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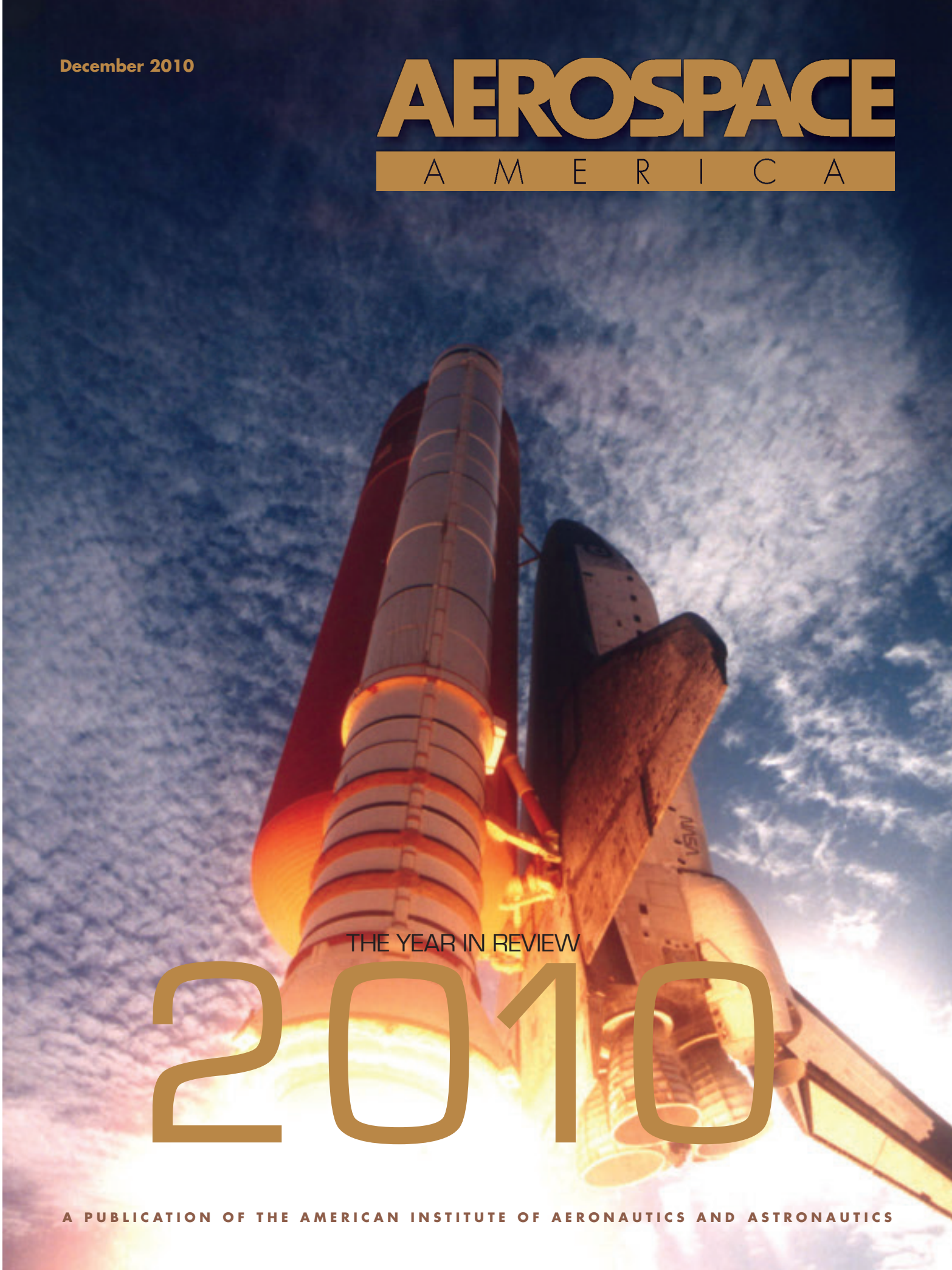

THE YEAR IN REVIEW

2010

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Life sciences and systems

The life sciences and systems (LSS) community is conducting numerous aerospace-related efforts focusing on enabling human exploration of space. Science and technology efforts have been under way at space organizations around the world to address the anticipated life support needs for future space endeavors.

Desert RATS simulated lunar exploration in the Arizona desert.

A modular air revitalization system for future manned spacecraft bound for the ISS and other LEO destinations has completed its preliminary design review, clearing the way for work to begin on a ground test unit. Under NASA's CCDev (commercial crew development) project, Paragon Space Development passed the milestone in July with its commercial crew transport air revitalization system.

A panel discussion sponsored by the House Committee on Science and Technology, AIAA, and the American Society for Gravitational and Space Biology was held in September. The panel focused on the emergence of the biological economy and leveraging of telemedicine, agriculture, energy and the environment, and how space biological research enables these terrestrial applications.

In response to requests from Congress, NASA asked the National Research Council to undertake a decadal survey of life and physical sciences in microgravity. Research proposed for the next decade by the life and physical sciences communities would expand use of the space environment to solve complex problems in these areas to deliver both new knowledge and practical benefits for humankind. Their interim report is available on line (http://www.nap.edu/catalog.php?record_id=12944). The final report is due in early 2011.

Desert RATS (research and technology studies) simulation testing was conducted in Arizona to simulate planned operations for future exploration of the Moon or Mars. Desert RATS included two space exploration vehicles (SEVs) and a habitat demonstration unit (HDU) that simulated a pressurized excursion module habitat (with testing of a prototype "space greenhouse"). Two crews, each consisting of an astronaut and a geologist, conducted closed operations in the SEVs for a week, performing several EVAs, then docked with the HDU for simulation of suit maintenance, geology, general maintenance, and food growth experiments.

The flame extinguishment and the smoke aerosol measurement experiments took place on the ISS. Conducted in reduced gravity, they were aimed at improving the reliability of future spacecraft fire suppression and detection. The capillary flow experiment improved our ability to control fluids in two-phase systems; the constrained vapor bubble looked at phenomena important in advanced wickless heat pipes; and IVGen produced medical quality intravenous fluids in reduced gravity.

In late December 2009, ESA astronaut Frank De Winne became the first non-U.S., non-Russian to take command of the ISS. Two Italian astronauts are preparing their missions to ISS: Paolo Nespoli for Expedition 26-27, and Roberto Vittori for STS 134. Vittori will execute life science and radio-biology experiments. ESA is increasing the ECCO (ESA cold container) fleet to allow the return of biological samples to Earth at controlled temperature, without the need of a power supply.

The European Science Foundation has initiated a 24-month project called THESEUS (towards human exploration of space: a European strategy) to develop an integrated life sciences research roadmap enabling European human space exploration in synergy with ESA's strategy to identify potential nonspace applications and dual R&D.

A Russian-led multinational effort to simulate the isolation of a 500-day mission to Mars is under way in Moscow. By September the mission had been in progress for 90 days and had simulated more than 15 million km of transit from Earth but was still 200 million km from Mars.

Systems needed for maintaining breathable air in spacecraft are being developed at several NASA centers. Planning continues on the next tests of the pressure swing amine bed technology intended for use on Orion, Altair, EVA systems, and lunar electric rover applications. A closed-loop CO_2 removal system is being built incrementally to reduce power associated with water recovery and to integrate CO_2 compression with the CO_2 removal function. Technologies for recovery of O_2 from CO_2 and H_2 from methane have progressed significantly this year.

by **Joe Chambliss**