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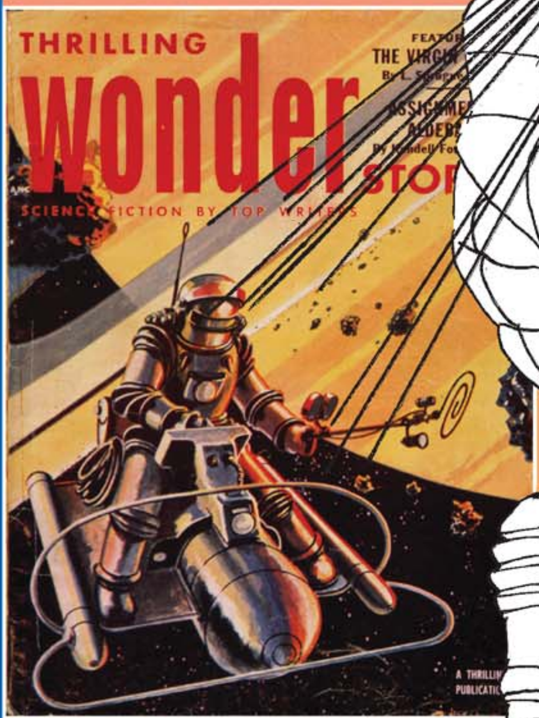
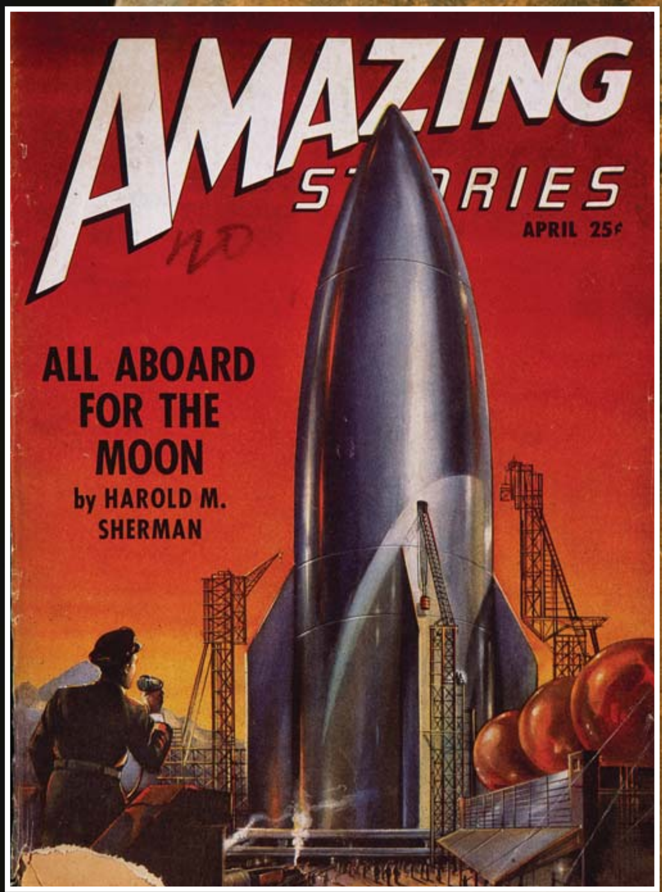



# SCIENCE FICTION, TECHNOLOGY FACT

esa

# INTRODUCTION

**Artwork has played an influential and central role in science fiction literature. It has partly defined the scope of the genre and has brought the startling and imaginative visions of outer space, exploration of other worlds, interplanetary spaceflight and extraterrestrial beings into the minds and consciousness of the general public. In magazines and books, film and television, advertising and video, the artist's vision has transformed words into dazzling and compelling images that still lift the spirits and brighten the soul.**

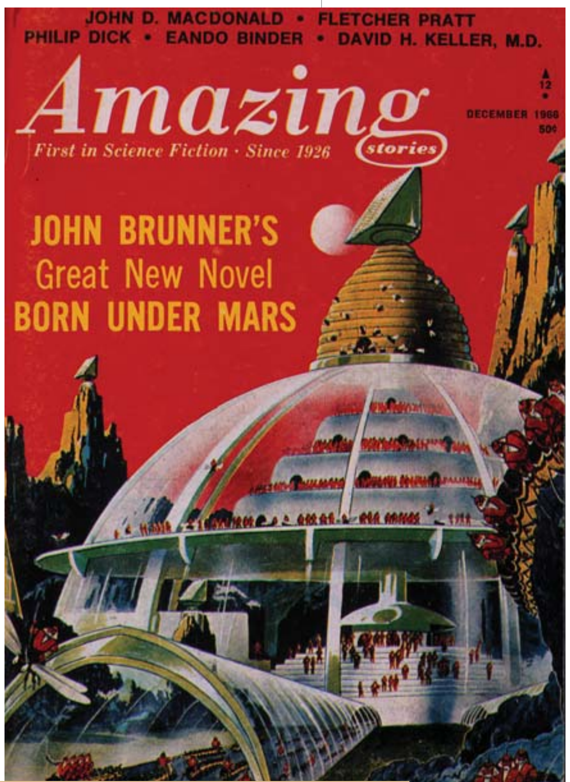



A range of books gives wonderful examples of book and magazine covers, as well as paintings, illustrations and film posters, depicting science fiction themes and scenes. They trace the history and development of science fiction art, giving many examples of the images behind the stories, noting the technologies and ideas inherent in the pictures, and describing the lives and works of the artists and illustrators. Pulp magazines, with their lurid covers and thrilling, violent, sex-laced and fantasy-filled stories, fostered the talents of some of the greatest popular writers of the time and virtually invented the genre of science fiction.

Although fantasy and science fiction tales were published occasionally and artists had depicted fantasy scenes in engravings for many years, the first science fiction magazine proper, Amazing Stories, appeared in 1927, published and edited by Hugo Gernsback, a native of Luxembourg, with all the covers and interior artwork done by Frank Rudolph Paul, a native of Austria. Since then, the genre – full of descriptions of space technologies and systems, often just pure imagination but sometimes based on some semblance of fact – has never looked back.


A couple of years ago, ESA studied science fiction literature, artwork and films to see whether there were any ideas, particularly in older stories, that might be worth a closer look today given the new advances in technologies. The study was carried out by the Maison d'Ailleurs in Yverdon-les-Bains, Switzerland, which houses one of the largest collections of science fiction literature in the world. Seeing some of the wonderful cover pictures of the books and magazines in the collection – essentially lost art – and noting the unfettered imagination of the artists as they depicted their chosen scenes forty, fifty, sixty years ago, prompted the idea of selecting some of the thousands of covers and juxtaposing them with the reality of today. Showing, for example, what space stations actually look like in space today compared with how artists many years ago imagined they might appear – long before they were on the drawing boards and even before the first satellite had been launched.

**There are numerous examples of concepts proposed or illustrated in early science fiction writings that have become reality. Examples include: ultra-high velocity projectile launchers (1865); retro-rockets (1869); planetary landers (1928); rocket fins for aerodynamic stability (1929); vertical assembly buildings (1929); clustered rocket boosters (1929); spacewalks, pressure suits, life-support tethers (1929); the construction of an orbital space station complete with living quarters using materials ferried up, with regular service visits (1945); communications via satellites in geostationary orbit (1945); solar and light sails (1920, 1951, 1963); multiple propellant storage tanks (1954); streamlined crew modules for atmospheric entry (1954).**

