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Tech Watch: NASA's Heat Ray, Rocket Defense, Martian Spacesuit and More

NASA'S Heat Ray Rocket Defense Martian Spacesuit Hurricane Hunting Plane

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October 1, 2009 12:00 AM

NASA's Heat Ray

By Seth Fletcher

When—or if—NASA's Crew Exploration Vehicle (CEV) flies to the moon and back, it will re-enter Earth's atmosphere faster than the space shuttle, at some 25,000 mph. "There's no material out there that can do that without burning up some," says George Sarver, support project manager for the CEV at the Ames Research Center in Silicon Valley. To develop a shield that's tougher than the shuttle's notorious tiles, scientists at Ames blasted hockey-puck-size slabs of composite materials with an arc jet. The giant blowtorch simulates re-entry conditions, expelling gas at nearly 18,000 F (hotter than the surface of the sun). The arc jet tested five materials; NASA has to decide which is the most cost-effective to produce because the CEV's shield will be replaced after every mission. The shield's first real-world test is set for 2012, when the CEV will visit the International Space Station.

AMES ARC JET STATS

Maximum temperature:

Approximately 18,000 F

Power supply:

An electrical substation provides up to 150 megawatts.

Crew:

20 to 30 full-time personnel, even when the jet isn't active

Rocket Shield

By Noah Shachtman

There's a promising defense against rocket-propelled grenades (RPGs), one of the biggest threats to American troops in Iraq. But don't expect it on the front lines anytime soon. In a demonstration earlier this year, the Trophy Active Protection System, an Israeli-built RPG countermeasure, knocked grenades out of the sky before they could hit a U.S. Stryker armored vehicle. The system tracked incoming RPGs by radar from 3280 ft. away and fired a kind of buckshot as they closed range, neutralizing the projectiles in midair. The Pentagon's Office of Force Transformation has added Trophy to an experimental Stryker it plans to send to Iraq, and the Israeli military is equipping Merkava 4 tanks with the system. But the U.S. Army is moving away from Trophy. Sure, it "demonstrated technical capability against a variety of munitions," Col. Don Kotchman noted. But there were too many unanswered questions. What happens to those flying shards of neutralized RPG? And what if American infantrymen get in the way? The Army, which recently contracted Raytheon to investigate its options, hopes to test and field some sort of RPG defender by 2011.



Heavy Metal Talker

By James Vlahos

Humanitarian robotics was the theme of the 2006 IEEE International Conference on Robotics and Automation, held in Orlando, Fla., which attracted more than a thousand leading roboticists from around the world. But the primary goal in building humanoid robots isn't to advance human mimicry, but to better understand humans. The Waseda Talker No. 5 (WT-5), developed by scientists at Japan's Waseda University, is meant to explore the mechanics of human speech by reverse-engineering it. Metal lungs produce air that vibrates rubber vocal cords; the sound is sculpted by a sinus, a tongue, teeth, a nose and rubber lips. WT-5 isn't ready to deliver the Gettysburg Address, but, aided by speech-recognition software, it can mimic 50 vowel and consonant sounds. Insights gained from WT-5 may be used one day to help people with speech disabilities or students learning foreign languages. In other words, WT-5 is creepy, but it means well.



Resident Astronaut

Mankind's long journey to Mars starts in the North Dakota badlands.

By Thomas D. Jones, Four-time shuttle astronaut and author of *Sky Walking: An Astronaut's Memoir*

An ambitious team of about 40 student engineers from a five-college consortium has designed a prototype Mars spacesuit, which is currently being tested in the rugged badlands in western North Dakota. But these aren't your average recipients of NASA grant money. One of the five schools, all of which are based in North Dakota, is a community college. And the 14-month effort, led by University of North Dakota (UND) aerospace engineer Pablo de Leon, cost NASA just \$100,000, a mere fraction of the cost to develop the suit that I wore on my three shuttle spacewalks. The North Dakota Experimental (NDX) Planetary Space Suit won't leave Earth anytime soon, and it lacks state-of-the-art gloves and a life-support system, but the design has effectively tackled the unique conditions facing would-be red planet explorers. "We started with a clean-sheet Mars suit design," de Leon tells me, "concentrating on walking mobility."

