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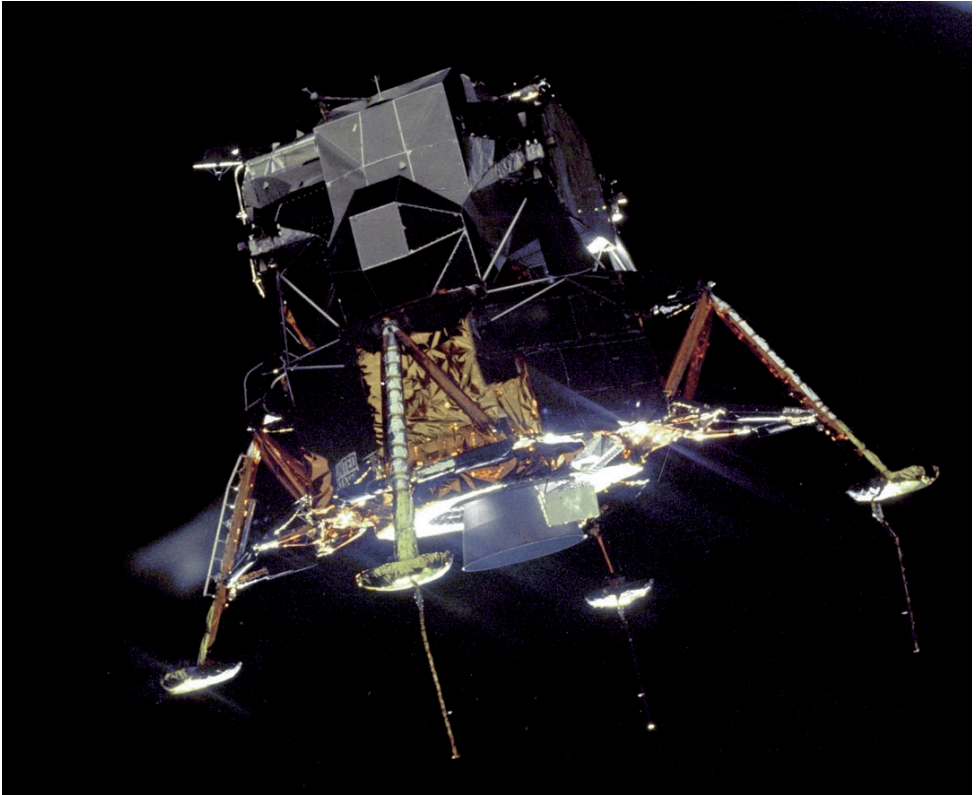
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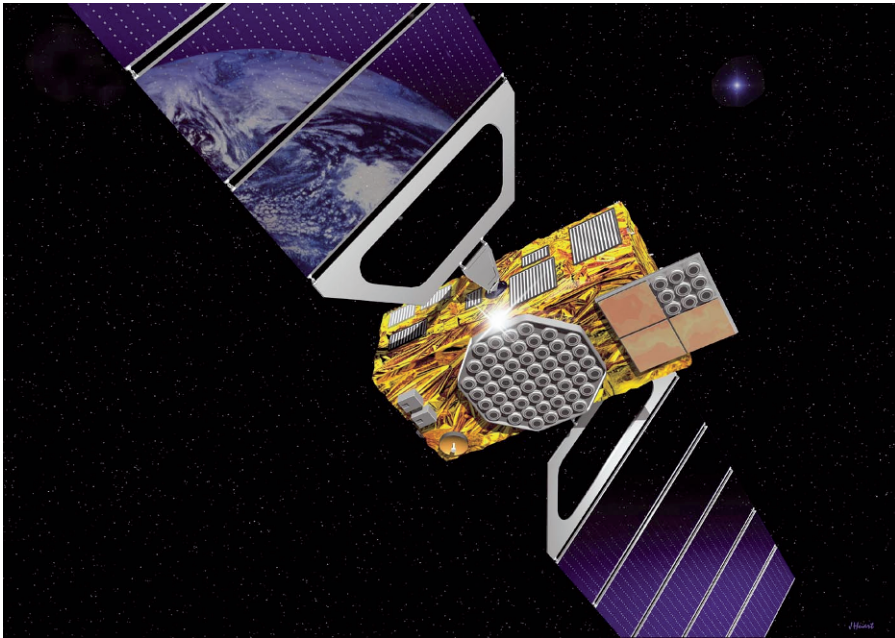
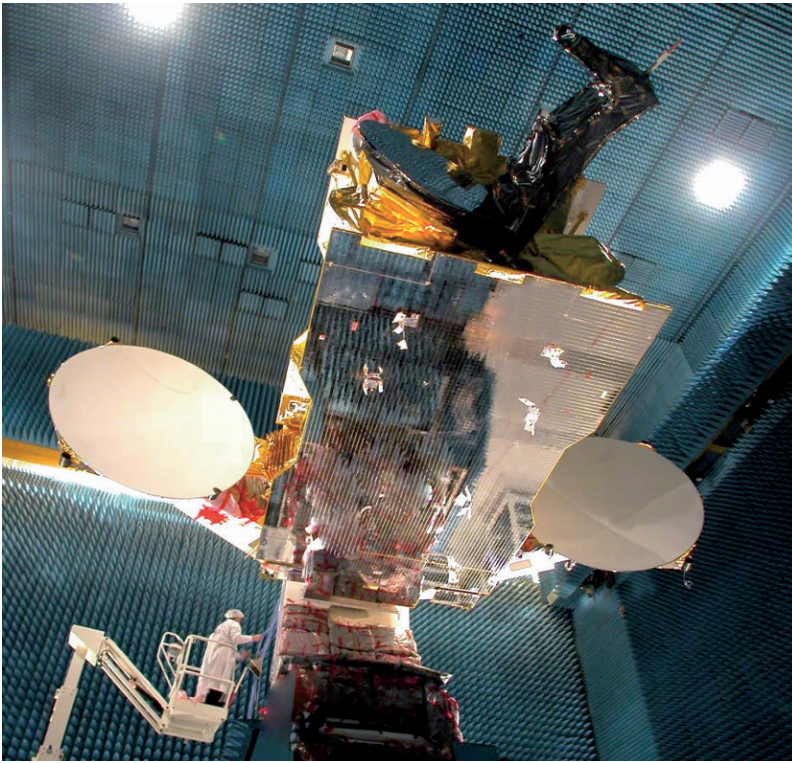
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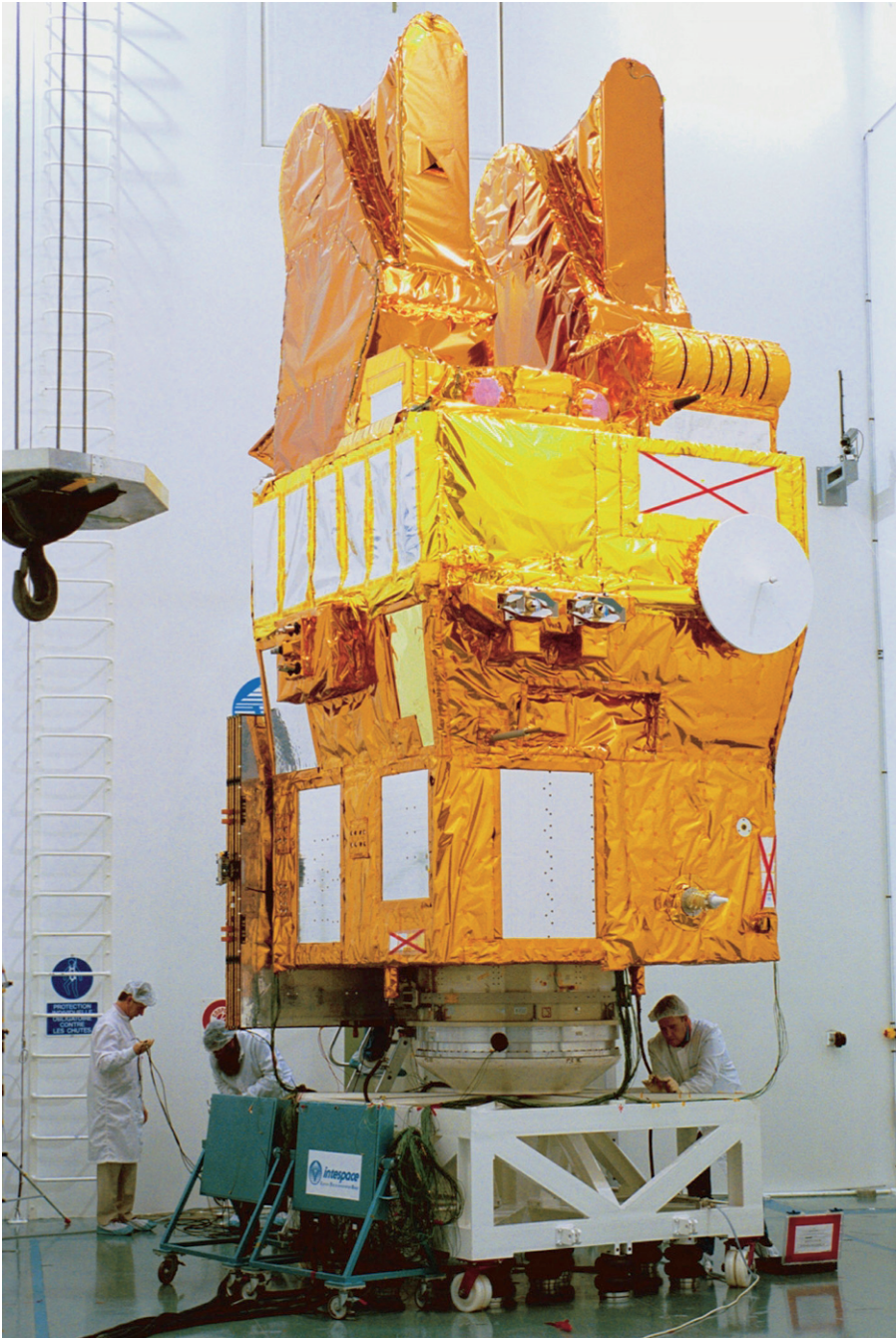
Majestic Saturn above an ethereal landscape of Titan, as depicted by the imagination of Chesley Bonestell. This is a colour rendition of Figure 10.1 on page 212. Such artist's impressions were an inspiration to me, when I was growing up in the 1950s, before the exploration of the solar system had begun. Image courtesy of Bonestell Space Art.



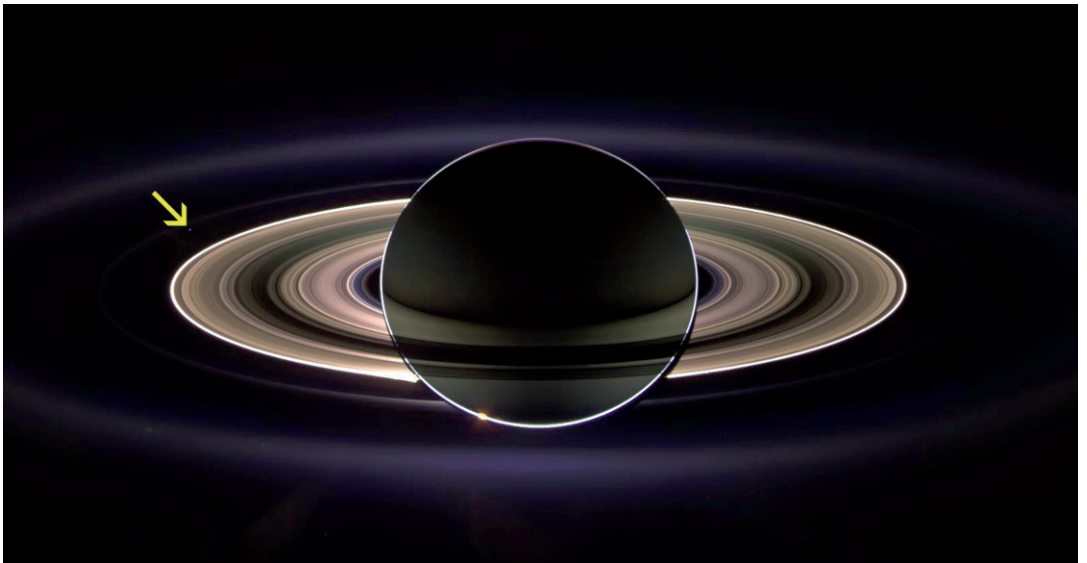
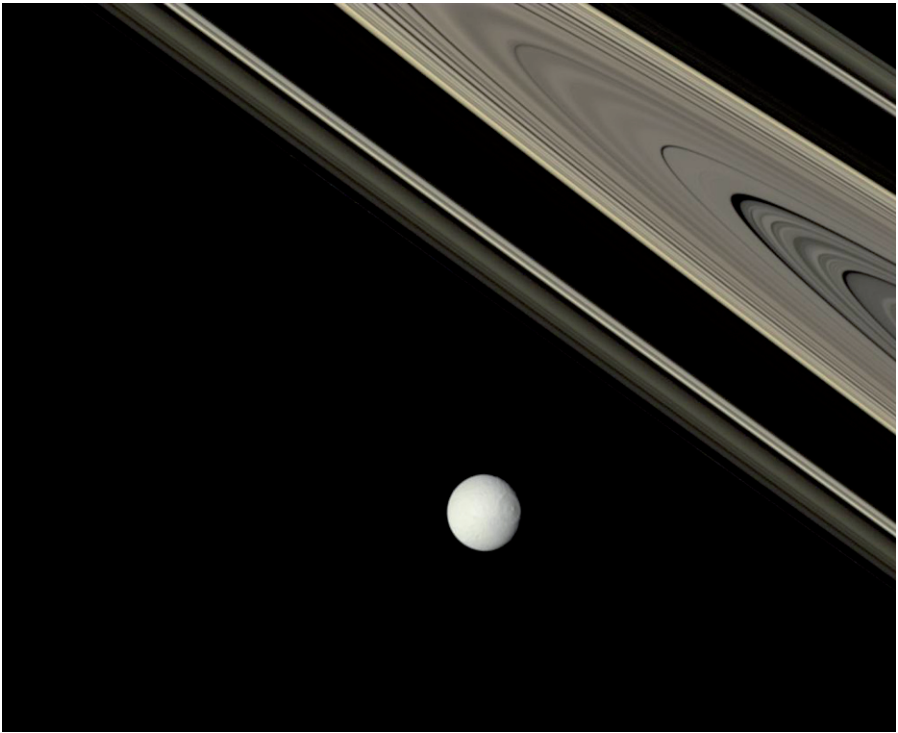