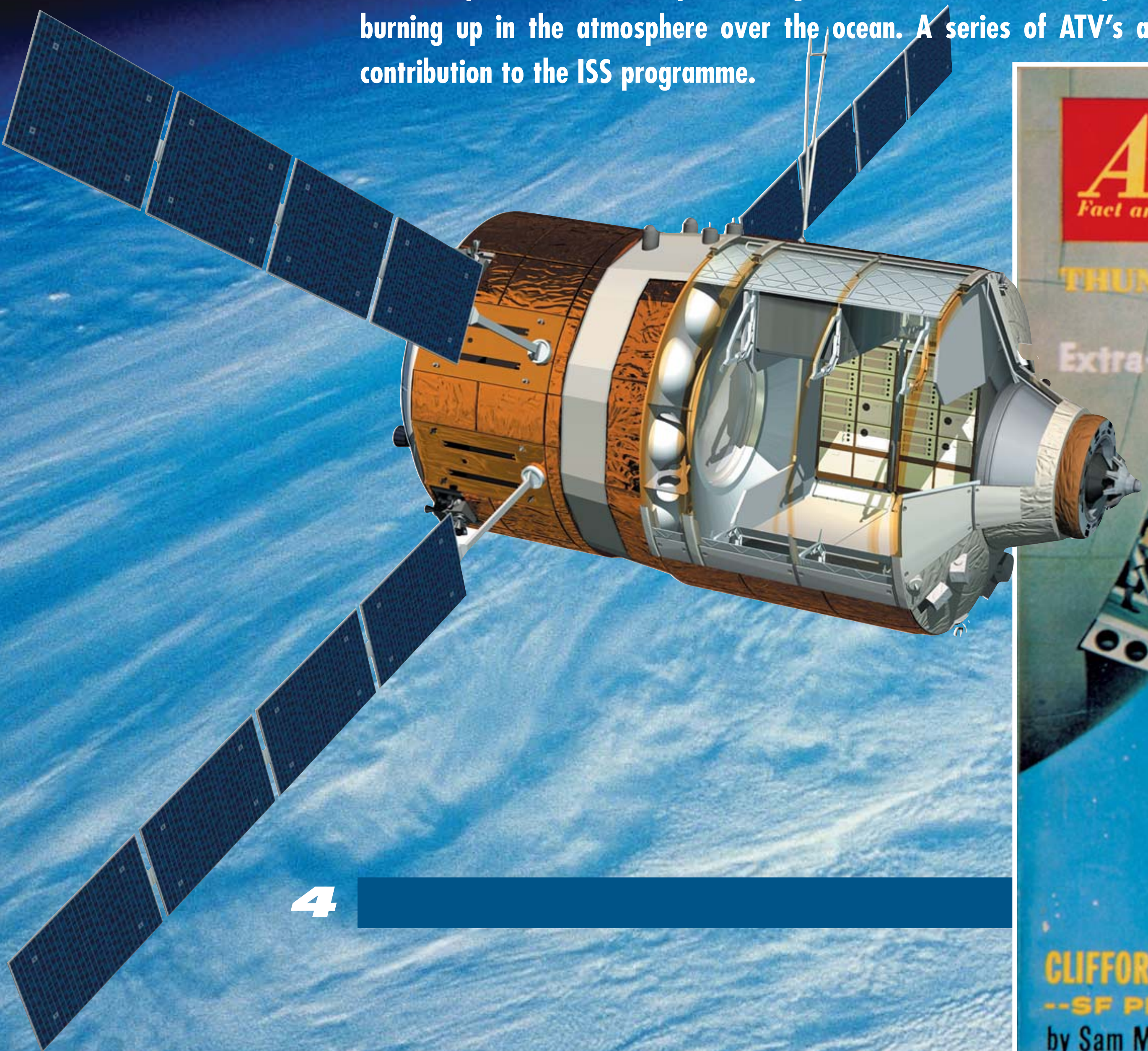


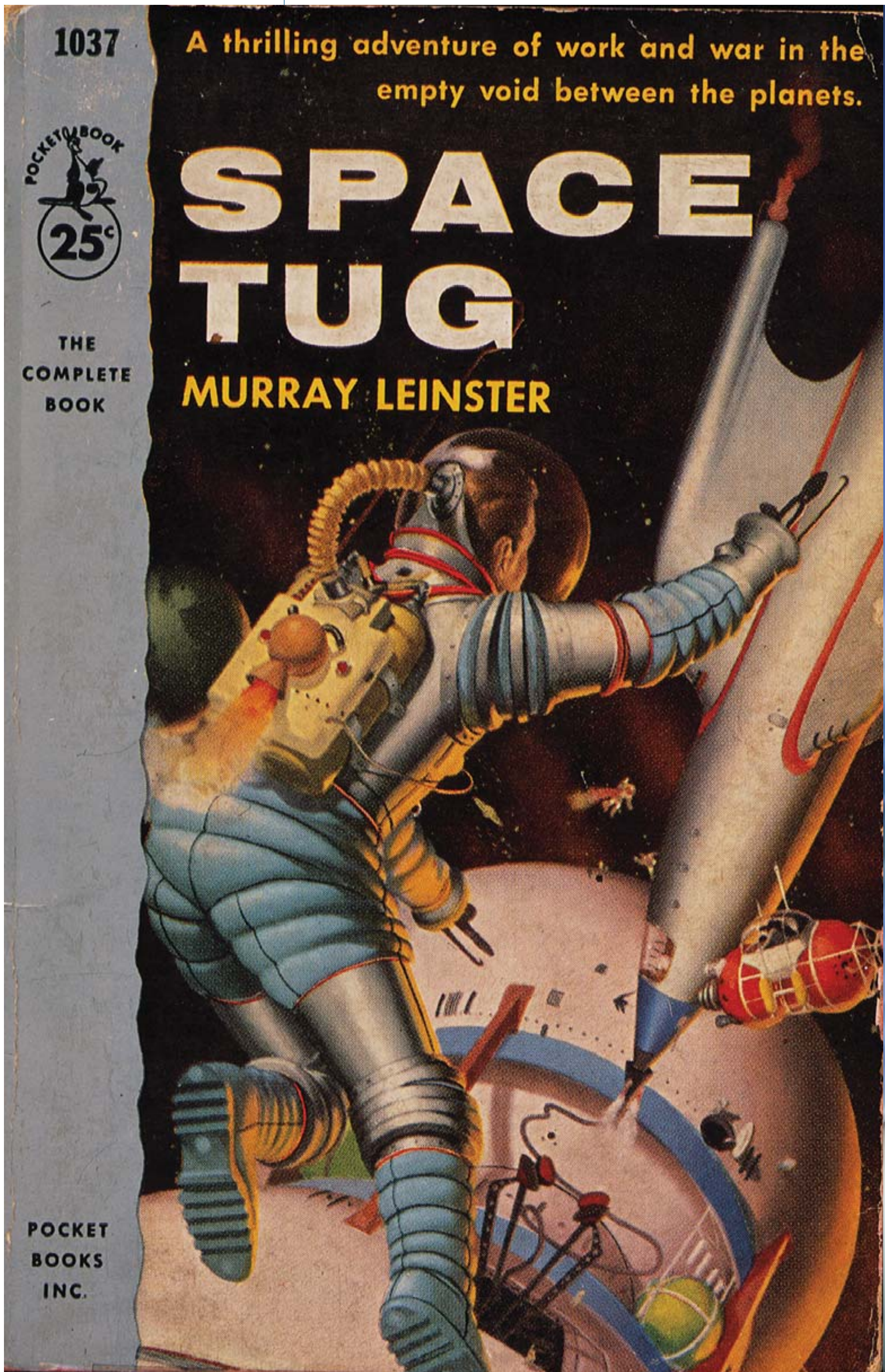

What this book gives is a tiny sampling of science fiction book and magazine covers from the collection of Maison d'Ailleurs, together with images from ESA's own photograph collection. The idea is to show how close or how far was an early artist's conception from what was later built and launched. In many instances, we are not yet at the stage that science fiction authors and artists imagined. While we have constructed a handful of space stations – in very different forms to that imagined by most science fiction covers – we have not yet established settlements on planets (or indeed in space), nor have we yet achieved interplanetary flight. On the other hand, some of the renderings of spacesuits or planetary landers and rovers are close to what we employ in space today.

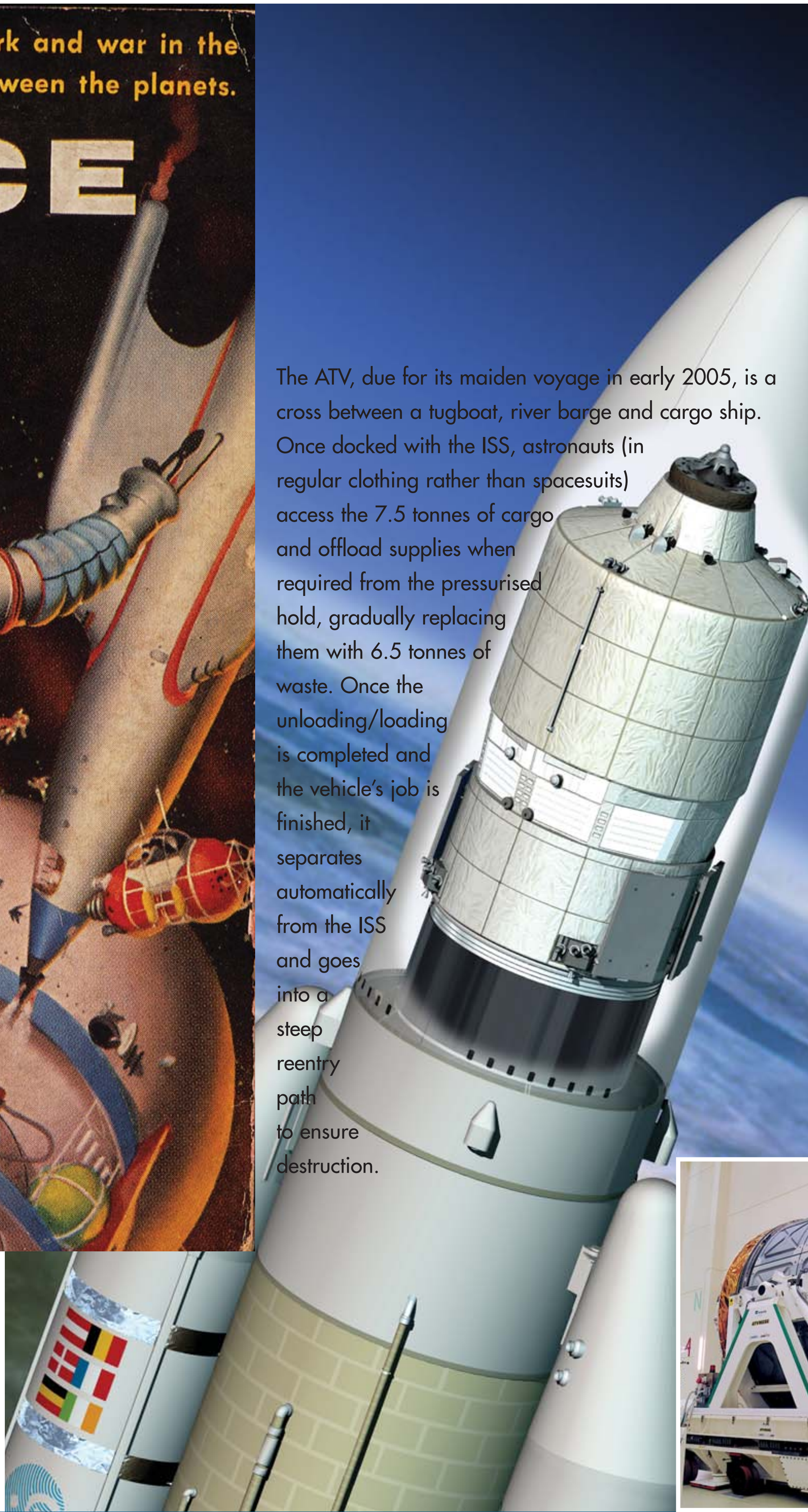
This is interesting because early science fiction authors, artists and illustrators described space concepts and spacecraft based on the limited scientific knowledge available at the time, whereas more modern writers generally portray the same basic systems as used in real-life spaceflight, even though artistic licence is often employed. In addition, advances such as miniaturisation and robotics provide modern writers and illustrators with the benefit of existing and proven technologies that can be directly adapted. Anything produced much before the first satellite, Sputnik, appeared in 1957 was more a product of real artistic inventiveness.

