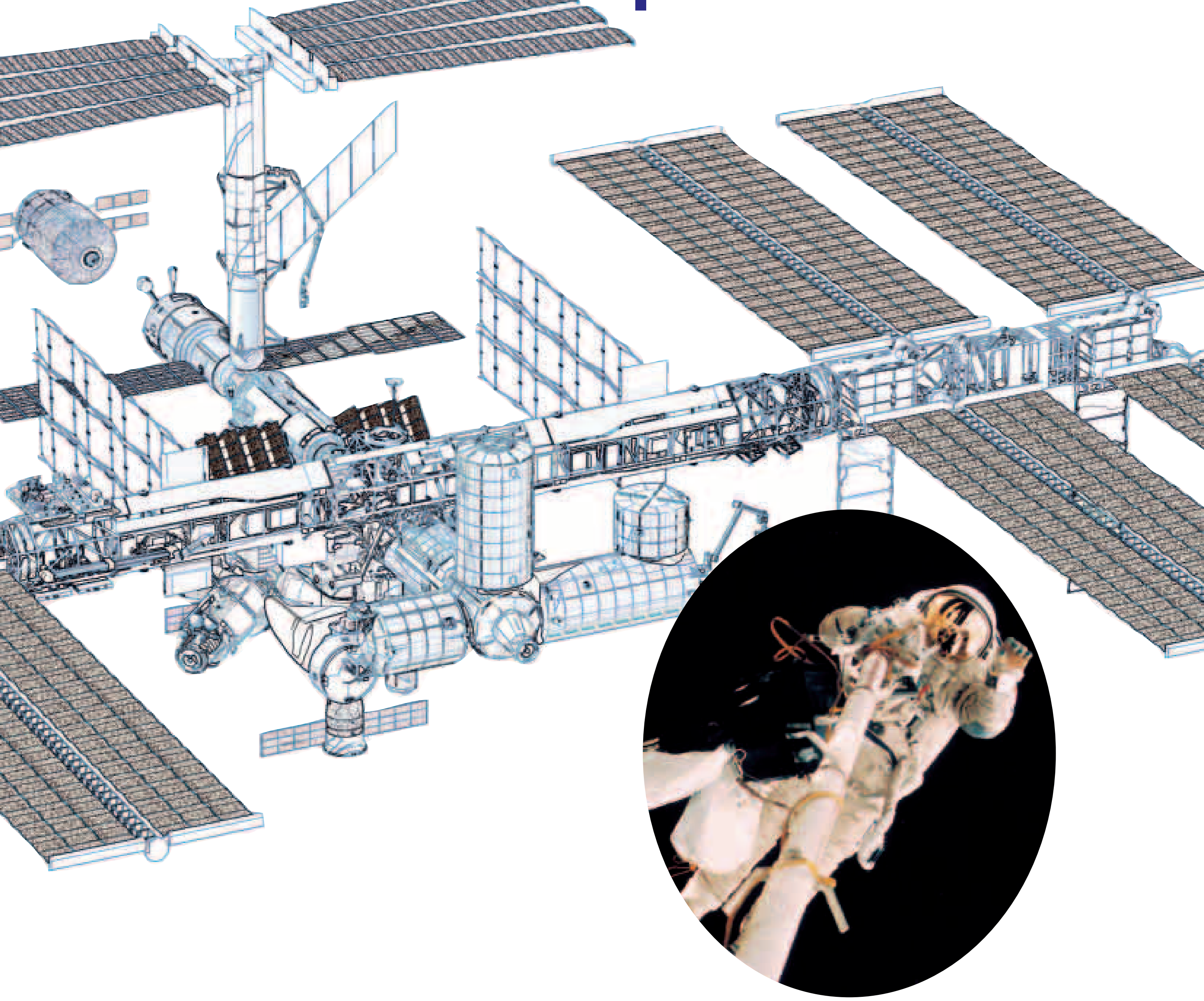
BR-221

A Case for Humans in Space

The European Astronauts



European Space Agency
Agence spatiale européenne

Directorate of Manned Spaceflight and Microgravity
Direction des Vols Habités et de la Microgravité

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Human Spaceflight
SPACE FOR LIFE

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Foreword

European astronauts from ESA Member States have been going into space since 1978, when Sigmund Jähn made his first flight on board a Russian spacecraft. Since then, 38 spaceflights with 31 astronauts from nine different ESA Member States have been successfully performed. Whilst these missions had been prepared and realised by ESA and several national astronauts groups within our Member States, the ESA Council decided in 1998 to concentrate all astronaut activities within a single European Astronaut Corps.

Since the formation of this single European Astronaut Corps, I have had several opportunities to talk with our astronauts about their views on human space exploration and to realise the variety and wealth of their different missions and experiences. I have asked them about their personal experiences during their space missions, their visions and dreams, and the potential they see for human space exploration in the future.

Encouraged and impressed by these answers, which in their remarkable variety reflect the broad diversity of the European Astronaut Corps, I have asked our astronauts to share with you, the reader of this brochure, their personal views on why humans have ventured and should continue to go into space.

It is my hope that you find the answers as fascinating and enlightening as I do.

Jörg Feustel-Büechl
Director of Human Spaceflight

Space has always been a source of inspiration: it offers a unique view of our planet which each one of us would like to experience in person; it opens the way to interplanetary exploration, bringing advances in our knowledge of the Universe and its history, and remains the backdrop against which an astonishingly successful human and technological adventure has been played out. It forms a major part of France's national research and innovation policy, and as such, is of strategic importance. It affects all areas of business activity and many aspects of the lives of our fellow European citizens.

It also has its uses as an essential component of services which are enjoyed by all and which nowadays are virtually taken for granted: television and satellite communications, weather forecasting, global positioning on land, in the air and on the seas, and satellite images with a field of view and resolution able either to embrace a whole continent or pinpoint details on a building.

For more than 20 years, France and Europe have been investing in space research through human spaceflight. Like any cutting-edge sector, human spaceflight carries with it great hopes and holds great potential for progress. Currently, as we prepare to enter a major new phase in the history of human space endeavour, international cooperation is being strengthened as we seek to satisfy ever more that thirst for exploration that has always driven humankind.

Today, new opportunities are opening up. ESA, with its AURORA project, is rising to the challenge to take us on to the next episodes in the great adventure which still lies ahead: travelling to the Moon and then on to Mars. The global space community is preparing for action. Some of its members are seeking to achieve their ambitions quickly. But the sheer scale of what remains to be explored makes cooperation at a global level essential. Europe has no choice but to pull together. That must be our priority, for in space, there can be no national policy without a European policy, and there can be no European policy without alliances with key partners having substantial expertise in space.

It is in response to these imperatives that France is providing support for ESA's European Astronaut Corps, of which I myself was fortunate to be a member. I feel certain that, together, they will carry the European banner high in pursuit of the new endeavours that lie ahead.

Claudie Haigneré,
French Minister for Research and New Technologies

In their recently endorsed Charta, the European Astronaut Corps presented their vision, mission and values (see page 36). One of the five values mentioned was given the Latin word Audacia ("audacity") and explained as follows: "We acknowledge that spaceflight is a dangerous endeavour. While accepting the risks inherently involved in space travel, we work to minimise these risks whenever we can. Audacia reminds us that the rewards will be unparalleled if we succeed."

Indeed, even well-controlled risk does not mean that we can or should try to totally exclude risk.

It is remarkable that a major asset of human space exploration is the high degree of personal identification of the public with the crews and their lives. Risks and sacrifices are inherent features of such endeavours. Today, with all our capabilities to store data and use knowledge-bases as well as to perform complex computer calculations and simulations that make some people believe risk can be accurately computed, there is a danger that we become averse to risk. We may aim at perfection, but it cannot be a reality. If we accept nothing but success, we will stop taking chances and our accomplishments will diminish. Thus, in this never-perfect world, the astronauts must often take over the responsibility for exploring some of the more hazardous routes – after all, hazards are an inherent part of exploration and it is our astronauts who ultimately have to accept this challenge.

Ernst Messerschmid,
Head of the European Astronaut Centre
European Astronaut

Human spaceflight in Europe is a truly unique enterprise. ESA prepares and conducts space missions in close cooperation with the two main space agencies: the American NASA and the Russian RSA. Our ability to go to space is based on our long and successful partnership with both the USA and Russia. ESA is the only space agency to have such a well-balanced cooperation with these two agencies, which is also reflected in the almost equal numbers of spaceflights performed: 19 missions within NASA programmes and 18 flights using Russian space vehicles.

Our European Astronaut Corps has gained a rich experience with this cooperation. The ESA Astronauts have accomplished a wide variety of complex tasks in space. They have participated as payload specialists, research cosmonauts, mission specialists and flight engineers, they have performed operational tasks such as robotics, EVAs, deployment and repair of satellites, as well as gained experience in long-duration missions.

We might point out that our experience in performing those difficult tasks, together with our history of shared activities between American and Russian partners, is truly exceptional. ESA has become a reference for spaceflights in cooperation.

Today, we are all united in the construction of a unique space test platform, the ISS. The task is a rather difficult one, but we are proud to be part of this program with our European hardware: Columbus and ATV are to be launched in the near future.

The ISS will be the best place to test new space technologies for our future exploration of space. The next step is an expedition back to the Moon and then to Mars. Today, this quest is very challenging both for technical and financial reasons. On the scale of a trip to Mars, our research on ISS is an affordable way to find solutions to problems which might be encountered on such a complex voyage. Now is the time for ESA to use this experience to establish its own priorities for future human spaceflight projects.

Michel Tognini,
Head of the Astronauts Division
European Astronaut

Passion, Motivation and Perseverance

Jean-François Clervoy
Member of the European Astronaut Corps
ESA / EAC, Cologne, Germany

A significant but less easily quantifiable benefit from human space exploration is education. The dream force carried by the human presence in space catches the imagination of the young and brings an encouraging example of passion, motivation and perseverance. It influences the choice of school students to take up scientific or technological studies.