Those magnificent men in their flying machine—the Lunar Module Eagle, with Neil Armstrong and Buzz Aldrin aboard, in lunar orbit prior to their historic descent to the moon's surface in July 1969. The three years of the Apollo moon landings corresponded with my time at university, and I remember it has a time of great optimism and excitement, which was influential in shaping my career ambitions. Image courtesy of NASA.



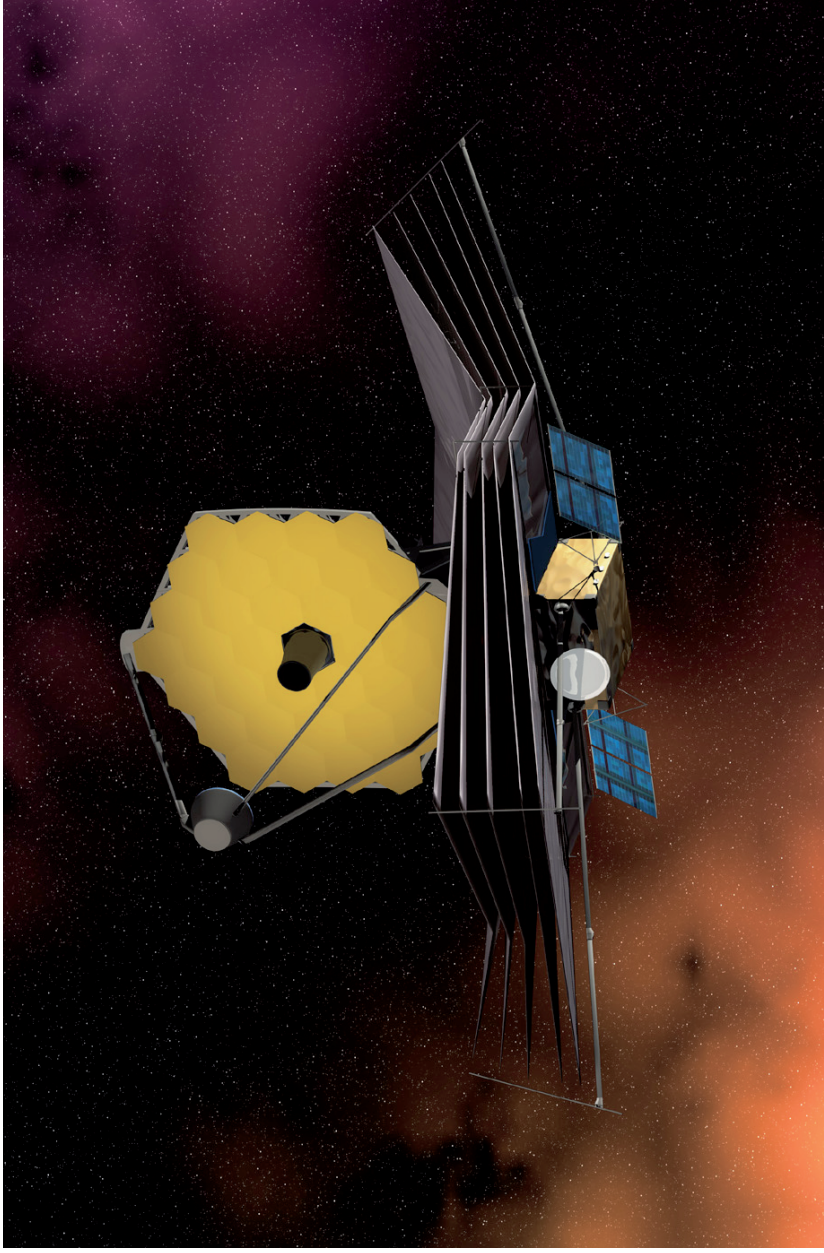
In the decades after Apollo came the boom in space applications. **Communications** and **navigation**, in particular, have had a major impact on people's everyday lives. The upper picture shows Hot Bird 8, a geostationary Earth orbit communication satellite. The spacecraft is shown without its solar array in a ground test facility prior to launch. Image