# SUPPLYING STORES IN SPACE

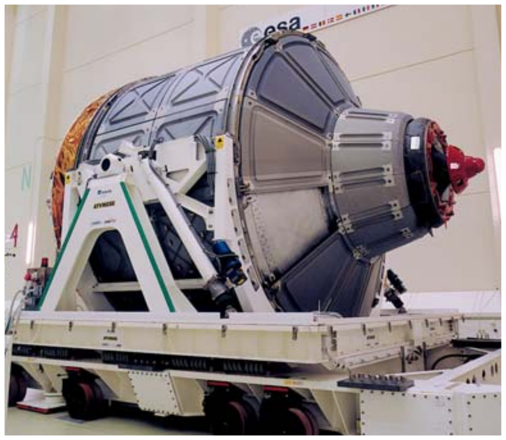
**The Automated Transfer Vehicle (ATV) is an unmanned ferry designed to supply the International Space Station (ISS) with equipment, food, clothing, water, air (nitrogen and oxygen), propellant and other stores. ATV approaches and docks with the ISS automatically, where it can remain attached for up to six months, during which time it can support the attitude control of the station and reboost it to compensate for atmospheric drag. In addition, the ATV disposes of waste from the ISS by burning up in the atmosphere over the ocean. A series of ATV's are planned as part of ESA's contribution to the ISS programme.**



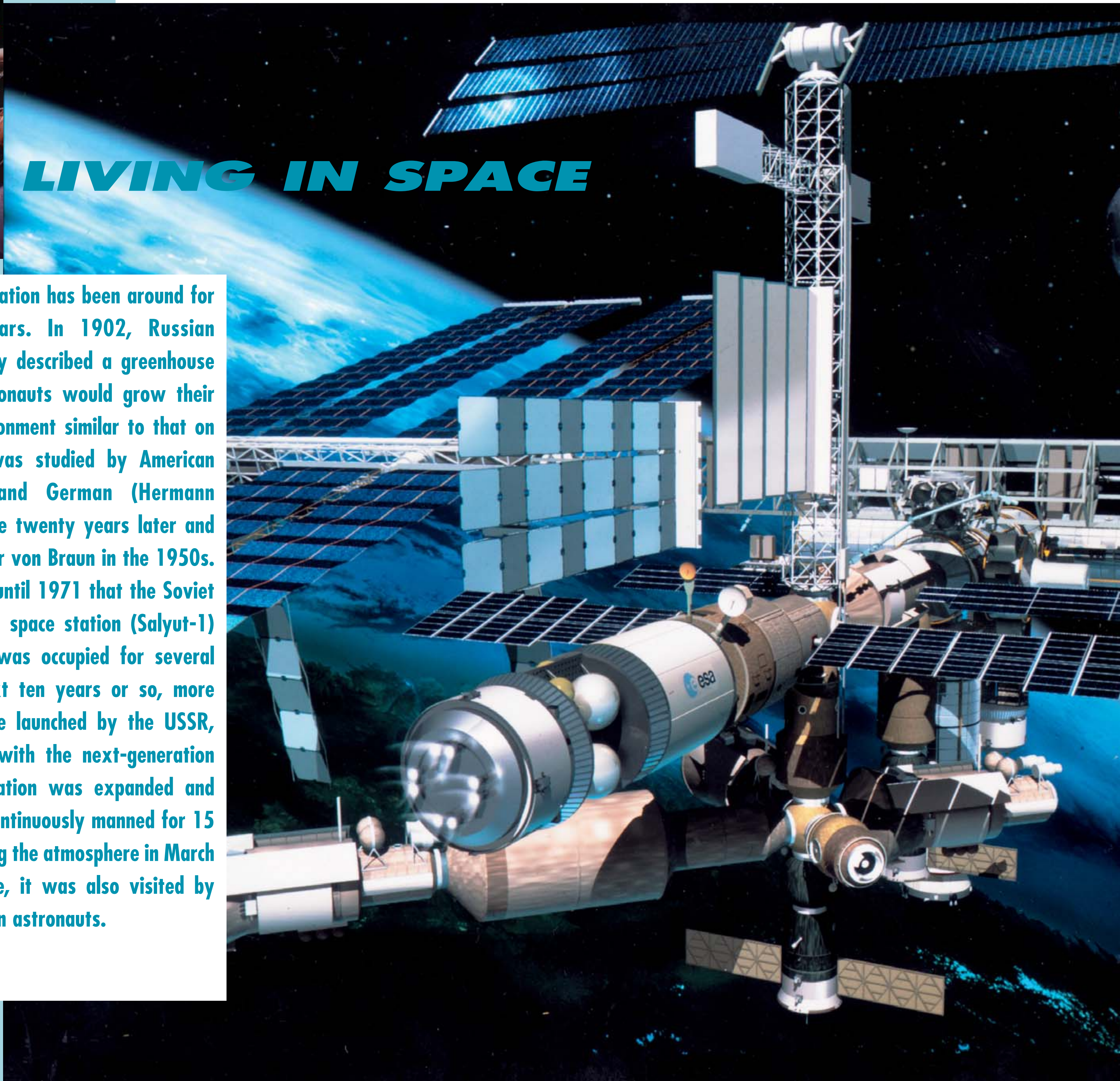


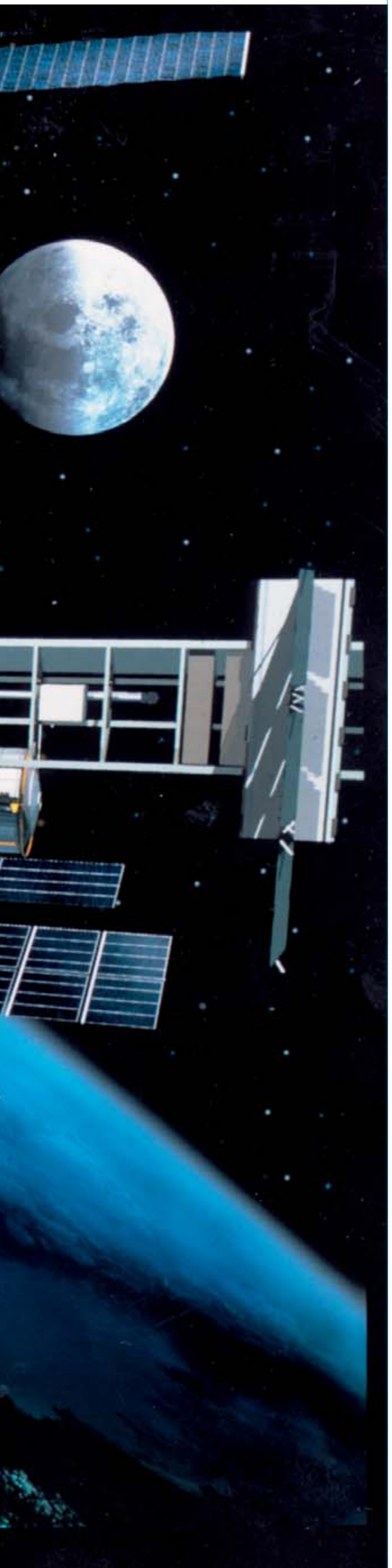
The ATV, due for its maiden voyage in early 2005, is a cross between a tugboat, river barge and cargo ship. Once docked with the ISS, astronauts (in regular clothing rather than spacesuits) access the 7.5 tonnes of cargo and offload supplies when required from the pressurised hold, gradually replacing them with 6.5 tonnes of waste. Once the unloading/loading is completed and the vehicle's job is finished, it separates automatically from the ISS and goes into a steep reentry path to ensure destruction.