Why does space exploration make people dream? Because of two main factors: Space is still full of things to be discovered and the technical challenge to master space travel remains a strong source of pride because it is hard. When the crew members succeed in their mission's critical tasks – such as docking to and resupplying the Russian space station Mir, capturing and repairing the Hubble Space Telescope, operating complex scientific experiments – their emotions and pride are intense, their belief to serve humankind by

Where robots can help humans to limit risks and costs, they should be used – always as a pathfinder or accompanying support. The Hubble Space Telescope's scientific return is universally recognised. Its modular concept allows the regular replacement of scientific and technical equipment by more recent technology parts, either for repair or improvement. However, it is unthinkable to design an entirely automated servicing mission. This was demonstrated during the last mission where each space walk lasted more than 8 hours instead of the planned 6, due to multiple unforeseen problems that no robot could have mitigated. Today's space explorers are like the first aviators whose motivations were not understood by all, and who, through their perseverance, allowed aviation to take an exponential rise. Imagine: every second, a transport aircraft takes off somewhere in the world. The question should not be "Human or robot?" but "Which type of robot to precede humans, and which type of robot to accompany humans?"

contributing to the progress of science is strong, their sense of achievement vivid. From the very beginning of humankind we have explored our environment because our conservation instinct tells us that it maximises our chance of survival. We explore to increase our knowledge for the benefit of all.

“Spaceflight provides a mixture of strong emotions, enormous pride and heavy responsibility. They must be passed on to future generations.”

“Space exploration is not only about science, it is part of our human destiny.”

Jean-François Clervoy

Born 19 November 1958 in Longeville-les-Metz, France.

Education
Received his baccalauréat from Collège Militaire de Saint Cyr l'Ecole in 1976; passed Math. Sup. and Math. Spé. M' at Prytanée Militaire, La Flèche in 1978. Graduated from Ecole Polytechnique, Paris, in 1981; graduated from Ecole Nationale Supérieure de l'Aéronautique et de l'Espace, Toulouse, in 1983; graduated as a Flight Test Engineer from Ecole du Personnel Navigant d' Essais et de Réception, Istres, in 1987. Clervoy is Ingénieur Général de l’Armement (French Defense management).

Spaceflight Experience
STS-66 (3 - 14 November 1994) – the Atmospheric Laboratory for Applications and Science-3 (ATLAS-3) mission was part of an ongoing programme to determine the Earth's energy balance and atmospheric change over an eleven-year solar cycle. Jean-François used the robotic arm to deploy the CRISTA-SPAS atmospheric research satellite 20 hours after lift-off, and logged 262 hours and 34 minutes in space, orbiting the Earth 175 times.

STS-84 (15 - 24 May 1997) was NASA's sixth Shuttle mission to rendezvous and dock with the Russian Space Station, Mir. As payload commander, Jean-François’ primary tasks were the coordination of the execution of more than 20 experiments, the operation of the docking system and the Spacelab double module, and the transfer of 4 tonnes of equipment between Atlantis and Mir. He was also trained as a contingency spacewalker on this mission. STS-84 was accomplished in 144 Earth orbits and 221 hours and 20 minutes.

STS-103 (19 - 27 December 1999) was an 8-day mission. The primary objective was the repair and servicing of the Hubble Space Telescope (HST), including the replacement of the six gyroscopes, which are necessary to meet the telescope’s very precise pointing requirements. Jean-François was the flight engineer for ascent, entry and rendezvous. He used the robot arm to capture and deploy the telescope, and to manoeuvre the suited astronauts during three 8-hour spacewalks. STS-103 was accomplished in 120 Earth orbits and 191 hours and 11 minutes.

Current Assignment
Jean-François Clervoy is a member of ESA’s European Astronaut Corps. He is currently seconded to the ATV (Automated Transfer Vehicle) ESA project as Senior Advisor Astronaut in Les Mureaux, France.

Operational Expertise and Investment

Frank De Winne
Member of the European Astronaut Corps
ESA / EAC, Cologne, Germany

The European Astronaut Corps: a symbol of European identity.

Coming from an operational background, I would like to focus on the particular need of "operational expertise". In the fifties and sixties, the space budgets of the space-faring nations were almost unlimited and dreamers and explorers shaped the conquest of space. These dreams have given way to reality. Nowadays, space exploration is dictated by accounts and budgets. But space is more than just short-term investment in technology and research. People are not only scientists or engineers; they are also poets, dreamers, explorers and adventurers. In the past, these explorers and adventurers have discovered and opened new frontiers. Humankind has conquered the land, the oceans and the sky, and finally we have made our first steps in space. We will always try to go beyond the next horizon, to explore the unknown; it is in our genes. Every time we have done so, the long-term results have proved to be beneficial. Every day, we travel safely on the seas and in the air. Now the time has come for humankind to take the next logical step: the establishment of a civilisation that routinely ventures out into space. Despite budget difficulties and dramatic setbacks as the loss of the space shuttle Columbia, we now have established a permanent human presence in space with the ISS. It is imperative that we continue to invest wisely. In the past, Europe has done this and has acquired independent unmanned access to space. However, if it wants to be a major player in further space exploration and in establishing day-to-day space travel, it will also have to establish a capability in human access to space. This will require the further development of new technologies but also the establishment of solid operational expertise. In my past career as a military pilot I have participated in several operations. Although technology has always played a big part in the success, the biggest contributors to it were without any

Harnessing the skills of all Europeans will boost the feeling of a common European destiny and enhance European culture, values and norms.

On the ISS during the "Odissea" mission.

doubt the people (ground crew and aviators alike) who participated in the operations. Their motivation, resourcefulness and inventiveness to solve problems, their ability to adapt quickly to ever-changing situations and their capacity to work as a team made all the difference. These capabilities were acquired through many years of training and investment in operational skills. Having flown to the International Space Station and worked in support of other missions in the Russian control centre, I find much resemblance to this. The years of investing in training, operation centres, procedures and human spaceflight operations are really paying off. The role of Europe in manned spaceflight will depend greatly on the quality of its operators and on the will to invest in people as well as in technology. Therefore it is absolutely necessary, as we move towards more operational capabilities by developing additional hardware, that Europe also continues to invest in human operational expertise and learns to operate spaceships from launch till landing. The first steps into space have already been taken. The road ahead is open. All Europe really needs is to be willing to travel.

Frank De Winne

Born 25 April 1961 in Ghent, Belgium.

Education

Frank De Winne graduated from the Royal School of Cadets, Lier, in 1979. He received a Masters Degree in telecommunications and civil engineering from the Royal Military Academy, Brussels, in 1984. Awarded the Price of the AIA for the best thesis. In 1991, he completed the Staff Course at the Defence College in Brussels with the highest distinction. In 1992, he graduated from the Empire Test Pilots School (ETPS) in Boscombe Down, England.

Spaceflight Experience

From 30 October – 10 November, 2002 De Winne participated in the "Odissea" mission, a support flight to the International Space Station. He served as flight engineer on the newly designed Soyuz TMA spacecraft during ascent, and on Soyuz TM during reentry.

A prime task of the 11-day mission was the replacement of the TM-34 Soyuz vehicle attached to the Space Station with the new TMA-1 spacecraft, in order to deliver a fresh "lifeboat" for the resident crew to be used in case of an emergency.

During his nine days on board the Space Station, De Winne, whose flight was sponsored by the Belgian Federal Office for Scientific, Technical and Cultural Affairs (OSTC), carried out successfully a programme of 23 experiments in the fields of life and physical sciences and education, including experiments in an important new research facility designed and developed in Europe, the Microgravity Science Glovebox (MSG).

Current Assignment

De Winne is supporting the implementation of the White Paper on Space Policy with the European commission and preparatory activities for the Soyuz at CSG (Guiana Space Centre) project.

Astronauts as Laboratory Assistants

Pedro Duque
Member of the European Astronaut Corps
ESA / EAC, Cologne, Germany

In space laboratories, and especially during long flights, the astronauts are asked to perform myriads of different operations on scientific equipment. The crew time in orbit is a very scarce resource that requires a professional approach to managing it. We in STS-95 carried in our laboratory just a small subset of the number of devices that will work on the final Space Station, yet a crew of seven was continuously busy with monitoring, exchanging samples and performing manual operations. On the Space Station in 2003 it was no different for five people during eight days.

Why is that? Scientists are very practical people who normally do not have a special interest in having their experiments operated by astronauts. It takes a lot of effort for them to give us the necessary knowledge and the skills required to perform well as their laboratory assistants. It is the product of many years of work that they are putting in our hands, and that needs a trust that, understandably, is difficult to grant. It would seem that science experiments would be better off by being completely autonomous and separate from the crew. So why do they use the astronauts?

Naturally, we had some automatic facilities that worked unattended. But even the best of them require crew monitoring or exchange of samples. New facilities to be used in the Space Station will use the same principles. The reason is ultimately the cost involved: higher degrees of automation require enormous increases in technology development, qualification, tests and manufacturing, not to mention the increase in size and weight. The ESA facilities on STS-95 are the closest possible device to the paradigm of the “robot that does the work of the crew”. Europe is the leader in the development of such experiment robots, and this is attested by the Columbus facilities, but none is totally autonomous.

On the other hand, other experiments aboard STS-95 or the Station were more modest and required moderate, even extensive, crew time. And yet, this does not mean that they were scientifically less important. Of course, medical studies are in a class of their own, but plant biology, crystallography

Seeking advice for one of STS-95’s experiments from scientists on the ground.

Showing the movements of balls of different masses as part of an educational video during "Cervantes".

and fluid-dynamics experiments were also crew-intensive. The scientists who proposed these experiments had the advantage of not constraining themselves to the kind of data-gathering that the robots could achieve, and thus they were freer to open ways in science. It is because of these people that new branches of microgravity science are opening, which ultimately could lead to the creation of specific robotic facilities.

But this process is very long and requires the agreement of agencies to allocate funds to the new developments; in the meantime, science groups cannot spend large sums on automation and are thus only able to perform their experiments if we are there to help. Our presence allows the transition from performing experiments "as on the ground" to the necessary refinements needed to prepare them to be done "by the robots".

From all of our personal conversations with scientists, it comes across that the presence of astronauts, with the proper skills, knowledge, motivation and tools, makes science in space possible for many more experiments, rendering it therefore more "democratic".

Pedro Duque

Born 14 March 1963 in Madrid, Spain.

Education
Graduated with a degree in Aeronautical Engineering from the Escuela Técnica Superior de Ingenieros Aeronáuticos, Universidad Politécnica, Madrid in 1986.

