generation regarding contributions of humans in outer space to problem-solving on Earth and, finally, treating psychological, existential, social and ethical issues for crew members on long-term space missions beyond the Earth orbit. Ulrike Landfester, Anna Piotrowska, Christopher Mark Timmins, Agnieszka Lukaszcyk and Berna van Baarsen have contributed to this final section.

Humans in outer space – moving beyond

The case for a prospective activity supervised by the ESF was advocated and discussed at the end of the conference held in La Palma. ESF manages an instrument dealing with prospective actions called Forward Looks. It was therefore decided to prepare a corresponding proposal for the ESF Science Advisory Board and Governing Council. Recently the ESF Standing Committee for Social Sciences (SCSS) decided to take part in the reflexion concerning this proposal and to contribute to it. Dubbed “SpaceRoad”, this Forward Look proposal concept includes such topics as:

- Socio-economic costs and benefits vs. philosophical and ethical aspects of human spaceflight: is it legitimate to support exploration or should we only take care of “down-to-Earth” problems?
- Man *or* Machine, or Man *and* Machine?
- Isolation: can we cope with the psychological and intellectual challenges facing the first crews to reach the planet Mars and the first isolated settlements on the Moon, Mars or the asteroids?
- Past examples: can we use historical and social sciences knowledge to infer future behaviour connected to human exploration of the solar system?
- Space law, already a fairly active field: do we need new paradigms to address the legal and administrative challenges of administrative and social structures in lunar or Martian settlements?

- Philosophy, psychology and religion: what are the implications for secular and religious structures and institutions of (a) leaving the Earth; (b) finding non-terrestrial life forms, whether primitive in the solar system (Mars, Titan, Europa . . .) or civilised in the Universe (hints of existence by radio contact, e.g. the SETI programme)?
- “Supra-globalisation”: could the existence of colonies outside the Earth change the nature of international relations and the very perception that the human race has of itself? How can this process be guided?
- Arts: artistic expression as a means to share the human exploration experience.

Overall, humanities and social sciences questions relating to what will confront society if humans start to move and settle outside the Earth could be explored by such a foresight exercise. One goal then is to define a research “roadmap”, identifying the various disciplines concerned, linking the scholars in these disciplines and allowing them to share their experience in support of this challenging activity and coordinate their research in the future. The initial discussions and exchanges that took place during the Genoa, Vienna and La Palma meetings clearly indicate that these are highly interesting fields to explore. Europe could thus take the lead in bringing this a step further and providing a humanities and social sciences-based framework (in addition to a scientific one) for decisions and events that are expected to happen in the next decades in solar system exploration by humans.

Many questions need to be addressed during such a prospective discussion, such as: why do we (want to) explore other worlds? Should/can we live elsewhere? How much do we need Earth? Can we settle on other bodies without local disruption? Will settlements diverge from mankind? Will that help mankind? Will state/planet-wide institutions be able to provide a legal framework beyond Low-Earth orbit or will it be the Wild West or Columbian Exchange once again? Can the search for life and extraterrestrial intelligence ever be more than “voices from the past”? Can/should we prepare for encounters? Can/should we meet? Will we be allowed to if we are less advanced? If we do, what happens to society? What will it teach us about being humans? Can decade- or century-long projects be sustained in our societies and, if so, through which mechanisms? What can this “cosmic perspective” tell humankind about itself? These are highly challenging questions that will require an appropriate structure for this foresight reflexion, and adequate participation from various sectors of academia, but also representatives from space agencies and related institutions, policy makers and, most probably, from the public itself.

The core of this activity will take place during strategic thematic workshops that will be structured around overarching questions based on the above. A general



Fig. 3. Astronauts, cosmonauts and space experts from Canada, Europe, Japan, Russia, and the United States of America met at ESPI on 27 May 2010 to find common rationales and future perspectives for human spaceflight based on the respective cultural backgrounds of their countries and regions (Participants of the workshop (from left): Sergey Avdeev, Mamoru Mobri, Jean-Marc Comtois, Gerhard Thiele, Spyros Pagkratis, Jean-Francois Clervoy, Jeff Hoffman and Takao Doi) (source: ESPI).

conference will then gather the participants of the individual workshops. The conclusions of these workshops and conference will be debated and integrated during a consensus conference. If accepted by the ESF governance, this SCH-SCSS-ESSC Forward Look could start in November 2010. This activity is foreseen for the 2010–2012 timeframe.

Within ESPI the topic of humans in outer space has also been developing further. In May a meeting of astronauts and cosmonauts from Europe, the U.S., Russia and Japan took place at ESPI, where the various cultural approaches to human spaceflight and the lessons to be drawn for the public and political debate were investigated.⁵

In this context, this book is a timely contribution towards providing foundations, inputs and introductions to the debate on humans in outer space. It is a voyage that has taken up speed. Trans-disciplinary promotion will certainly support and shape political decision-making. In 2011, the fiftieth anniversary of Yuri Gagarin’s spaceflight is celebrated. This should certainly be regarded as another stimulus to think ahead.

¹The Global Exploration Strategy: the framework for coordination, published jointly by ASI, BNSC, CNES, CNSA, CSA, CSIRO, DLR, ESA, ISRO, JAXA, KARI, NASA, NSAU, ROSKOSMOS, May 2007.

²Worms J. C. et al. “ESSC-ESF Position Paper – Science-Driven Scenario for Space Exploration: Report from the European Space Sciences Committee (ESSC).” *Astrobiology* 9 (2009): 23–41.

³Codignola Luca and Kai-Uwe Schrogl, eds. *Humans in Outer Space – Interdisciplinary Odysseys*. Vienna: SpringerWienNewYork, 2009. The “Vienna Vision on Humans in Outer Space” is contained in the Annex to this Volume.

⁴European Science Foundation. “Humans in Outer Space – Interdisciplinary Odysseys, SCH-ESSC Position Paper”. Strasbourg: ESF, 2008.

⁵See “Astronauts join at ESPI to discuss cultural backgrounds of human spaceflight.” 27 May 2010. European Space Policy Institute. 25 Jun. 2010. http://www.espi.or.at/index.php?option=com_content&view=article&id=499:27-may-2010-astronauts-join-at-espi-to-discuss-cultural-backgrounds-of-human-spaceflight&catid=39:news-archive&Itemid=37.