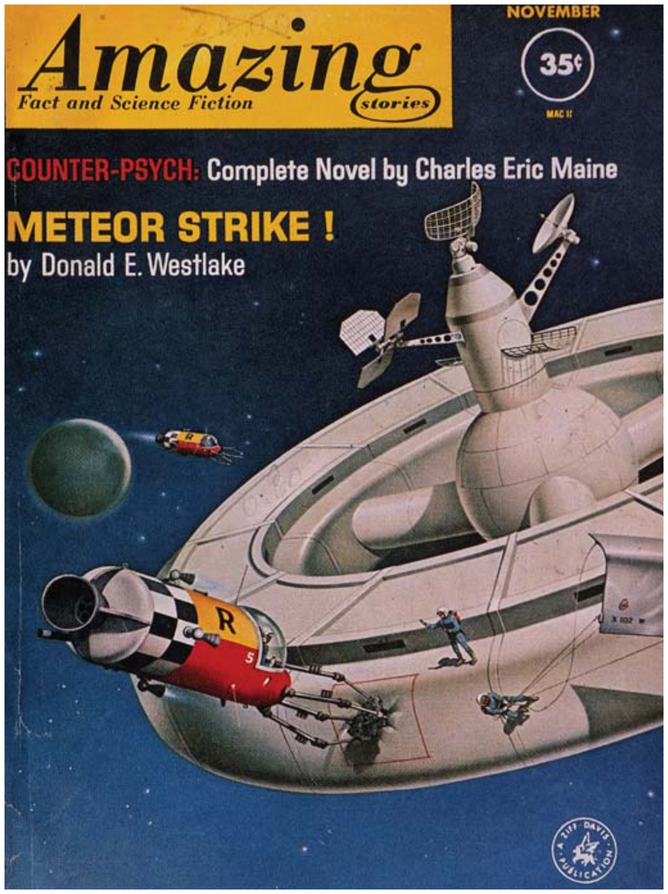




# LIVING IN SPACE




The idea of a space station has been around for more than 100 years. In 1902, Russian Konstantin Tsiolkovsky described a greenhouse in space where cosmonauts would grow their own food in an environment similar to that on Earth. The concept was studied by American (Robert Goddard) and German (Hermann Oberth) pioneers some twenty years later and then again by Wernher von Braun in the 1950s. However, it was not until 1971 that the Soviet Union placed the first space station (Salyut-1) into orbit, where it was occupied for several weeks. Over the next ten years or so, more manned stations were launched by the USSR, culminating in 1986 with the next-generation Mir. This modular station was expanded and stayed aloft almost continuously manned for 15 years before reentering the atmosphere in March 2001. During its time, it was also visited by American and European astronauts.







The Americans launched their initial space station, Skylab – created from the third stage of a spare Saturn-5 Moon rocket – in 1973 and it was occupied by three crews before being abandoned, as planned, in 1974. It was eventually guided to disintegration in the atmosphere in 1979. By then, a somewhat more ambitious laboratory, ESA's Spacelab, was in the works and it was first launched in 1983 aboard a Space Shuttle. Although not a true space station, Spacelab was a cylinder with a diameter of 4 m and a length of 6 m and, housed in the Shuttle cargo bay, offered a shirt-sleeve working environment. The last Spacelab flight took place in 1998, but the extensive experience provided the foundation for ESA's Columbus ISS module.

**In 1984, the United States committed itself to building a permanently manned space station – and invited other nations to participate. Europe, Canada and Japan responded with enthusiasm, but it was many years before the wrangling and politics, plus the dissolution of the USSR and subsequent accession of Russia to the programme, settled down sufficiently to allow the base in space to progress.**

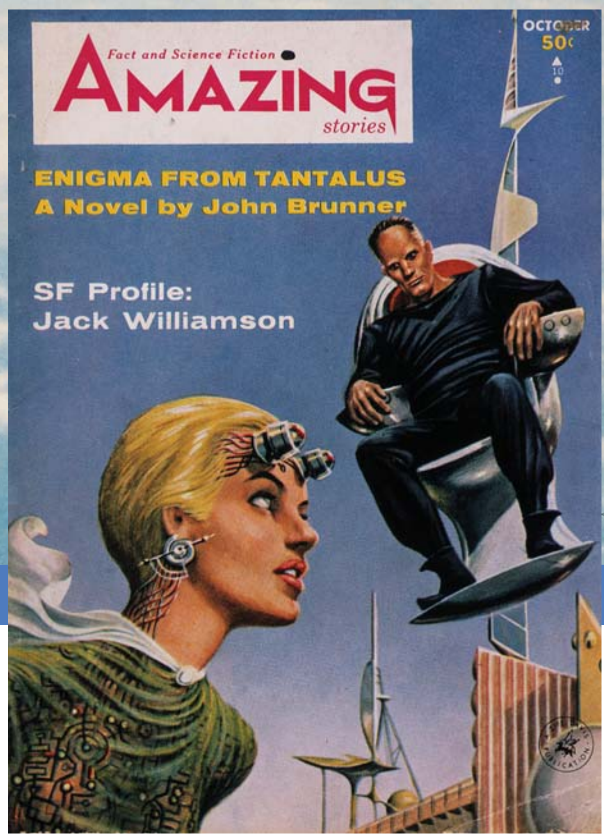
**The International Space Station is the most ambitious international space project ever undertaken, with 16 nations collaborating to create an orbital laboratory that will conduct research for the benefit of people on Earth. Construction began in November 1998 and, by the end of 2003, after nearly 40 missions to assemble and equip it, the orbital station is about a third of the way towards completion.**

The design of the ISS is very different from the spoked-wheel concept of many science fiction images. Early science fiction writers portrayed spacecraft and systems based on the scientific and technical knowledge available at the time. The wheel design reflected the belief that the discomfort and potential fatality of weightlessness must be combated by rotating the station to create artificial gravity, with the crew working and living inside the rim. With the founding of the US civil space programme in 1958 and the preparation of detailed space station designs, the wheel shape was found to be impractical and it was decided that docked modules offered the best approach. By 1970, both the USA and the USSR were planning modular designs for their stations. All modern space stations – Salyut, Skylab, Mir, the ISS – have been based on the cylinder. Cylindrical modules are added as necessary for living quarters, laboratories and utilities. In addition, huge Sun-following solar panels provide power, a feature missing from the science fiction pictures. One wonders how the artists conceived power being supplied to their circular stations.

# GETTING AROUND IN SPACE

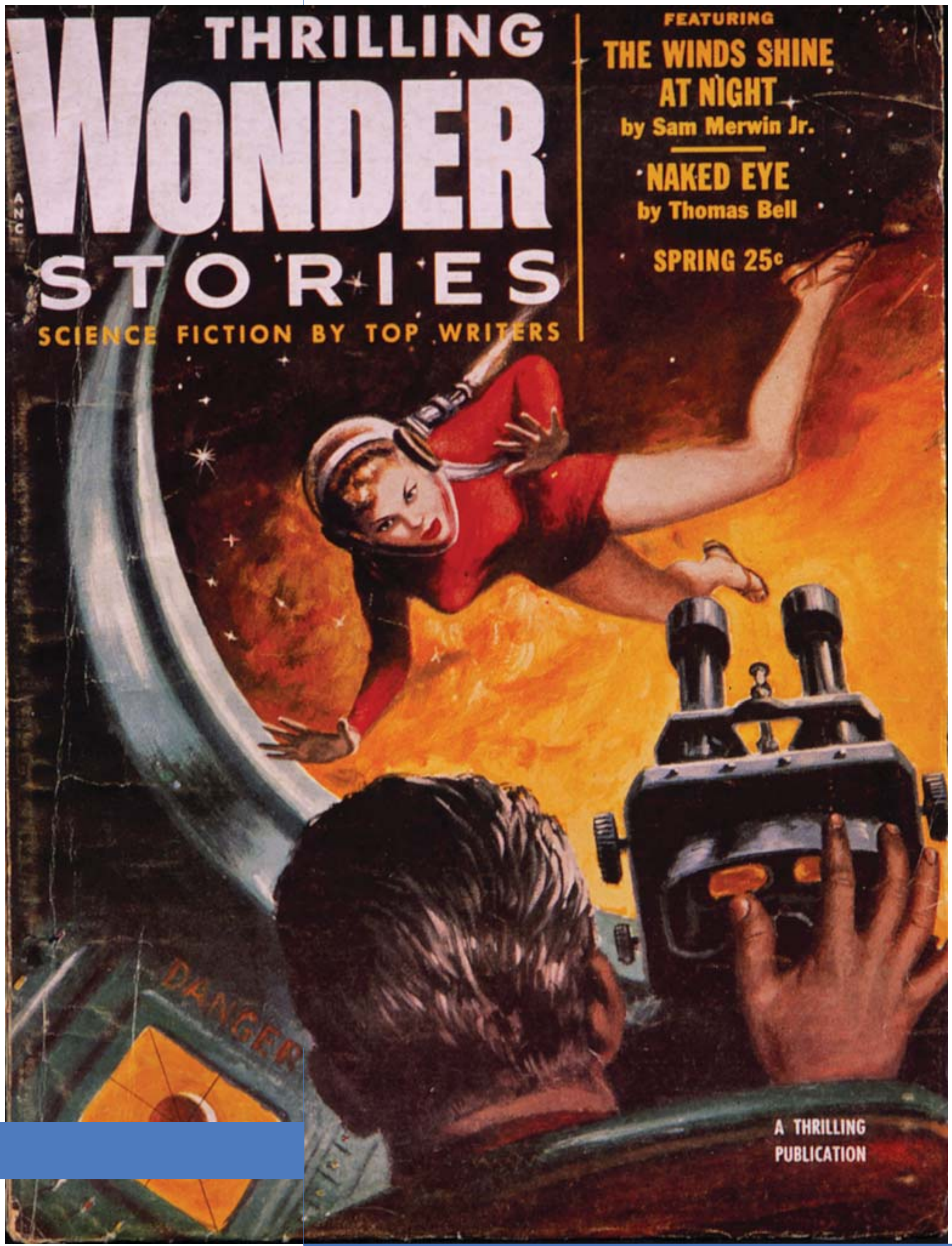

**In science fiction, a huge variety of personal transportation devices is called on to let astronauts move around outside their spaceships. They include anti-gravity devices, self-propelled rocket backpacks, tethers and umbilical cords, and teleportation. In real life, though, the number of devices used for extravehicular activity (EVA) is far fewer!**

In an EVA, or spacewalk, an astronaut leaves the protective environment of the spacecraft's pressurised cabin and ventures into the vacuum of space wearing a spacesuit. In the early days of EVAs, the astronaut was always attached to the spacecraft at all times by a safety tether. The tether provides general freedom of movement, but can limit some tasks because it is too short, may have to be moved to another attachment point, become entangled or offer no control




Personal manoeuvring units were developed because astronauts found tethers too restrictive; they offer more freedom and allow the user to roam further afield. One of the first was NASA's Manned Maneuvering Unit (MMU), a nitrogen-propelled backpack controlled by joysticks at the end of the arm rests. Moving the controllers left or right or pulling them fired nitrogen thrusters to propel the astronaut in different directions. The MMU snapped onto the back of a spacesuit's life-support backpack and allowed the astronaut to work outside without a tether as much as 100 m away from the Space Shuttle for up to six hours at a time.