Spaceflight Experience
Pedro flew as Mission Specialist on the Space Shuttle Discovery, STS-95 mission (29 October to 7 November1998). This nine-day mission was dedicated to research in weightlessness and the study of the Sun. He was responsible for the five ESA scientific facilities and for the extensive computer system and configurations used on the Shuttle. He flew again to the Space Station and back as Flight Engineer in two different Soyuz TMA spacecraft, staying there for eight days and fulfilling the so-called "Cervantes" programme, with microgravity science, educational activities and other tasks.

Current Assignment
In 1999, Pedro Duque was assigned to ESA/ESTEC, Noordwijk, the Netherlands, providing support to the Module Projects Division within the Directorate of Manned Spaceflight and Microgravity. He has returned to those duties after his second flight. He regularly undergoes currency training to be part of permanent crews on the International Space Station.

The Importance of Seeing it for Yourself

Reinhold Ewald
Member of the European Astronaut Corps
ESA / EAC, Cologne, Germany

In almost any venture of exploration there is a moment when the technical means have matured enough and the ground has been sufficiently prepared by field tests and remote sounding, so that the wish to go and see for yourself can come true. In the case of human spaceflight, I doubt that there was much discussion during the years 1957 to 1961 about whether human beings should follow the first Sputnik and the first chimpanzee into space or whether this endeavour should be strictly unmanned for decades to come. The question was decided within a short timeframe when the first humans set foot on the Moon. Every current and future space programme must continue to answer the question why and with what intention to continue flying into space.

For me, the answer is twofold: sending humans into space gives spaceflight an authenticity down here on Earth, and it is the most effective way of exploring space. Human presence is an engine for continuing progress in putting spaceflight to the best possible use for improving our life on Earth.

With the authenticity gained by sending human beings into space – humans who think, feel and report on their experiences – we are involving humankind as a whole in this exploration adventure. Though only a few hundred people have participated in spaceflights so far, the concept of space tourism is becoming a reality. The pressure is growing to improve spaceflight technology to a point where it is affordable to go into space for fun and see for yourself. Coming back from a spaceflight, the astronauts are regarded as eyewitnesses of an important event. This impression is shared by all of the space flyers who are involved in educational events, lectures and development activities. It is hard to prove, but I think that the branches of spaceflight that have been turned into profitable businesses would not be so far advanced if spaceflight had not always been linked with human crews onboard spacecraft, trying to push the frontier of what we can do yet a little further.

This audacity is rewarded by the tremendous gain in effectiveness by adding a crew. Robots do not decide things beyond their programmes, they are not curious and they are not able to criticise their learned set of rules in adverse conditions. A human mind is capable of all these helpful thoughts, commonly attributed to intelligence. So in a situation where the facts about what you will meet and what you can expect are more than fuzzy, you actually gain by sending humans. This is the case in most space activities of operational, technical and scientific nature.

The example of the Mir Space Station, which far exceeded its planned lifetime, showed convincingly that a human crew can overcome severe technical shortcomings and even near-catastrophic events. When the fire blazed aboard Mir in 1997, an automatic system would have had no other choice than to shut down the station. The crew went on fighting it because this was the reasonable thing to do as long as they did not endanger their safe escape. The later collision with the Progress space transport vehicle would have been more than enough reason to stop Station operations for an automatic system, but the crew demonstrated otherwise. Even recovering from the loss of attitude control is possible, as long as you use simple reasoning: a thumb's width on an outstretched arm is half a degree, so if a star takes 1 second to vanish and reappear behind the thumb your rotation rate is one full circle in twelve minutes. With this kind of quick calculation, the Mir crew was

successful in reestablishing the supply of electrical energy.

Let us take a look at Mars: are the marvellous photographs taken by the small rovers on the martian surface all there is to see? Or are we still missing important clues in solving the questions of martian and terrestrial history? In order to find out we have to go and see for ourselves!

Some facts on the MIR '97 mission: 29 experiments were performed in the fields of life science (70%), material and physical science (20%) and operational activities in the course of 18 days on board the Station. With launch and landing by Soyuz, four Russian cosmonauts, one NASA astronaut and myself worked together with three control centres (TsUP, GSOC and MCC-H) on a number of scientific national and international experiment programmes. A fire on board (23 February 1997, Flight Day 14) did not interrupt the experiment programme. The life science results were published in the refereed "European Journal of Clinical Investigation", December 2000 issue. They have resulted in direct applications or provided further clues for the treatment of back pain, osteoporosis, health status after prolonged immobilisation and in other fields of medicine. Research continues on the ISS today.

In analysing and repairing a multitude of problems a crew – here at work onboard Mir – beats any robot.

Reinhold Ewald

Born 18 December 1956 in Mönchengladbach, Germany.

Education
Received a Bachelor of Science degree in Physics from the University of Cologne in 1977 and a Master of Science degree in Experimental Physics in 1983. He graduated in 1986 with a PhD in Physics and a minor degree in human physiology.

Spaceflight Experience
MIR '97 was the second German-Russian mission to Mir (10 February to 2 March 1997). Ewald flew as a research cosmonaut on the Russian Soyuz-TM25 vehicle and spent 18 days onboard Mir. He performed experiments in biomedical and material sciences and carried out operational tests in preparation for the International Space Station. He returned on Soyuz-TM24.

Current Assignment
Reinhold Ewald was assigned as Crew Operations manager for the two Soyuz missions in 2002 that flew to the ISS carrying ESA astronauts. For the last Soyuz mission in 2003 and the one in 2004, he acts as ESA's Operations Manager from a duty station in ESTEC, Noordwijk, the Netherlands.

Electronics and Space

Léopold Eyharts
Member of the European Astronaut Corps
ESA / EAC, Cologne, Germany

During my flight on board the Mir space station in 1998, I was in charge of installing and performing a set of scientific experiments from different research areas: life sciences, biology, fluid physics and technology. Some of these experiments were designed to run automatically after their installation while others involved human test subjects.

Similar experiments had been flown during a previous spaceflight, but two of them were affected by failures of computer electronics. The main computer of a neuroscience experiment, Cognilab, refused to start. The boot process was stopping immediately after the computer was switched on. One of the electronics boards of another experiment, Dynalab, failed after a few days of normal operations.

In order to rescue the scientific programme of the flight, which was severely affected by these failures, it was decided to use the crew to help troubleshoot and fix the two computers. Cognilab was a closed box that did not allow direct communication with the software or operating system. Using real-time procedures worked out by the ground teams, we managed to communicate with it via a serial interface and a standard commercial laptop available on the station. We diagnosed a corruption of the computer boot sector and fixed it by reprogramming the memory. The experiment programme was completed successfully after this repair.

In the Soyuz, on the way to Mir.

Space Station training in Houston.

Likewise, Dynalab was a "black box" with no real interface allowing the operator to perform extensive troubleshooting. Again, the ground teams defined a strategy to tackle the computer problems, which had caused a lack of communications between the central "box" and the experiment sensors. Following the ground procedures, the crew identified a major failure of one of the electronic boards of the computer. Unfortunately, no spare item was available on board the station, and the experiment had to be terminated because of the short duration of the flight. But it is clear that the failed card could have been replaced and the experiment restarted using a new board delivered by a resupply vehicle.

During this relatively short spaceflight (three weeks), I was confronted twice with a problem that is very likely to

Flying the Space Shuttle Robotic Arm.

Computer surgery on the Mir Space Station.

occur when working in space: electronics failure. Corruption of data or memory is considered to be one of the most probable causes of failure affecting the computers used in space. Even though electronic devices are hardened and protected to face this well-known threat, coming from the natural electromagnetic environment of space, there have been several identified or supposed instances of such failures affecting various hardware on board manned or unmanned spacecraft.

It is obvious to me that space exploration will involve both automatic and human "components" because they are complementary. Automatic systems, or robots, will of course consist mainly of electronics, which we know are very sensitive to the space environment.

Identifying and fixing such failures is almost impossible to do remotely, without a significant degradation of the equipment or system performances. Only the direct action of human beings – astronauts – allows the full recovery of the initial operational capabilities, provided these operators have the appropriate tools and training. This has been demonstrated in the past during famous repair missions (for example of the Hubble Space Telescope), but also during the daily life and work of astronauts on board the Shuttle and the Space Stations.

Léopold Eyharts

Born 28 April 1957 in Biarritz, France.

Education
Graduated as an engineer from the French Air Force Academy of Salon-de-Provence in 1979. He qualified as a fighter pilot in Tours in 1980 and graduated from the French test pilot school (EPNER) in Istres in 1988.