courtesy of EADS Astrium. The lower image depicts one of the spacecraft in the Galileo satnav constellation proposed by the European Union. Image courtesy of ESA.



The space applications boom has also included an armada of **Earth observation** satellites in near-polar low Earth orbits. This is a colour reproduction of Figure 9.15 on page 199, showing the SPOT 5 spacecraft prior to launch—see page 154 for details of the spacecraft. The image also shows how the thermal control subsystem dominates the vehicle's appearance—see pages 198 to 206. Image copyright © CNES/Patrick Dumas.



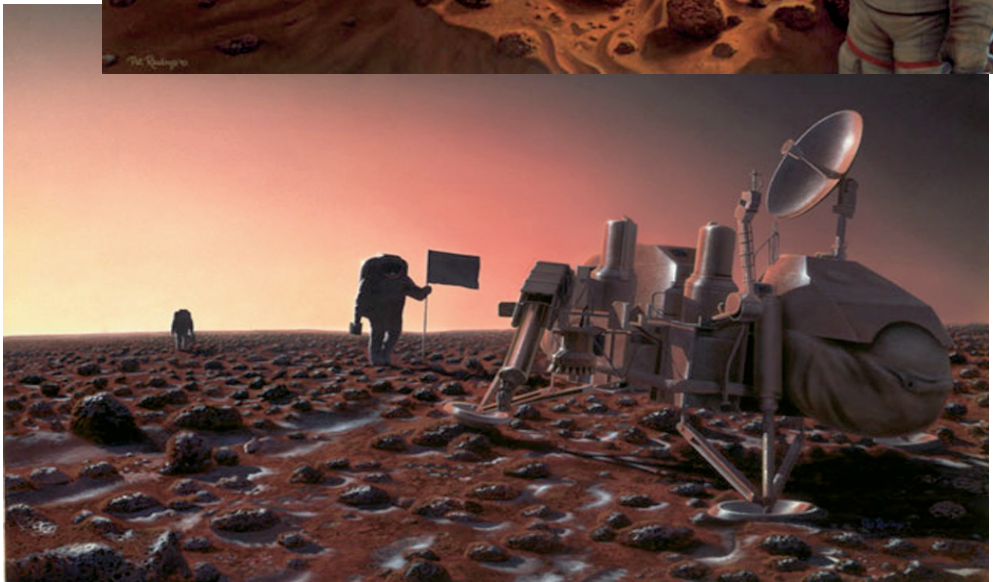
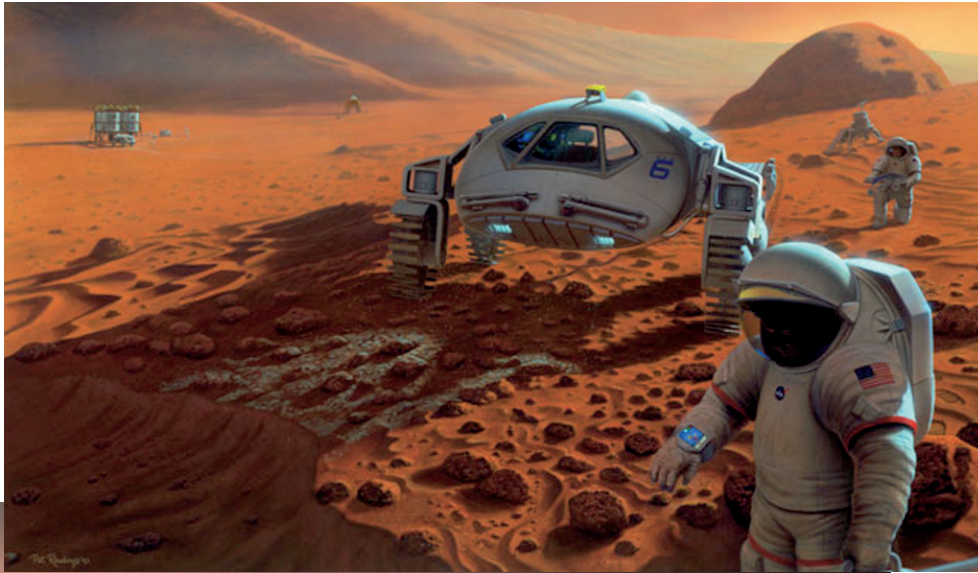