The MMU was an experiment – although big and bulky, it was successful. When the suited astronaut attached the MMU to his suit, the ensemble became a self-contained machine that could be used to capture a malfunctioning satellite. On one of its three flights, in 1984, it was used to rescue an ailing solar observatory, bringing it to the Space Shuttle for repair.



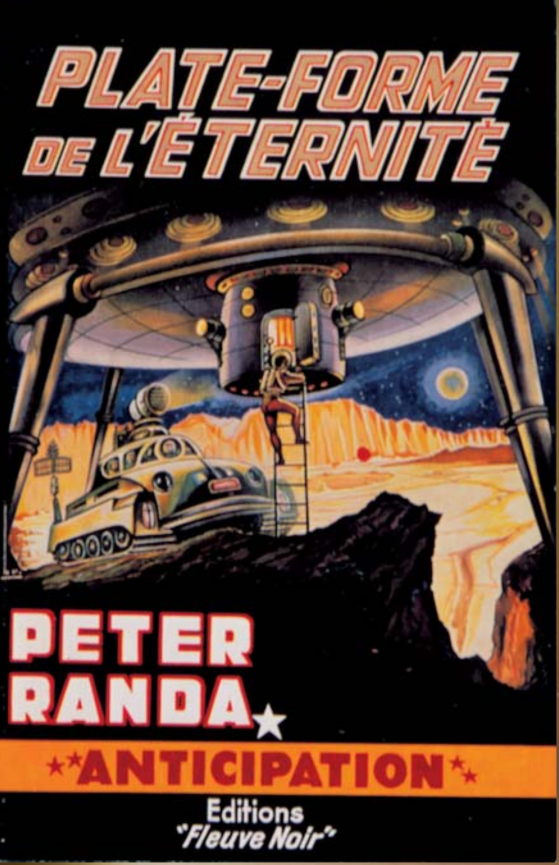

NASA's Shuttle and ISS spacesuit (EMU; Extravehicular Mobility Unit) is an independent suit that provides the astronaut with environmental protection, mobility, life support and communications. The EMUs, which come in various sizes, provide the necessities for supporting life, such as oxygen, a pressurised enclosure and temperature control. It also protects against radiation, micrometeoroids and the extremes of heat and cold. The self-contained life-support system contains seven hours of expendables, including oxygen, a battery for electrical power, water for cooling, lithium hydroxide for carbon dioxide removal and a 30-minute emergency life-support system. Because it is self- contained, the EMU eliminates the need for a suit-to-spacecraft supply line or umbilical.


# FASHION IN SPACE

The environments faced by astronauts during launch, life in space and spacewalks are very different, so their wardrobe includes different types of clothing. During Shuttle launch and reentry, a special suit is worn that is partially pressurised to prevent the excessive flow of blood from the brain to the legs once terrestrial gravity regains its grip. The suit is also fitted with an emergency parachute in case it is necessary to jump out of the Shuttle. Inside the Shuttle or ISS, the atmosphere is carefully controlled in terms of pressure, content and temperature so no special clothing is necessary, with the proviso that whatever is worn is hygienic and non-flammable. Clothing can be comfortable (preferably with pockets to keep small items from floating around) and shoes are necessary only during exercise.


Some of the biggest fashion houses are involved in designing clothing for space and are experimenting with different fabrics, materials and technologies to improve hygiene, comfort and safety. The harsh environment of space demands strong yet lightweight materials able to withstand extremely high temperatures and impact forces. Space technology developments to create these innovative garments are benefiting the terrestrial textile and clothing industries. Fashion spin-offs from space include:

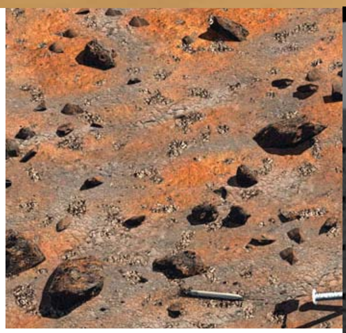
- jackets that embed wearable antennas;
- intelligent shirts, embodying shape-memory alloy threads, which can be ironed simply using a hair dryer, or with sleeves that can go from long to short by the application of hot air;
- overalls that keep the wearer cool in hot conditions or warm in cold climates;
- glasses that demist themselves.



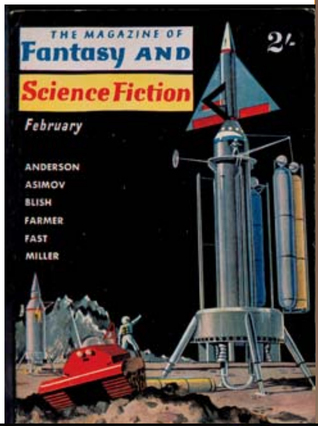

# LANDING AND ROVING OFF-EARTH

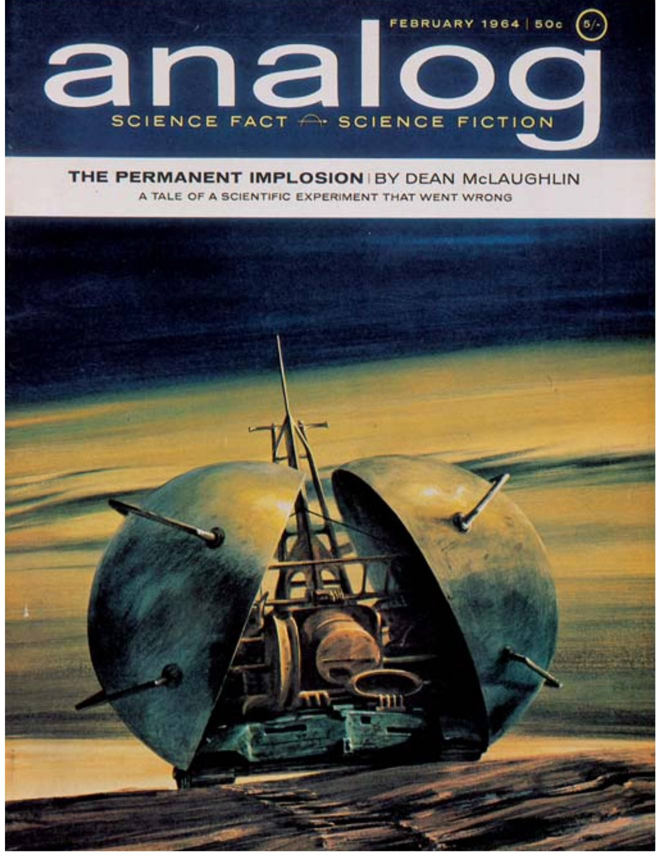
**If defying gravity and taking off from the Earth is still a major undertaking, then landing on a planet millions of kilometres away is even more challenging. Not only does a spacecraft have to travel an extremely long distance to find its target, it then has to land in a pre-selected area in such a way that it is not damaged – a difficult feat when the precise surface features are largely unknown.**

Landers come in various shapes and sizes, ranging from highly complex manned lunar landers with a requirement to take-off again to automated sample analysers that stay put. Unmanned landers are becoming smarter, able to guide themselves to the surface using sensors and cameras to check out the landing zone and avoid hazards such as rocks and craters. In future, they will carry impact protection systems lighter than the tough but heavy airbags used at present on some landers. Landing gear is being designed with shock absorbers to survive impact on uneven and rough terrain and so avoid toppling over. More sophisticated technologies will also allow future landers to carry more equipment, for example, ground-penetrating radar, drills and hoists for collecting rock and soil samples for in-situ analysis or eventual return to Earth.