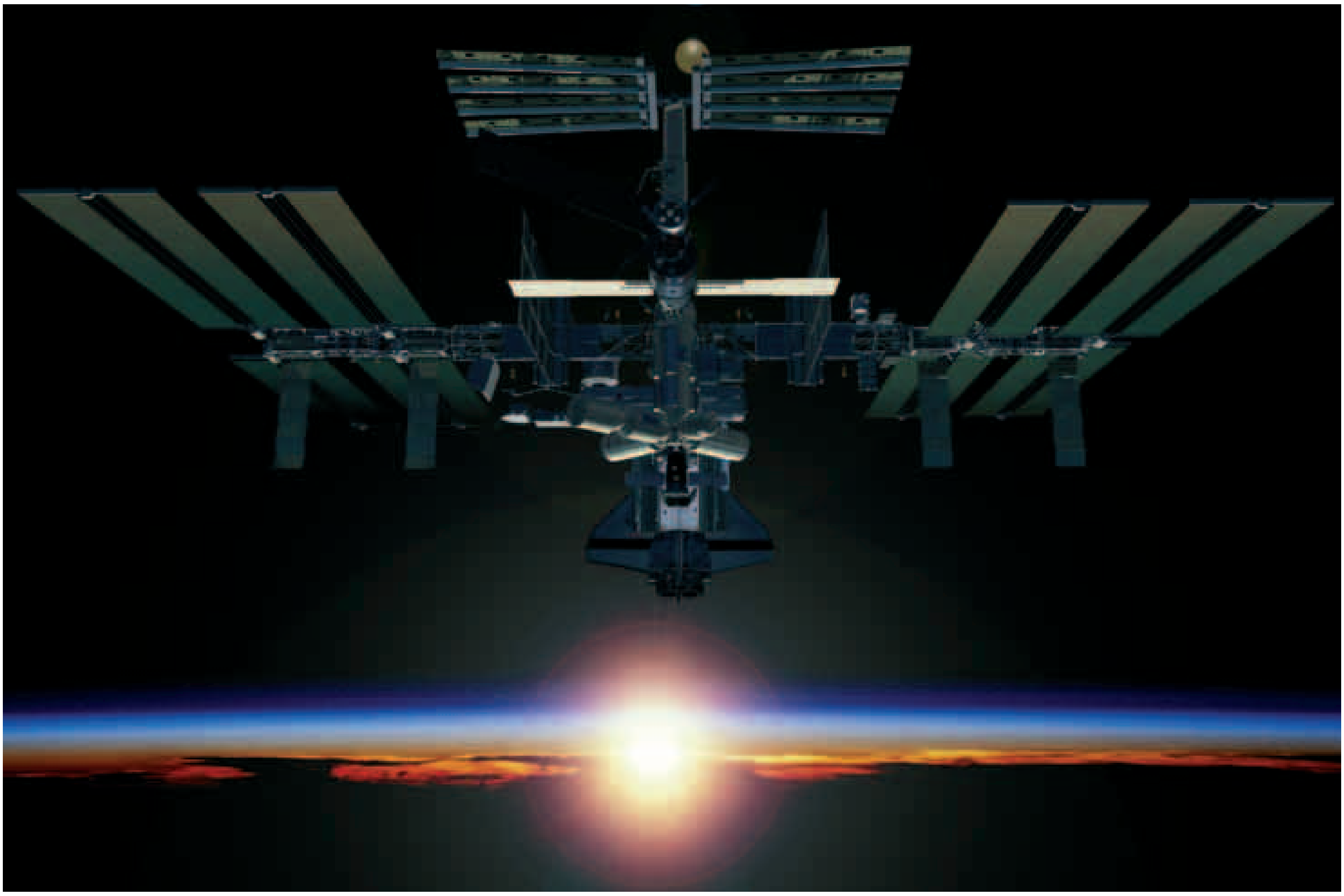
Spaceflight Experience
Mission to the Russian space station Mir (29 January to 19 February 1998). During this Franco-Russian mission, called "Pegase", he performed various French experiments in the areas of medical research, neuroscience, biology, fluid physics and technology.

Current Assignment
Léopold Eyharts received technical assignments within the NASA Astronaut Office at the Johnson Space Center, Houston. He is working in the ISS Operations Branch on ISS Software and Systems. He is also training as a non-assigned crewmember, both on the Space Shuttle and the ISS.

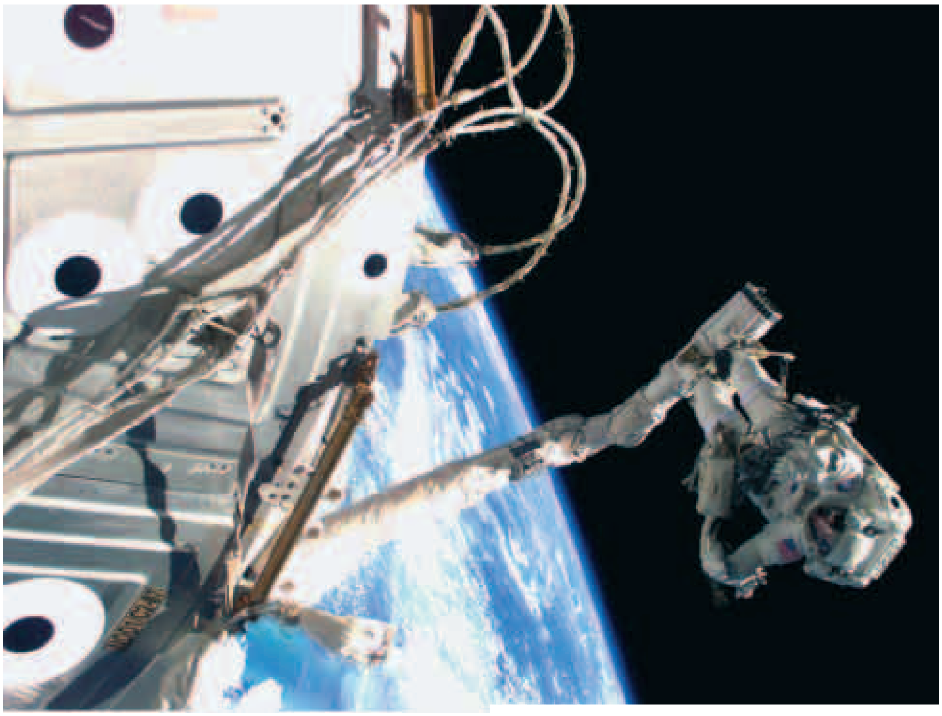
Learn to Live and Work in Space

Christer Fuglesang
Member of the European Astronaut Corps
ESA / EAC, Cologne, Germany

I have yet to go to space myself, but during my several years of training in Europe, Russia and America, I have often talked to many of those who have spent anything from a few days to over a year in this ultimate frontier of humankind. I have been privileged to be able to follow spaceflights and astronauts in action from the "front row". A couple of exciting events that immediately spring to mind when I think of the usefulness of humans in space is how Yuri Malenchenko on Mir and later Yuri Gidzenko on the



"During my upcoming mission I will do a couple of exciting spacewalks (EVA's), continuing the building of the International Space Staton."



International Space Station have saved the invaluable Progress spacecraft – and probably also complete missions – by taking over manually and by remote control from the space station. They managed to dock the Progress when the automatic system failed. Vladimir Djanibekov and Viktor Savinikh docked manually to the uncontrolled Salyut-7 and brought the freezing Space Station back to life in 1985. The importance of having human action is proven continuously: while I am writing this text, two space-walking astronauts are repairing a solar array on the ISS that did not stretch out properly.

At the other end of the spectrum, I have been intrigued talking to scientists who have experienced conditions in space themselves, explaining how they made observations with their own eyes and minds on fluids, animals, crystals etc. This inspired me to propose an experiment, 'SilEye', which flew for several years on Mir. A follow-up is in work for the ISS. My good friend and long-time space inhabitant Sergey Avdeev is also involved in this project, which studies the light flashes that most humans experience in orbit. This phenomenon is linked to the radiation environment and is both interesting and important to understand in detail. I hope to record my own data on this subject some day.

However, in my opinion the most important aspect of sending humans into space is simply to learn how to live and work there. And when you talk to astronauts and cosmonauts as well as to the general public, that is actually what everybody talks most about. We also need to improve how we live, work, build and travel in space. How else are we going to be able to exploit this last infinite frontier?

"I look forward to living on the ISS, seeing sixteen sunrises per day. I dream of flying to the Moon and of the day humans finally reach Mars."

Christer Fuglesang

Born 18 March 1957 in Stockholm, Sweden.

Education
Graduated from Bromma Gymnasium, Stockholm, in 1975 and received a Master of Science degree (Engineering Physics) from the Royal Institute of Technology (KTH), Stockholm 1981. Received a Doctorate in Experimental Particle Physics in 1987 and became a Senior Lecturer in Particle Physics in 1991 at the University of Stockholm.

Current Assignment
Christer Fuglesang is a member of ESA's European Astronaut Corps, whose homebase is the European Astronaut Centre located in Cologne, Germany. He is currently training at NASA's Johnson Space Center in Houston to prepare for the Space Shuttle mission STS-116 to the ISS, which will probably not take place before 2006.

Lessons Learnt from the Tethered Satellite

Umberto Guidoni
Member of the European Astronaut Corps
ESA / EAC, Cologne, Germany

I am going to talk about my first spaceflight, the STS-75 mission on board Space Shuttle Columbia in 1996. The primary objective of the STS-75 mission was the deployment of a satellite tethered to the Orbiter with a conducting cable of 20 km length. The idea was to take unprecedented measurements in the ionosphere by perturbing the plasma using the tethered satellite as a gigantic probe for collecting electrons, generating a current of more than 1 amp on board the Space Shuttle.

According to the plan, the satellite was supposed to stay "on station" at 20 km distance for roughly 24 hours and be retrieved into the cargo bay to be brought back home at the end of the mission.

The actual flight didn't quite work like that! The thin cable connecting the satellite to the Orbiter was severed when the satellite was being reeled out, about 1 km shy of its final distance.

It was a dramatic change in the mission plan with the flight controllers in the Mission Control Center trying to understand the causes of the failure, and with the flight crew reacting in real time to handle the contingency. It is a great example of how things can go wrong in space and how important it is to have astronauts on board to handle off-nominal situations. There was an almost instantaneous response from the crew because we had been practising for more than a year on all aspects of the mission, including contingency situations and, among them, the possibility that the tether could break. The presence of human beings in space might cost a lot of money because of the safety measures involved, but it buys an even

View of the Space Station from the Shuttle. Clearly visible is the robotic arm assembled by the STS-100 crew.

Umberto using the ergonometer on the Shuttle. Astronauts have to exercise their bodies to counteract the effects of weightlessness.

greater flexibility that is impossible to achieve with any automatic system – even the most sophisticated ones.

If we look at the complexity of the Space Station assembly and the exploration of the Solar System ahead of us, the capability to cope with unplanned situations will be even more important for the future missions. It will be the key to success!

It should not be a complete surprise; after all, human evolution on Earth is highly successful because our species has been able to adapt to a changing environment, constantly facing new challenges. I see no reason why we shouldn't take advantage of our genetic ability while we are embarking on an even bigger challenge: trying to leave our planet and turn our attention to the stars.

Umberto Guidoni

Born 18 August 1954 in Rome, Italy.

Education

Graduated from Classic Lyceum 'Gaio Lucilio' in Rome, Italy, in 1973. He received his Bachelor of Science degree in Physics and Doctorate in Astrophysics (Summa Cum Laude) from the University of Rome in 1978. He was then granted a post-doctoral fellowship in plasma physics at the Thermonuclear Research Center of CNEN until 1980. He is a Reserve Officer in the Italian Air Force.