As well as communications, navigation and Earth observation, **science** has of course been a major driver in the development of space technology. The images above, of Saturn and its system of rings and satellites, were taken by Cassini/Huygens—see page 156 for details of the spacecraft. The upper picture shows a beautiful image of the moon Tethys, which is 1071 km (665 miles) in diameter, against a backdrop of the rings. The lower picture shows Saturn in front of the Sun, with the ring system beautifully backlit. The arrow shows a small smudge, which is the Earth—all of humanity and its affairs confined to 4 pixels on a digital photo! Images courtesy of NASA/JPL—Caltech.



The launch of space observatories, such as the Hubble Space Telescope (HST), has had a major impact on our understanding of the universe in which we live. The image depicts the James Webb Space Telescope (JWST) which is the next generation beyond Hubble. The observatory, which will have a mass around 6,500 kg, is named after the NASA administrator James Webb who was in post during the period 1961 to 1968. The JWST is an extremely ambitious program, involving launching the telescope, in around the year 2013, to the L_2 Lagrangian point 1,500,000 km (930,000 miles) from Earth. The main mirror of the telescope is nearly 3 three times larger than that of the HST. The rather strange bed-like structure is a thermal shield about 260 square meters in area. Image courtesy of ESA.



Manned spaceflight activities since Apollo have been confined to Earth orbit. The focus of this activity over the last decade or so has been the construction of the International Space Station (ISS) in a near-circular low Earth orbit with an orbital inclination of 52° , and at an altitude of about 350 km (220 miles). The image is reminiscent of Kubrick's 2001—a *Space Odyssey*, with space-walking astronauts working on large space structures. To progress beyond Earth orbit, we need to learn to live and work in this environment. Image courtesy of NASA.



What will **the future** hold? It is always difficult to know, of course, but one space ambition on the agendas of all the major space agencies is a manned landing on the planet Mars within the next thirty years or so. The images depict human exploration of the Martian surface, with astronauts (in the lower picture) visiting the historic site of one of the robotic Viking landings in 1976. Artist's impressions by Pat Rawlings. Images courtesy of NASA.