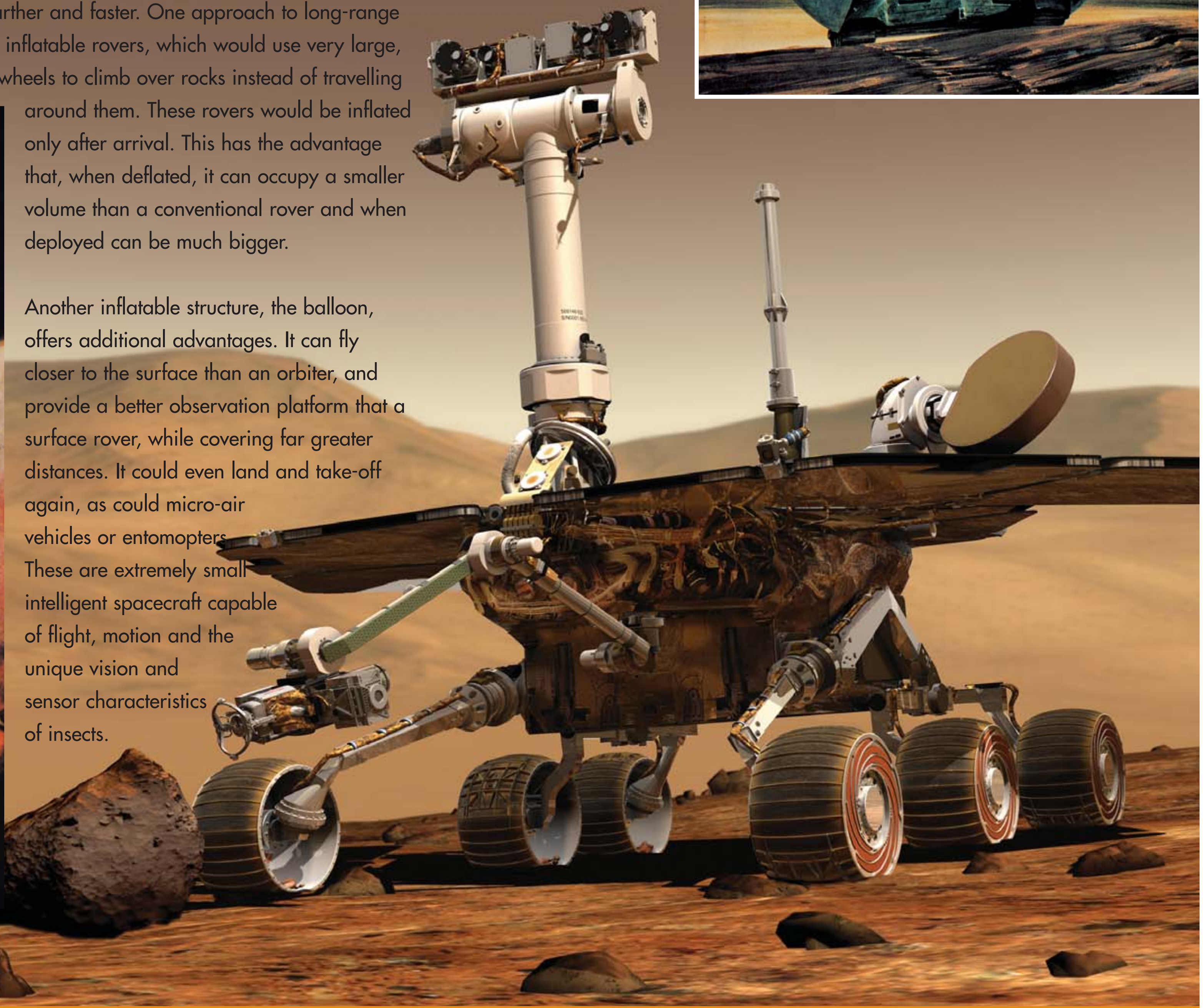
But simply landing and staying in one place is often not enough. The terrain farther afield may need to be explored and sampled. This is a job for the rover – a small wheeled, tracked or legged vehicle capable of slowly moving over a planet's surface and communicating back to its parent lander or orbiter or even directly with Earth. Current rovers can cover some 100 m each day and over a kilometre during the whole mission. They also rely on smart technologies to know where they are, where they want to go and which soil and rock samples are worth studying and collecting.




To explore a planet further, future generations of rovers must go farther and faster. One approach to long-range mobility is inflatable rovers, which would use very large, inflatable wheels to climb over rocks instead of travelling around them. These rovers would be inflated only after arrival. This has the advantage that, when deflated, it can occupy a smaller volume than a conventional rover and when deployed can be much bigger.


Another inflatable structure, the balloon, offers additional advantages. It can fly closer to the surface than an orbiter, and provide a better observation platform that a surface rover, while covering far greater distances. It could even land and take-off again, as could micro-air vehicles or entomopters. These are extremely small intelligent spacecraft capable of flight, motion and the unique vision and sensor characteristics of insects.

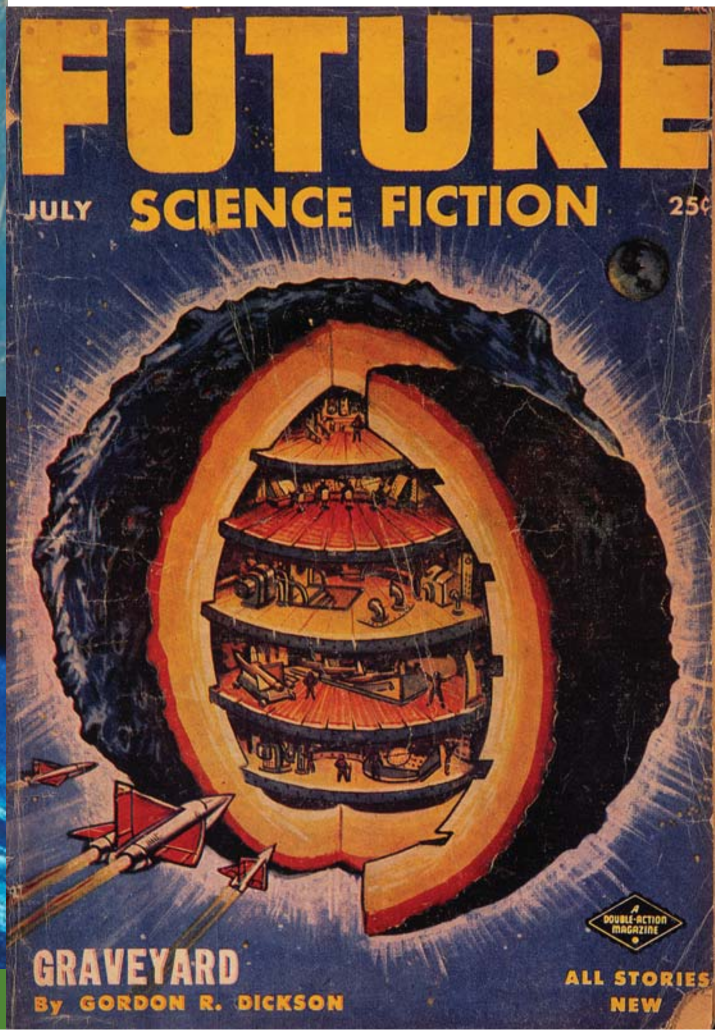


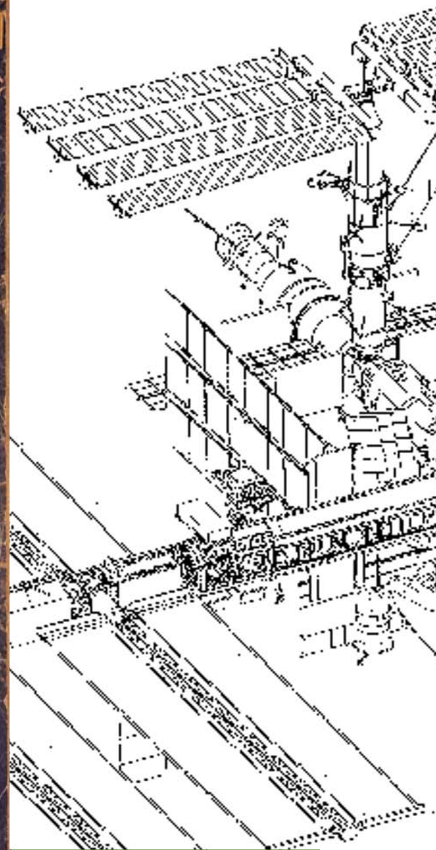
# MAKING GOOD USE OF SPACE

Some of the pictures show the interiors of imagined spacecraft. Even so, the accommodation looks fairly cramped. For the first few years of the ISS, the living quarters of the astronauts is the Russian Zvezda module, which is an updated version of Mir's core module. At 13 m long, Zvezda is about the size of a small boat and provides sleeping, eating and bathroom areas. There is also a treadmill and bicycle. The eating-kitchen area has a food heater, a fridge-freezer, food cupboard, table and chairs. The sleeping area comprises a couple of cabins where the crew can sleep, relax and have some privacy away from it all. The bathroom has a toilet and wash unit. In outer space, all surfaces become equally important, and every inch must be used efficiently. Every available patch is used for equipment racks and storage units and the emphasis is on making optimum use of materials and technologies that collapse, fold, inflate, deflate, expand, contract and extend to save space.