Spaceflight Experience

Umberto flew as a Payload Specialist on the STS-75/TSS-1R mission, which was a 16-day mission (22 February to 9 March 1996). The principal payloads were the reflight and deployment of the Tethered Satellite System (TSS) and the third flight of the United States Microgravity Payload (USMP-3). The TSS experiment produced a wealth of new information on the electrodynamics of tethers and plasma phyics despite the tether breaking after reaching a distance of 19.7 km from the Space Shuttle, just shy of the 20.7 km goal. Scientists were able to devise a programme of research making the most of the satellite's free flight while the astronauts' work centred on research related to the USMP-3 microgravity investigations. In April 2001, Umberto flew the STS-100 mission, a Space Station assembly flight, which carried the Multi-Purpose Logistics Module (Raffaello), provided by the Italian Space Agency for the International Space Station (ISS). The mission also carried the Space Station Remote Manipulator System (SSRMS), the Canadian robotic arm that will be used extensively to assemble the ISS.

Current Assignment

Umberto Guidoni is assigned to ESA's European Space Research and Technology Centre (ESTEC) as crew support for the payloads that are being developed for the Columbus Laboratory. Columbus and its payloads will be the European contribution to the scientific research performed on board the International Space Station.

A Space-Faring Species

André Kuipers
Member of the European Astronaut Corps
ESA / EAC, Cologne, Germany

Future of mankind
People have always been curious and explored dangerous environments. Without this urge we would never have gotten where we are now. Humans are made for 1 g, 1 bar, 5 km per hour on our own legs and about 25ºC. Even on Earth we surpassed these specifications very quickly by going to sea, the poles, the desert, under water and to high altitudes. Space is just the next border to cross. People have long dreamt about it and now we can technically do it.

If people express their opposition to humans in space, I often ask them if they expect that humans will still be only on this planet one hundred, one thousand or more years from now. Almost all say then that of course people will spread out into the Universe.

For this reason, one of the tasks of astronauts is to find out how humans can live and work in space for long periods. Astronauts are paving the way for the space-faring human race of the future. Not only for explorers, scientists, miners on the Moon or colonists on Mars in the far future, but also for space tourists. I expect space tourism on a substantial scale to happen in the much nearer future.

Stimulating effect
Astronauts represent the people on Earth, they are the manifestation of their dreams. Through astronauts, people can explore, much like the people of the past followed the expeditions into new regions on the planet. Whenever I give a presentation, people in the audience – schoolchildren, students, laymen, scientists – are intrigued by the human aspect of spaceflight. Manned spaceflight stimulates young people to choose scientific or technical careers, which is of great importance to our society. It is possible to identify with a fellow human being, but you cannot identify with a robot. Seeing pictures taken by a robot on Mars is very exciting, but it also makes people even more enthusiastic to see humans walk there one day.

International cooperation
The fact that human beings from nations who were enemies not long ago are working together for the benefit of people on Earth in such a visible way might prevent conflicts on Earth and is therefore a very good reason to have humans in space.

André Kuipers training in the Soyuz TMA simulator for his spaceflight.

Man versus robot

Astronauts are the eyes and hands of the scientists and technicians on the ground. For certain chores, robots will become more and more important, and many tasks are already automated, but robots are still far from being as able to react to unforeseen events or to adapt to new situations as humans are. Humans can make decisions based on experience and can react quickly in case of time pressure. When robots can only be directed from Earth, lack of communication or long delay times, like on Mars, will severely reduce the mission results.

Automated equipment is more complex and not always as flexible as needed, and malfunctions still need in-flight repair. During my work as a project scientist, I have seen several in-flight repairs of equipment by astronauts that saved the experiments. An example is the repair of a gas supply valve of the ESA Anthrorack during the Spacelab-D2 mission.

The experience of humans who have worked in space both with highly automated equipment and with equipment requiring heavy manual involvement is of great value for the development of new research. Experimenting in weightlessness is often different from what people on the ground expect.

Test subjects for medical research

Astronauts are also needed as test subjects for research into the functions of the human body.

Kuipers testing his spacesuit at a simulated altitude of 30 kilometers in a hypobaric chamber.

Many functions in our body are influenced by gravity. Only in a laboratory in orbit can we eliminate this condition for a longer time. Studying bodily functions in weightlessness gives additional information to research on Earth. This has already led to changes in text books and correction of long-held theories – even theories that have been awarded the Nobel Prize. This has happened even though we have only had the chance to do research for a short period in total, only a few weeks or months here and there with a limited amount of subjects.

People on Earth benefit from this research in many fields, from bone loss to the equilibrium system. The benefits come not only from the fundamental knowledge, but also from the knowledge gained by developing new equipment for medical research in space. And as with all research, we cannot predict what fantastic cure or prevention of sickness the life sciences research on the Space Station will one day bring to mankind.

André Kuipers

Born 5 October 1958 in Amsterdam, the Netherlands.

Education

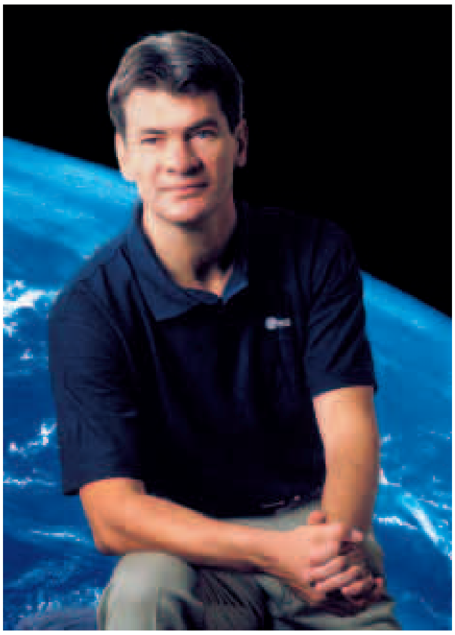
In 1977, André graduated from van der Waals Lyceum, Amsterdam and received a Medical Doctor degree from the University of Amsterdam in 1987.

Current Assignment

During the last two Soyuz missions with ESA astronauts to the International Space Station, André Kuipers supported ESA's ground team in the Russian Control Centre TsUP as "Crew Interface Coordinator". He was also backup of Pedro Duque for the Soyuz 7S mission, which took place in October 2003.

Currently, André Kuipers is preparing as a Flight Engineer for the Soyuz 8S flight to the International Space Station at the Yuri A. Gagarin Cosmonaut Training Centre (Star City) near Moscow. He is looking forward to his first spaceflight, scheduled for April 2004.

Humans vs Machines



Paolo Nespoli
Member of the European Astronaut Corps
ESA / EAC, Cologne, Germany

I have not actually flown in space, but I deal with machines almost every day as part of my training. I must admit that some of these machines are very complex and capable to the point that some of them seem to have a soul. Nevertheless, I believe that we as humans find it difficult to understand and feel what a machine must be experiencing and therefore we have difficulty in relating to it. It is much easier for a human to relate to what other humans have experienced.

During recent years, I have participated in many Public Relations events, especially addressing young people in schools. During these events, I can see sparks in their eyes and smiles on their faces when I talk about my

"There are daily interactions with complex and sophisticated equipment when training for a spaceflight."

"One of the most rewarding aspects of being an astronaut is the ability to stimulate and inspire."

experiences and feelings. I guess the fact that they can see and talk to somebody real and identify with my experiences makes them curious and enthusiastic.

I believe there is a unique thing that astronauts can do and machines cannot: motivate people and make them dream. If we can motivate young people to dedicate themselves to furthering their knowledge, we have accomplished a very important goal. They will certainly pass this knowledge to others.

Paolo Nespoli

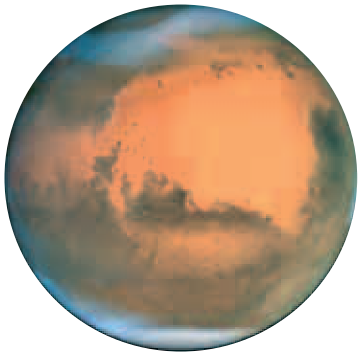
Born 6 April 1957 in Milan, Italy.

Education
Received a Bachelor of Science in Aerospace Engineering in 1988 and a Master of Science in Aeronautics and Astronautics in 1989 from the Polytechnic University of New York. Awarded a Laurea in Mechanical Engineering in Italy in 1990.

Current Assignment
While awaiting his first spaceflight assignment, Nespoli is currently working at NASA's astronaut office in Johnson Space Center, Houston. He performs proficiency training to maintain the acquired qualifications as well as attending advanced courses. He also carries out several technical duties for NASA and ESA.

Expanding Borders of Human Knowledge and

Claude Nicollier
Member of the European Astronaut Corps
ESA / EAC, Cologne, Germany



"We will soon travel to far-away destinations - Mars and beyond..."

I was privileged to take part in four Shuttle flights between 1992 and 1999. Two of these were visits to the NASA/ESA Hubble Space Telescope for repairs and maintenance of the orbiting observatory. The other two were devoted to tests of the Italian-American Tethered Satellite, with the addition of the in-orbit deployment of the EURECA Scientific Platform, and the performance of various micro-gravity experiments.

Human intervention on Hubble has been very successful on all servicing missions so far. Although technically advanced, the Telescope would have been immensely more complex and expensive had it been designed to be serviced by robots to the same extent. Despite the fact that limited robotic servicing is a possibility in the future, the Telescope would have remained ineffective without past on-orbit intervention. For instance, the optical problem affecting its performance early in the programme would never have been fixed. We would also not have been in a position to update scientific instruments to state of the art as has been done on the second and the fourth servicing missions. On numerous occasions during these servicing missions, the flexibility of human intervention was used to engage alternate rather than planned operational paths, which is typically the kind of action robots or automatic systems are not well suited for. Hubble is more than fourteen years old, but it remains a modern discovery machine, and regular human intervention has been critical to maintain this status.

Working on Hubble during mission STS-103, December 19-27, 1999.

The Tethered Satellite System was another Shuttle payload whose operation depended heavily on humans. Satellite deployment and retrieval and the active damping of the satellite and tether oscillation modes were strictly dependent on manual intervention through the Orbiter's Reaction Control System and satellite thrusters. Here again, this was a question of cost. The system was experimental and it would have been unwise to pay the large cost of automation for a complex system in its early testing and development stage. The Tethered Satellite concept has not been pursued in its dynamical and electrodynamical applications for

International Space Station support. It might only be a question of years until the idea comes back as an effective way to control Station altitudes without using propellant, or as a way to provide artificial gravity in human spacecraft cruising to distant destinations in the Solar System.