Although stiff and inflexible below the waist, my space shuttle suit was comfortable, and I had complete confidence in its proven safety systems. But that suit's weight and semirigid pants would completely hobble an astronaut on Mars. The NDX uses a Kevlar restraint layer joined by tough nylon inserts to provide joint flexibility, and carbon fiber to keep the suit lightweight enough for extended strolls. The NDX, de Leon says, is just the beginning. "The idea is to establish a center for suit expertise here." The new suit isn't the only product of the NDX effort. Two recent UND grads, fresh from putting the suit through its paces, are headed for new jobs—with NASA in Houston.



Book of Life Closed, Again

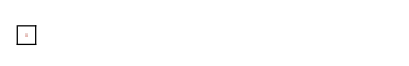
By Alex Hutchinson

Scientists have finally completed sequencing the entire human genome: The results for the last chromosome to be decoded (Chromosome 1) were published in the journal *Nature* in May. So disease and unhappiness are finally things of the past, right? Not quite. "The diagnostic potential of the sequence is much shorter-term than the curing potential," says Simon Gregory, who headed the Chromosome 1 team at Britain's Wellcome Trust Sanger Institute. The human genome project started in 1990, and draft versions were released in 2001 and 2003. Here's a breakdown of the latest version—the last one, Gregory promises:

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223.8 million nucleotides, nearly 8 percent of the genome.
356 diseases localized to this chromosome, including Parkinson's and Alzheimer's.
4471 single nucleotide polymorphisms, where a tiny variation determines matters such as who can, and can't, metabolize aspirin.



Hunting Hurricanes

There's no stopping the next monster storm, but a new fleet of planes might tell us which way the wind is blowing.
By Carl Hoffman



Weather forecasts can save lives during hurricane season, and the most accurate forecasts call for multiple flights through the eye of a storm. "We cannot live without aircraft data," says Richard Knabb, a meteorologist at the National Hurricane Center (NHC). "There's currently no other way to get inside the system." Many scientists collect data from planes that soar above the Gulf Stream or from research-oriented flights into the storms in WP-3D Orions, but the only group directed to fly into every single hurricane is the U.S. Air Force Reserve's 53rd Weather Reconnaissance Squadron.

Based at Keesler Air Force Base in Biloxi, Miss., the 53rd now flies 10 WC-130Js--the newest version of the venerable 40-year-old C-130. On paper the modified cargo-hauler is perfect for the task: strong and slow, with four turboprops that perform better in storms than jet engines, and enough range for flights that can last up to 15 hours. The plane isn't specially reinforced to survive hurricanes--but its high-tech upgrades do include an enhanced radar package and a more automated cockpit. However, the 130J has weathered a storm of criticism from the Pentagon amid reports of radar problems and difficulties flying in, of all things, severe weather.

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Having flown into 15 hurricanes last year, the 130J is cleared for another season. And while the plane is relatively new, the mission is the same: The moment a low-pressure system develops in the Atlantic, a 130J takes off, carrying a pilot, co-pilot, navigator, weather officer and dropsonde operator. Plunging into the storm's eye wall at 10,000 ft., the crew releases dropsondes, 1-pound GPS devices that float by parachute, measuring factors such as humidity and wind speed.

Dropsonde data has helped improve the NHC's ability to forecast a storm's path, but predicting intensity--which calls for surface-level wind-speed readings--has proved elusive. That could change next year when the WC-130Js will get radars that gauge the height of waves being churned by a storm. Oddly enough, the most powerful hurricanes aren't the toughest to fly through. "It's the storms that are breaking up or regenerating that are rough," says the 53rd's Tech. Sgt. James Pritchett. "There's a lot of movement in the aircraft. People get sick."



The carbon and silica compounds that will protect the CEV during re-entry were heated up to 5000 F by NASA's arc jet, a room-size blowtorch that's cooled by more than 1000 water lines.

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