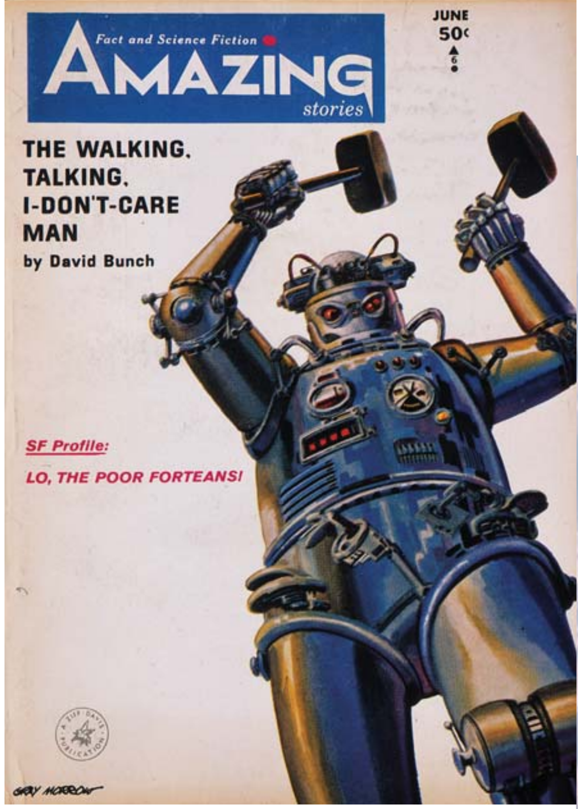


Over the years, interior designers and architects have been involved in designing the interior of Skylab, the structure of the ISS, and futuristic space hotels. More so than conventional terrestrial houses, the design of manned spacecraft and space stations as habitable environments has had to consider psycho-physiological safety and efficiency issues in addition to all the challenges of living in space and the effects of weightlessness. Design concepts have incorporated smooth surfaces for easy cleaning, waste management compartments, storage modules, water supply, storage and recycling units, food freezers, air filtration and quality systems, and colours for ease of identification and to suit moods and give some semblance of home.

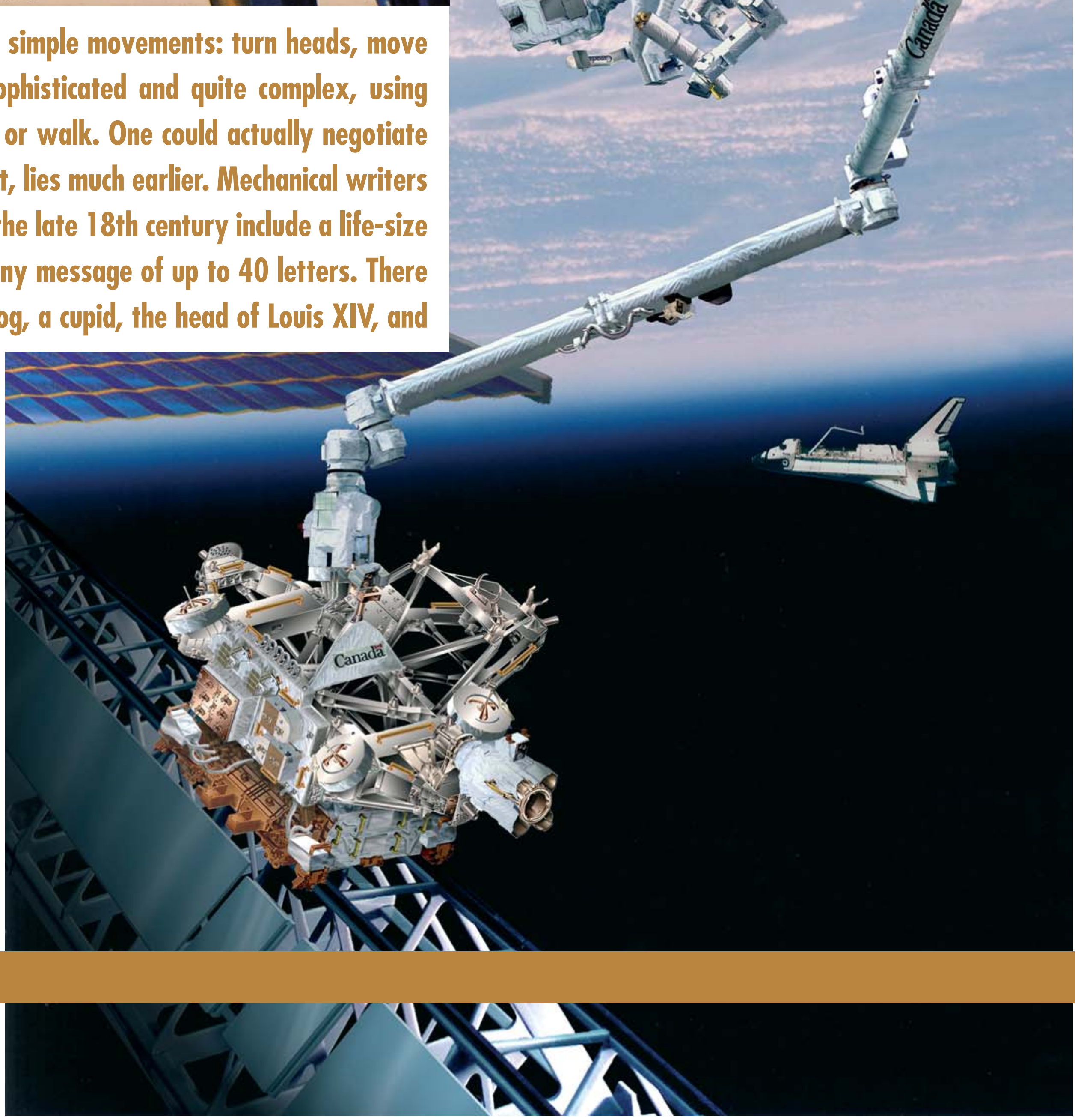


# ROBOTS




**The term robot appears to have been first used in 1921 in a Czech play describing a utopia where humans were waited on by machine servants. However, such automata were well-known in Victorian times and were manufactured in quantity during 1880-1920. These mechanical dolls and toys could perform simple movements: turn heads, move arms and legs, put tongue out and so on. Others were more sophisticated and quite complex, using hydraulic or pneumatic devices. Some could sing, play instruments or walk. One could actually negotiate its way across a room to pour drinks for guests. Their origin, in fact, lies much earlier. Mechanical writers were invented and built in 1753. Several spectacular automata of the late 18th century include a life-size and life-like figure of a boy seated as a desk, capable of writing any message of up to 40 letters. There was also a similar figure of a boy who drew four sketches (of a dog, a cupid, the head of Louis XIV, and the profiles of Louis XVI and Marie Antoinette), and there was a young girl who played the clavichord by the pressure of her own fingers upon the keys.**




The first commercial robot was devised in 1956 in America and today, nearly fifty years later, millions of robots are used for routine banal jobs in factories, laboratories and elsewhere, for example, to cut, join, weld, spray and inspect parts. Other types are autonomous vehicles that can work underwater, on planetary surfaces or be used for entertainment, as in the 'Robot Wars' television series. Those with some form of legged locomotion are often like spiders or insects with six or eight legs. However, very few conform to the mechanical humanoid so often depicted in science fiction stories and films. Making a machine capable of supporting itself on two legs and walking, moving and carrying out tasks commonplace for humans remains a daunting challenge for robot designers.

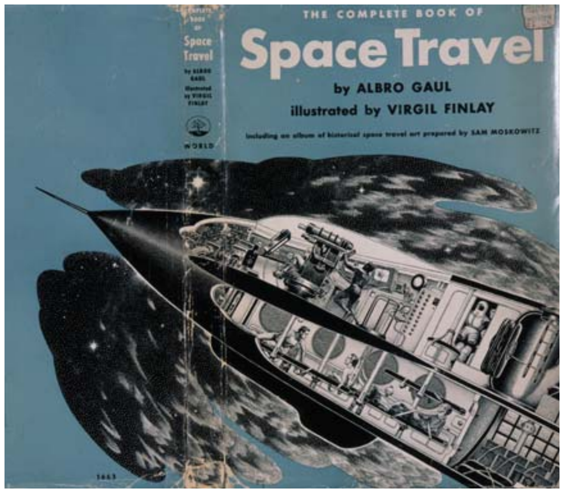

Nevertheless, serious attempts are being made to construct two-legged robots. In Japan, Honda has created a series of humanoid robots culminating in Asimo, based on the 'P3' (Prototype 3), a 1.6 m-tall machine, completed in 1997, that can walk at more than 1.5 kph and navigate around furniture. P3's proportions and the positions of its joints were adapted from the human body.

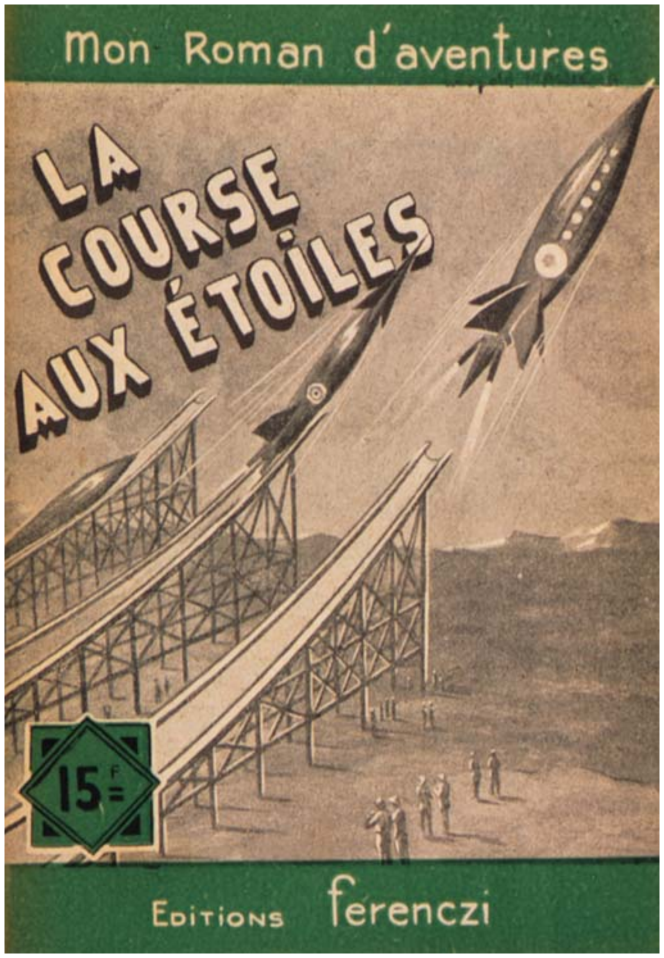
**Compared to P3, Asimo's weight and height were significantly reduced (43 kg and 1.20 m). Its size was chosen for it to operate freely in the human living space and to make it people-friendly. This size allows Asimo to operate light switches and doorknobs and to work at tables and workbenches.**