Hubble and the Tethered Satellite are two examples of systems where human involvement in orbit made a huge difference. In general, complex space systems servicing and maintenance, or new systems in their test or early development stage, are best handled through human intervention in space.

But space is much more than Hubble and a satellite at the end of a conducting cable. We have benefited tremendously from all aspects of space utilisation and exploration since we ventured outside of the Earth's atmosphere more than forty years ago, and there is much more to come. ESA's Aurora Programme, and similar efforts among our partners, will soon open the Solar System to robotic and human exploration. Continuing the journey, building up on what has already been accomplished to establish and exploit several working places in the Earth's neighborhood and in the Solar System, will result in a significant expansion of human knowledge, and consequently in a dramatic increase of human capabilities.

Claude Nicollier

Born 2 September 1944 in Vevey, Switzerland.

Education
Graduated from Gymnase de Lausanne, Switzerland, in 1962; received a Bachelor of Science in Physics from the University of Lausanne in 1970 and a Master of Science degree in Astrophysics from the University of Geneva in 1975. He also graduated as a Swiss Air Force pilot in 1966, as an airline pilot in 1974, and as a test pilot in 1988.

Spaceflight Experience
A veteran of four spaceflights, Claude has logged more than 1000 hours in space. He flew as a mission specialist on STS-46 in 1992, STS-61 in 1993, STS-75 in 1996 and STS-103 in December 1999.

STS-46 Atlantis (31 July to 8 August 1992), was an eight-day mission during which the crew deployed the European Retrievable Carrier (EURECA) science platform, and conducted the first Tethered Satellite System (TSS) test flight.

STS-61 (2 - 13 December 1993) was the first Hubble Space Telescope (HST) servicing and repair mission, a joint ESA/NASA undertaking. During the eleven-day flight, the HST was captured and restored to full capability through a record of five spacewalks by four astronauts.

STS-75 Columbia (22 February to 9 March 1996) was a 15-day flight, with principal payloads being the reflight of the Tethered Satellite System (TSS) and the third flight of the United States Microgravity Payload (USMP-3). The TSS successfully demonstrated the ability of tethers to produce electricity. The TSS experiment produced a wealth of new information on the electrodynamics of tethers and plasma physics before the tether broke at 19.7 km, just shy of the 20.7 km goal. Scientists were able to devise a programme of research making the most of the satellite's free flight while the astronauts' work centred on research related to the USMP-3 Microgravity investigations.

STS-103 Discovery (19-27 December, 1999) was an 8-day mission with the primary objective to repair and service the HST, in particular the replacement of the six gyroscopes that are necessary to meet the telescope's very precise pointing requirement. During this spaceflight, Claude carried out his first spacewalk of 8 hours and 10 minutes duration, to install a new computer and one of three fine guidance sensors. He is the first European with spacewalk experience on a Shuttle flight.

Current Assignment
Claude is currently assigned to the EVA (Extravehicular Activity) Branch in the NASA Astronaut Office in Houston, supporting the preparation of future spacesuits for EVAs.

Getting to Grips with the Space Station

Philippe Perrin
Member of the European Astronaut Corps
ESA / EAC, Cologne, Germany

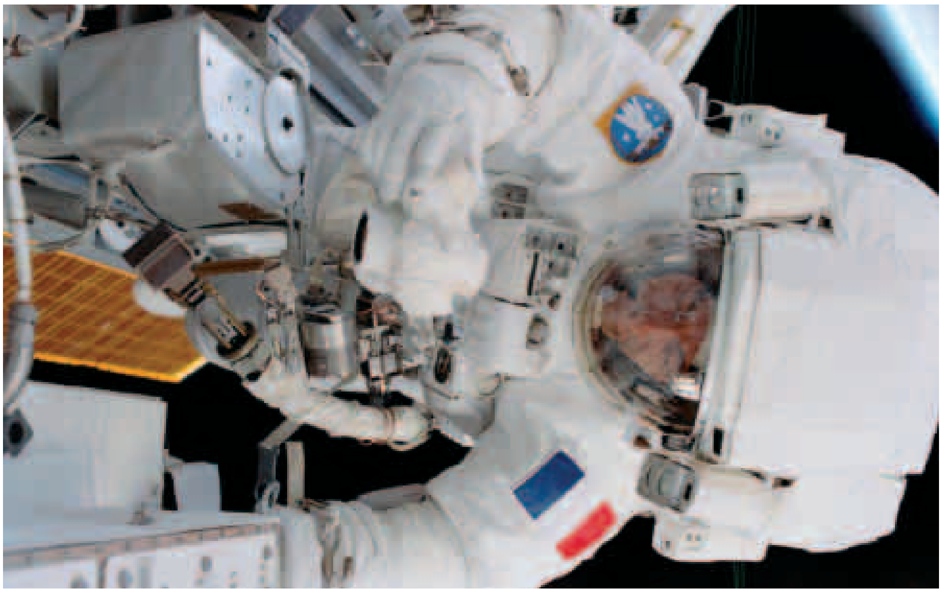
I was too young in the Apollo days to have personal memories of these adventures in space. I consider myself to be from a new generation, a generation that was deprived of the exhilaration and inspiration of outer space exploration. As a teenager I developed my own dreams from books and films like "2001, A Space Odyssey", and that inspired me to become an astronaut: to go on a journey through the whole Solar System.

My role on the STS-111 mission was to help assemble the Space Station by performing three spacewalks. The first two spacewalks were dedicated to the installation of the Mobile Base System or MBS, basically the base of the Station's robotic arm. Men and robots are complementary. As I was working outside, I used a robotic arm to carry me from one side to the other, but at the same time the robot could not have been installed without the dexterity of my human hands. This inter-dependence became very obvious during my third space walk: two months prior to our launch, the Station's arm failed because of a short circuit in one of the Wrist Roll electrical motors. My crew was asked to quickly train for a rescue mission: without the arm, the whole Station assembly was on hold. We did not have the luxury of taking our time to train extensively, although the task was very critical. Fortunately, the Canadian arm had been very cleverly designed and our only challenge was to run against the clock. It was like serious surgery: to get access to the Wrist, we first had to disassemble the End Effector. If by the end of the spacewalk we had not been able to re-attach the End Effector, it would have run out of electrical heating just like a human hand running out of blood.

This was a lot of responsibility on my shoulders as a first flyer, but the bliss was infinite when I learned that we had successfully repaired the arm and put the Station back on track in the assembly phase.

I feel very privileged to have been given the opportunity to do three space-walks, during which I was able to marvel at the natural beauty of our

"In human spaceflight, you rely on each other in critical situations, which creates wonderful friendships."



"Thousands of people rely on you to install the hardware they have developed over so many years – and you have so little time!"

planet. But I also realised that this planet is our own spacecraft stranded in a barren cosmos with limited resources. Everything we learn in assembling big structures in orbit will be very helpful when the time comes to assemble the future Mars-bound spacecraft or huge telescopes.

The question is not whether men will or will not land on Mars but when they will do it. Instead of giving this privilege to future generations, I want my own generation to take part in the achievement of a return to the Moon or a mission to Mars. It will transform everybody's life to witness new space explorations by putting it into the perspective of the whole evolution process.

Exploration of the Solar System is within our reach: I have had the chance to fly in space with Franklin Chang-Diaz, the inventor of what could be the future engine of Mars missions: a plasma rocket capable of shrinking the trip to the red planet from one year with the current technology to a few months with this new technology.

Today, the International Space Station is a fantastic laboratory to discover and develop all the missing links for future explorations to the Moon and Mars.

Philippe Perrin

Born 6 January 1963 in Meknes, Morocco.

Education
Entered the French Ecole Polytechnique (Paris) in 1982. Graduated as "Ingénieur Polytechnicien" in 1985. Received his Test Pilot Licence in 1993 from the Ecole du Personnel Navigant d'Essais et de Réception (EPNER), the French Test Pilot School at Istres Air Force Base. Received his Airline Pilot Certificate in 1995. Perrin is Colonel with the French Air Force.

Spaceflight Experience
He served as mission specialist (MS1) on STS-111 (5 - 19 June 2002) on board Space Shuttle Endeavour. The STS-111 mission delivered a new ISS resident crew and a Canadian-built mobile base for the orbiting outpost's robotic arm. STS-111 also brought home the Expedition Four crew from their six-month stay aboard the Station.

As MS1, Perrin was in the cockpit during ascent. He focused most of his time on orbit preparing and carrying out three successful spacewalks. On the first two extravehicular activities, he helped to install the MBS, on the third he performed a late-notice repair of the Station's robot arm by replacing one of its joints. He spent a total of about 19 hours outside the ISS.

During that mission, Perrin was also arm operator and berthed the MPLM back into the Orbiter Payload bay towards the end of the mission. He was also in charge of portable computers and worked as the main board engineer (MS2) during the rendezvous phases.

Current Assignment
In December 2002, Perrin joined ESA's European Astronaut Corps. He is providing engineering support to the ESA Automated Transfer Vehicle (ATV) project at the ATV Control Center in Toulouse.

Human Exploration of Space – a European Le

Thomas Reiter
Member of the European Astronaut Corps
ESA / EAC, Cologne, Germany

The urge for exploration is one of the most elementary attributes of humans. It is not only driven by the need to survive and improve our living conditions, but also by curiosity and fascination.

Even though nowadays almost every square meter of our immediate environment – the Earth's surface – has been explored, even though we are able to look into remote areas of our Universe and scientific research has progressively improved our life, space has maintained or even increased its public attraction for human exploration. This is mainly due to three reasons:

- the fascination of sending our own representatives into space and to other celestial bodies. Only human beings are able to share their experiences and feelings with the people on Earth during and after such extraordinary voyages.
- our deep interest in revealing the secrets of our Universe and understanding the phenomena, natural laws and mechanisms that govern our environment, including micro- and macrocosmos
- our awareness of the huge potential to utilise space for the benefit of humankind.

Unfortunately, purely utilitarian aspects of spaceflight often dominate public discussions, even though the support of the general public is more evenly based on all of the above reasons. There is no doubt that spaceflight in general needs to help people solve problems of day-to-day life. However, the specific cultural benefits of human spaceflight and the necessity for basic scientific research in space are obvious.

Aware of our history, we name European space projects after explorers, whose extraordinary endeavors have a lasting impact on European society in its cultural, scientific and economical evolution. Those scientists who made historical advances in expanding our knowledge and understanding of the natural laws, who laid the foundations of most natural sciences by exploring the unknown in an abstract way, need to be considered as explorers as well. What all these people have in common is a deep conviction of their goals, perseverance, courage, and a vision. Together with my colleagues in the European Astronaut Corps I share these virtues, which I believe to be true European virtues. Furthermore, we share a vision of the human exploration of space as a prerequisite for the expansion of our knowledge, the enrichment of our culture and the improvement of our living conditions.

Compared to our ancestors we are in a much better position today: we can rely on highly automated probes for the

Repairing failed systems: one of the areas of human spaceflight that requires the crew's skills.

gacy

initial acquisition of information about the hostile environment in space, on the Moon and on other planets. However, even though these probes will continue to precede humans in the future, they will never be able to replace us. It is the combination of cognitive, sensory and motor skills, attributes like creativity and intuition, that determine our unique capabilities and distinguish us from machines. Based on my own experience during the Euromir-95 mission to the Russian Space Station Mir, I can declare that no computer, no robot or any other automatic device would have been able to deal with the technical problems that arose from time to time.

In view of our European history I believe that the fascination of exploring the unknown across all borders – and the acknowledgement of our active role in this process – is still undiminished. People understand that the benefits coming from human spaceflight extend beyond pure utilitarian objectives. In my opinion no other activity is more suitable to foster the generation of a European identity.

Europe's evolotion towards the world's biggest knowledge-based society is a fascinating goal which deserves not only full support from political leaders but from all European citizens. The human exploration and utilisation of space can play a significant role in achieving this goal.

Installation and checkout of the astrophysical sensors in the "European Space Exposure Facility" on the Spektr-module.

Thomas Reiter

Born 23 May 1958 in Frankfurt/Main, Germany.

Education
Thomas Reiter has a Masters Degree in Aerospace Technology. He graduated from Goethe High School in Neu-Isenburg in June 1977, from the Armed Forces University in Neubiberg in December 1982 and from the Empire Test Pilots School (ETPS) in Boscombe Down, England, in December 1992.

Spaceflight Experience
ESA-Russian Euromir 95 mission to the Mir, along with Russian colleagues Yuri Gidzenko and Sergey Avdeev. Thomas Reiter was assigned as flight engineer for the record-breaking 179-day mission (3 September 1995 to 29 February1996). He performed some 40 European scientific experiments and participated in the maintenance of the Mir. He performed two spacewalks to install and later retrieve astrophysical sensors of the European Space Exposure Facility experiments (ESEF). After the mission, he was trained as Soyuz Return Commander.

Current Assignment
Within the Directorate of Human Spaceflight, Microgravity and Exploration Programme, he is providing support to the European Robotic Arm and Columbus programmes. Since April 2001 he is assigned to the first ISS advanced training class to prepare for one of the first European long-term flights on board the ISS.

Spaceship Earth and Beyond

Hans Schlegel
Member of the European Astronaut Corps
ESA / EAC, Cologne, Germany

The decision to send humans into space is purely a cultural and political one. Only the nations with the potential and vision to play a major role in shaping the future of our Earth – and even more of mankind – undertake the effort to push their capabilities and influence beyond current borders. By doing so, they gain new knowledge, technical possibilities and, most importantly, personal inspiration for their people. Spaceflight in general is one of the most visible and obvious frontiers to all people on Earth. Seeing and understanding that this endeavour is undertaken by the international community puts the various goals and motivations of individual humans and organisations into broader perspective.

It is human spaceflight that makes all of us aware of and emotionally touched by the fact that our Earth is nothing but a big spaceship that we need to maintain carefully, and whose resources we should use wisely. With this insight it is evident that we should invest some of our resources to go beyond the horizon of our spaceship Earth, to find what exists out there and to develop the technology necessary to leave the Earth and have access to our planets and moons. In the long run, the knowledge and capabilities gained will benefit all humans.

The roots of these thoughts are exactly what motivate people to study and become scientists. General curiosity about nature and the laws that govern it are the foundation of our civilisation

Working in weightlessness like in a laboratory on Earth.

and have led to the enormous gain of knowledge in the last few centuries. This is also what motivated me to apply to become a Science Astronaut, and as a result I was able to fly on the German-American Spacelab D-2 mission in 1993. Spacelab is a science laboratory developed and built under the management of the European Space Agency, and carried into space by the American Space Shuttle. It provides an earthlike laboratory environment in space. We conducted 90 experiments in eleven major scientific fields. During our 10-day mission, we worked around the clock in two shifts and were challenged to use all of our knowledge, experience and talent to satisfy the expectations of hundreds of scientists and engineers back on Earth. Many year before the mission, they had come up with the scientific questions and have developed optimised experiments from that point on. Now it was up to us to perform them in microgravity. We worked intently and experienced vey much the same things that thousands of experimental scientists experience back on Earth day after day – unexpected events, the need for flexibility and adaptability, sometimes even improvisation. The only thing lacking was the freedom to repeat an experiment run due to limited resources of time, electrical power, cooling and other environmental parameters.

It was amazing how often our skills as experimenters were needed in order to achieve a successful goal-oriented outcome of our various experiment runs. Our intuition and senses were helpful in many ways to make the mission as successful as it was. Microgravity in Earth orbit offers exciting conditions for many fields of experimental sciences. The scientific results of our mission were published in a book of more than 900 pages. Now, eleven years later, we recognise that the results have inspired and helped many scientific groups to come up with new ideas and develop more experiments in space and on Earth. As in Earth-bound laboratories, the experiments were designed, iterated, conducted, interpreted, adjusted and led to a meaningful outcome by humans. Humans are always the source of innovation, making use of all possible facets of their perception and senses. This is why human presence is essential to carry out experiments, especially in such a unique and relatively new environment as weightlessness.

Hans Schlegel

Born 3 August 1951 in Überlingen, Germany.

Education

Hans Schlegel spent the academic year 1968/1969 in the US as an American Field Service (AFS) exchange student and graduated from Lewis Central High School, Council Bluffs, Iowa. In 1970 he graduated from Hansa Gymnasium at Cologne, Germany. In 1979 he received a Diploma in Physics (Master of Physics) from the University of Aachen, Germany.

Spaceflight experience

From 26 Apri to 6 May 1993, Schlegel served as Payload Specialist on STS-55 aboard Space Shuttle Columbia. Ninety experiments were conducted during the German-American Spacelab D-2 mission to investigate life sciences, material sciences, physics, robotics, astronomy, and the Earth and its atmosphere. He trained for two years as a Cosmonaut at Yuri A. Gagarin Trainig Centre in Moscow and was certified as Second Flight Engineer for the MIR space station. During the German-Russian MIR-'97 mission he served as a Crew Interface Communicator (Capcom) in the German Mission Control Centre for the experiments.

Current Assignment

In August 1998, ESA sent him to the Johnson Space Center for training as a Mission Specialist with the NASA Astronaut Class of 1998. Since January 2003, in addition to training, he has also been assigned to the Capcom branch of the Astronaut Office in Houston, where he is responsible for the ground-to-space communication with the ISS crew.

“Der bestirnte Himmel über mir”

Gerhard Thiele
Member of the European Astronaut Corps
ESA / EAC, Cologne, Germany

The world watched in disbelief and horror when, on 1 February 2003, Space Shuttle Columbia disintegrated on reentry in the Texan sky, claiming the lives of seven astronauts, just sixteen minutes away from home. The space community mourned the loss of a distinguished, unique crew, some of us lost close friends, and families lost their beloved ones. In the face of this tragedy, inevitably the question was asked: Should we fly into space? Is the risk not too high, the price we are paying for this endeavour not excessive?

It is difficult, if not impossible, to answer questions regarding the value of our deeds when they are connected with an account for human lives. I will not attempt to answer this question. I know I would fail.

But then, why are we flying into space? There is no easy answer; if there was we would not ask the same question again and again. But maybe the tragic fate of the seven Columbia astronauts provides a clue. Why were people around the globe shocked when they heard the news, regardless whether they lived in Moscow or Sydney, Tokyo or Capetown, Mexico City or Paris? Let alone the people of the US and Israel. Many of us can still recall where they were and what they were doing when they first heard the devastating news. (The very same is true for the landing of Apollo 11 on the Moon: it seems that both triumph and tragedy evoke powerful emotions and lasting impressions.)

People feel attached to these astronauts. But what are these ties? I believe they root in our deepest inner self. Human beings have a desire to explore the unknown, to comprehend the worlds beyond, to probe the boundaries – and thus push them further. And even though as grown-ups we often tend to forget or neglect our natural curiosity, as mothers and fathers we have answered countless “Why?” questions. Is not the growing child, asking all these questions (Why does the Sun shine? Why is the sky blue? Why are the seas salty? Why are the mountains high? ….) a symbol of the human being who grows by asking questions in the desire to better understand himself and his surroundings?

Why should the sky be the limit? I recommend you go outside on a clear night, away from the frequently blinding lights of the city. Take a look at the stars and let your mind wander! The questions will come back. Philosopher Immanuel Kant wrote: “Nothing fills me with more, ever increasing awe than the stars above me and the moral law within me”*. After all, we are born from stardust. The elements constituting our bodies did not exist when our Universe was created some ten billion years ago. According to our current understanding of the Universe everything heavier than hydrogen or helium was created inside the stars and released into the Universe in countless violent explosions, thus generating the prerequisites for life and, eventually, us human beings on planet Earth. The sky *is not* the limit, we have proven it (even though we have failed tragically more than once).

Is spaceflight a romantic vision only? The answer to this question is clearly “No”. Spaceflights have resulted in many measurable and valuable results. This is true not only for science, but some results affect our daily lives already without us taking much note of it. European astronauts have contributed to quite a lot stories of success in the past 20 years. I will restrict myself to two examples, not because I think the others are less important, but because I feel especially attached to these missions. Firstly, I would like to mention

*The German original version by I. Kant:
„Zwei Dinge erfüllen das Gemüt mit immer neuer und zunehmender Bewunderung und Ehrfurcht, je öfter und anhaltender sich das Nachdenken damit beschäftigt: Der bestirnte Himmel über mir und das moralische Gesetz in mir.“

The crewmembers of STS-107. Top row, from left: David M. Brown, William C. McCool, Michael P. Anderson; bottom row, from left: Kalpana Chawla, Rick D. Husband, Laurel B. Clark and Ilan Ramon. On 1 February 2003, the seven crewmembers were lost with the Space Shuttle Columbia. This picture was on a roll of unprocessed film recovered from the debris. (NASA)

the missions centered around the Hubble Space Telescope. Its undisputed success, resulting in an ever better understanding of our Universe, would not have been possible without the respective service and repair missions carried out by the astronauts (including Claude Nicollier and Jean-François Clervoy from ESA). The second example is the Shuttle Radar Topography Mission (SRTM), which aimed at generating a digitised, high-resolution model of the Earth's topography between 57°S and 60°N. Not only scientists are using the SRTM results. Topographic maps based on SRTM data are being implemented into aviation approach charts, enhancing the situational awareness of pilots and, thus, ultimately contributing to safer air travel.