**The Asimo two-legged walking technology features predicted movement control in addition to the earlier walking control technology, providing more flexible walking. As a result, the robot walks more smoothly and more naturally. The introduction of intelligent, real-time, flexible-walking i-WALK technology allows the robot to walk continuously while changing directions, and gives it even greater stability in response to sudden movements. Honda has also introduced a speech feature to make the operation of Asimo easier. The robot can recognise and respond to some 50 different calls, greetings and queries in Japanese, and can move its body and arms in response to about 30 different action commands in Japanese.**


But these mobile robots have a rival in immobots (immobile robots). It is costly to produce and maintain physical robots and there is a trend towards the use of autonomous networked software agents known as immobots. They can look inside themselves, whereas traditional robots focus on exploring and manipulating their external environment. This inner focus enables them to control their complex internal functions such as sensor monitoring and goal tracking, parameter estimation and learning, failure detection and isolation, fault diagnosis, avoidance and recovery. Immobots thus have a great potential as automomous space probes, capable of repairing themselves.

# REFERENCES





**Di Fate, V.**
**Infinite worlds: the fantastic visions of science fiction art**
Penguin Studio, 1997

**Frewin, A.**
**100 years of science fiction illustration: 1840-1940**
Hart-Davis, MacGibbon Ltd, 1975

**Haining, P.**
**The classic era of American pulp magazines**
Chicago Review Press, 2000

**Hershenson, B. & Allen, R.**
**Horror, sci-fi & fantasy movie posters**
Bruce Hershenson, 1999

**Launius, R. D. & McCurdy, H. E.**
**Imagining space: achievements, predictions, possibilities**
Chronicle Books, 2001

**Raitt, D. et al:**
**Innovative Technologies from Science Fiction from Space Applications**
European Space Agency, 2001 (ESA BR-176)

**Reibaldi, G. & Caprara, G.**
**Space base Europe: how the International Space Station is used to improve life on Earth**
European Space Agency, 2002

**Robinson, F. M.**
**Science fiction of the 20th century: an illustrated history**
Collectors Press, 1999

**Zukowsky, J. (ed)**
**2001: building for space travel**
Harry N. Abrams, Inc., 2001

All SF images are from the collection Maison d'Ailleurs/Agence Martienne

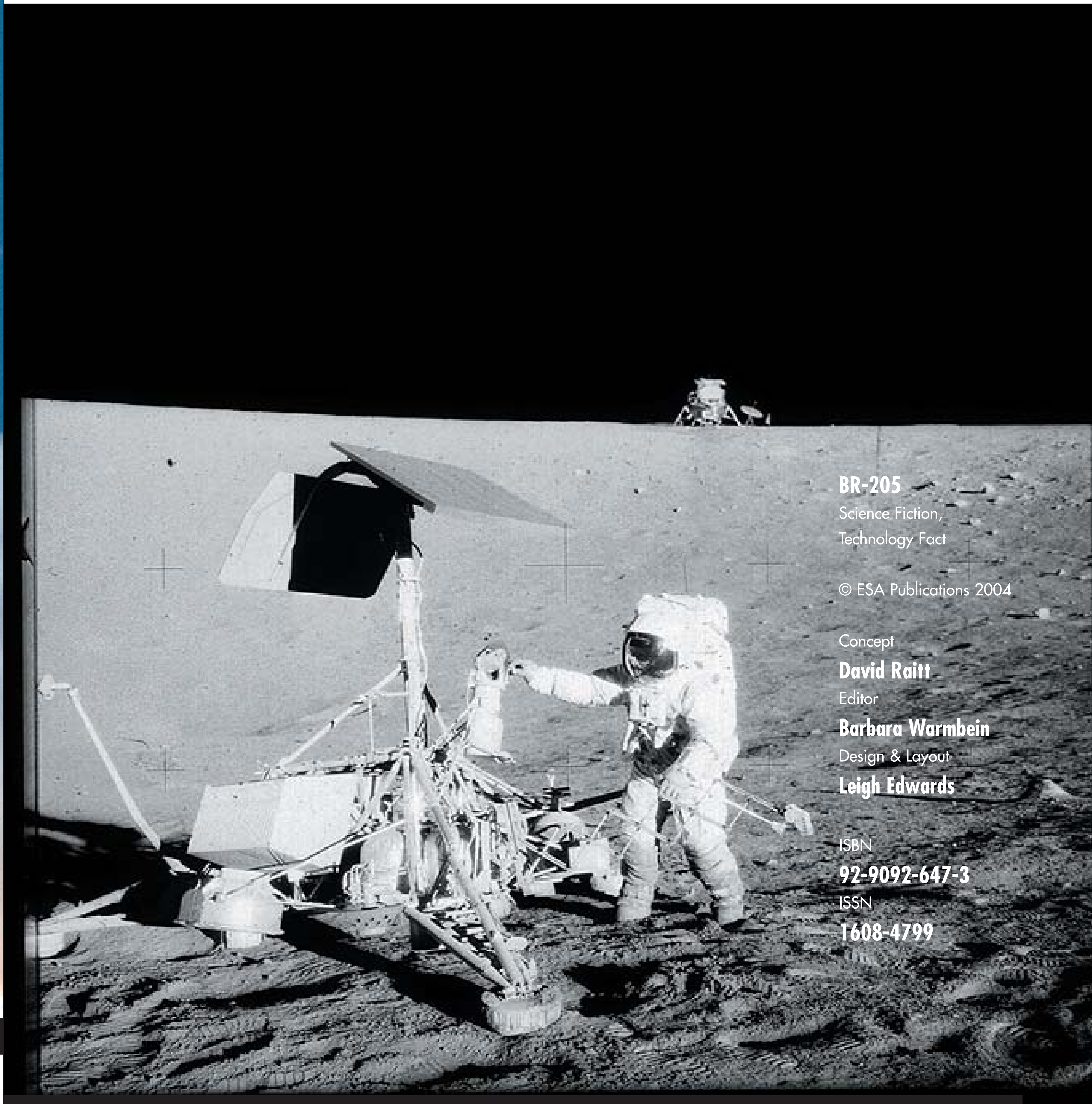
cover: Others Worlds (29 - 5.1953, ill. Malcolm Smith); Thrilling Wonder Stories (41/3 - 2.1953, ill. J. Coggins), p2: Amazing Stories (21/4 - 4.1947, ill. J.S. Krupa), p3: Météor (136 - 9.1964); Amazing Stories (12.1966, ill. Frank R. Paul), p4: Amazing Stories (36/6 - 6.1962, ill. Alex Schomburg), p5: Murray Leinster, Space Tug (Pocket Books, 1955, ill. Robert Schulz); Galaxy Science Fiction (49, ill. Jack Coggins), p6: Henry Bings, Lockende Zukunft (Bewin-Verlag, 1957), p7: Amazing Stories (35/11 - 11.1961, ill. Alex Schomburg); If Worlds of Science Fiction (1/9, ill. Ken Fagg), p8: Meccano Magazine (7 - 5.1958, ill. Eko); Amazing Stories (38/10 - 10.1964, ill. Emsh); Spazio (22 - 1.1961, ill. Robert), p9: Thrilling Wonder Stories (44/4 - 1954, ill. Walter Popp), p10: Croisière en l'an 2000 (Éditions O.K., 1946), p11: Street Comix (1/2 - 1952); Thrilling Wonder Stories (38/3 - 8.1951, ill. Earle Bergey), p12: Peter Randa, Plate-Forme de l'Eternité (Fleuve Noir, Anticipation 227, 1963, ill. Brantonne), p13: The Magazine of Fantasy and Science Fiction (2/3 - 2.1961, ill. Chesley Bonestell); Eric Frank Russel, Three to Conquer (Sogensha Co., 1965); Analog Science Fact & Science Fiction 72/6 - 2.1964, ill. John Schoenherr), p14: Galaxy (16/3 - 7.1958, ill. Dembe), p15: Amazing Stories (36/2 - 2.1962, ill. Alex Schomburg); Future Science Fiction (4/2 - 7.1953, ill. Luros), p16: Amazing Stories (39/6 - 6.1965, ill. Gray Morrow), p17: Science-Fiction plus (12.1953, ill. Frank R. Paul), p18: The Complete Book of Space Travel (World, 1963, ill. Virgil Finlay); Leopold Massiéca, La Course aux Étoiles (J. Ferenczi, 1953); E. J. Allingham, The Robot Man, The Boy's Friend Library (271 - 1.1931)



IMAGES: **Maison d' Aillews:** 2,3,4,5,6,7,8,9,10,11,12,13,14,15,17,18.

**ESA:** 4,5,6,10,11,15,16. **NASA:** 2,7,8,9,12,13,14.

**American Honda Motor Co., Inc:** 17



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