These are just two out of many examples. Examples, which prove that we benefit from the bold attempt to explore the vast expanse beyond our atmosphere.

The crew of Columbia did not turn away from the challenge of a risky space mission. They were convinced that their work would benefit humankind. They knew that our rewards will be unparalleled if we succeed. We must not fail them.

Gerhard Thiele

Born 2 September 1953 in Heidenheim-Brenz, Germany.

Education
Completed final high school examination at Friedrich-Schiller-Gymnasium in Ludwigsburg in 1972; studied physics at Ludwig-Maximilians Universität in Munich, and at Ruprecht-Karls-Universität in Heidelberg, from 1976 to 1982; received his doctorate at the Institute for Environmental Physics of Heidelberg Universität, in 1985.

Spaceflight Experience
From 11 to 22 February, 2000, Gerhard participated as Mission Specialist in the STS-99 mission. The Shuttle Radar Topography Mission (SRTM) was dedicated to the first three-dimensional, digital mapping of the Earth's surface on a near-global scale. He was responsible for SRTM operations, including the deployment and retraction of the 60 m boom from Endeavour's cargo bay that carried one of the flight's radar systems. He was also one of two spacewalking crew members, in the event a contingency spacewalk was necessary.

Current Assignment
Following his flight, Thiele has been assigned by NASA for collateral duties as a Capcom, the interface in charge of communications between the Control Center and the Space Shuttle crew. This was the first time that this position has been assigned to a European astronaut.

From August 2001, Gerhard Thiele served as Head of the ESA Astronauts and Operations Unit at EAC in Cologne. In addition, he was acting Head of the Astronauts Division from August 2002 until April 2003.

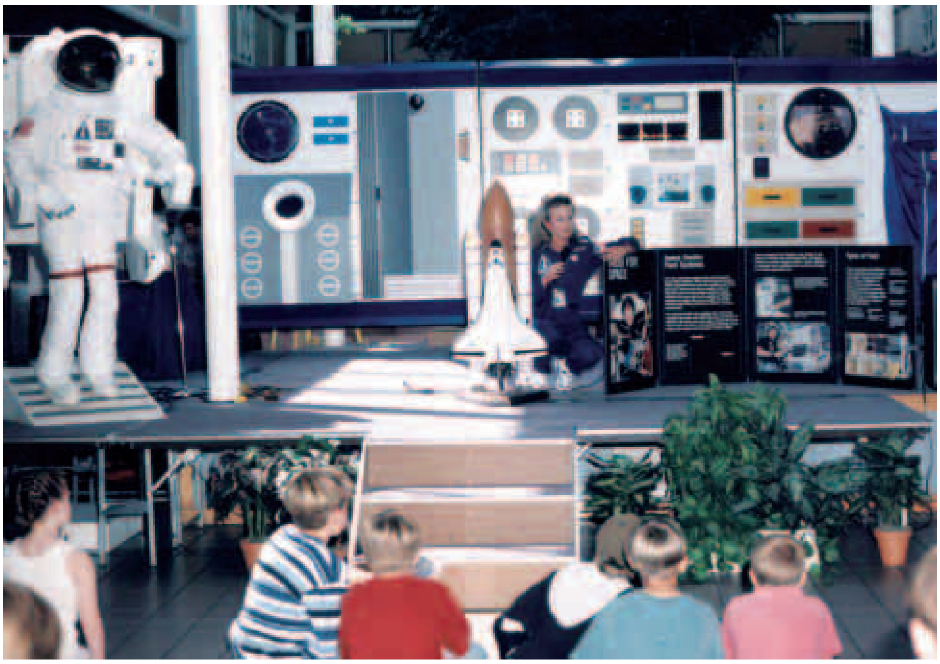
In January 2003, Thiele was assigned as backup of André Kuipers for the Soyuz 8S mission scheduled for April 2004. He started training at Yuri A. Gagarin Cosmonaut Training Centre (Star City) in May 2003.

Space Exploration: For the Benefit of Future

Roberto Vittori
Member of the European Astronaut Corps
ESA / EAC, Cologne, Germany

Vittori was the first ESA astronaut to fly with a space tourist. From left to right: Yuri Gidzenko, Roberto Vittori and Marc Shuttleworth.

Our planet has limited resources. This is immediately evident looking down to Earth from the window of the International Space Station, as I had the privilege of doing during my first space mission in April 2002.



Children want to explore and see what is out there.

Humankind is quickly taking over the entire planet and pushing it to the edge of irreversible changes that span the whole globe. Fossil fuels and the associated pollution are a great danger for the future of our natural resources on Earth; the population is on an exponential curve up to the point where our planet might be too small to sustain it.

Exploring space has no immediate rationale that can support and justify the effort. By definition, exploration is a term which includes the uncertainty of the final result. But exploration could be the long-term solution to allow the exuberant, dynamic and aggressive nature of us, human beings, to find vital spaces outside Earth, so as to continue to build and expand beyond of our beautiful planet.

Generations

Roberto Vittori and Frank De Winne in preparation for their flight on the Soyuz spacecraft.

The Moon could be a harbour and industrial area for our civilization. Mars could host colonies.

Explore to see what is out there, outside our planet. This is what my two children, Edoardo and Davide, would like to do. Explore to preserve the resources of the Earth. Explore to satisfy the human desire to find answers and proceed further.

"Fatti non foste a viver come bruti, ma per seguir virtute e conoscenza." (Dante, Divine Comedy, Inferno XXVI) "You were not formed to live the life of brutes, but virtue to pursue and knowledge high."

Explore for ourselves, for our children and for the benefit of generations to come.

Roberto Vittori

Born 15 October 1964 in Viterbo, Italy.

Education
Roberto graduated from the Italian Air Force Academy in 1989. Completed basic training with the U.S. Air Force at Reese Air Force Base in Texas, US, in 1990. Graduated from the U.S. Navy Test Pilot School in 1995. Completed the Italian Air Force's Accident Prevention course (Guidonia A.F.B., Italy) and Accident Investigation course (Kirtland A.F.B., New Mexico, US) between 1996 and 1997.

Spaceflight experience
From 25 April to 5 May 2002, Roberto Vittori participated in a taxi flight to the International Space Station, under an agreement between the Russian Space Agency Rosaviakosmos, the Italian Space Agency ASI and ESA. One main goal of this mission was the successful delivery of a new "lifeboat" to the Station for use by the resident crew in the event of an emergency.

Current Assignment
In August 2002, Roberto Vittori was relocated to NASA's Johnson Space Center in Houston, where he supports the New Generations Space Vehicles branch.

Charta of the European Astronaut Corps

Our Vision

Shaping and Sharing Human Space Exploration
Through
Unity in Diversity

Our Mission

We Shape Space by bringing our European values to the preparation, support, and operation of space flights that advance peaceful human exploration.

We Share Space with the people of Europe by communicating our vision, goals, experiences, and the results of our missions.

Our Values

Sapientia: We believe that Human Space Exploration is a wise choice by and for humankind. Sapientia reflects our commitment to pursue our goals for the advancement of humanity.

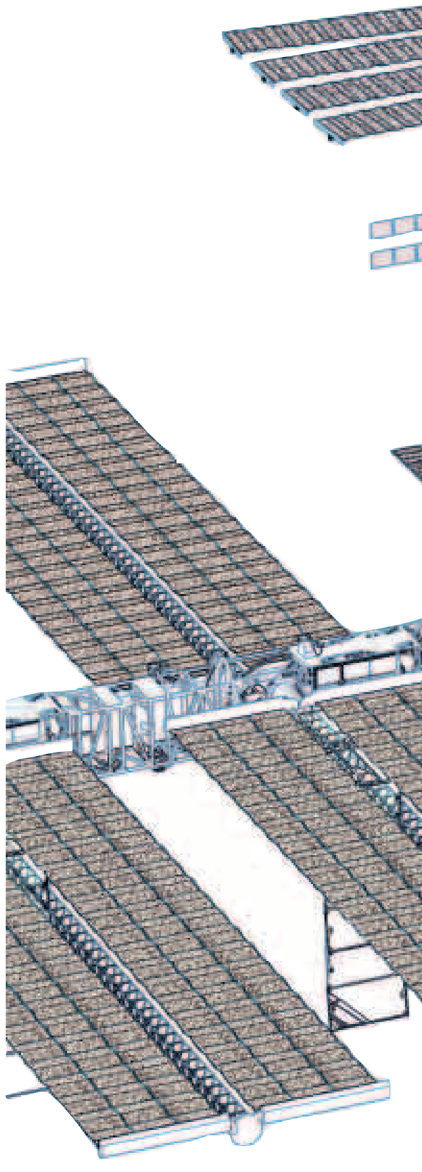
Populus: We put people first, in two ways: First, the purpose of our missions is to contribute to a better future for people on Earth. Second Populus serves as a reflection of our respect for the people with whom we work: that we value their opinions, praise their work and compliment them for their support.

Audacia: We acknowledge that Spaceflight is a dangerous endeavour. While accepting the risks inherently involved in space travel we work to minimize these risks whenever we can. Audacia reminds us that the rewards will be unparalleled if we succeed.

Cultura: We continue the exploration started by our ancestors. Conscious of our history and traditions, we expand exploration into space, passing on our cultural heritage to future generations.

Exploratio: We value exploration as an opportunity to discover, to learn and, ultimately, to grow. We are convinced that humankind must embrace the challenge of peaceful human space exploration. We, the European Astronauts, are willing to take the next step.

Cologne, this fifteenth day of August twothousandone anno domini



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