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Deconstructing the defense budget

A conversation with William H. Gerstenmaier

Fast track to truly fast flight

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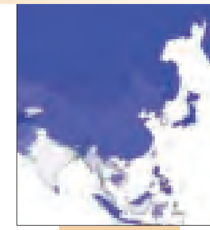


Asia in space: Trials and tribulations

A FLURRY OF ACTIVITY IN ASIAN ROCKetry during recent months has apparently brought one major failure, one significant success, and the expectation of a major step toward performing an orbital rendezvous.

The failure came with the first-stage breakup—or possible self destruction—of North Korea's latest major rocket test in April. The significant success came a few days later, when India launched a medium-range version of its Agni (Fire) missile, which is capable of reaching cities in northern China—thus making up some distance in the nuclear deterrence stakes with Beijing. And the major technological step is that this month China may achieve a space rendezvous controlled by human astronauts, possibly including a woman.

Failure and conjecture

North Korea's failure brought with it a welter of political speculation and pressure, none of it unexpected. Conjecture centered on what went wrong, with the prime candidate among analysts being a structural failure at or about Max Q, the point at which aerodynamic pressure is greatest after launch. This is where rockets generally throttle back to ease structural stresses from vibration until the critical time has passed. After this, as air pressure decreases with altitude, the rocket can be throttled up again to reach orbit.

The other widely discussed possibility is a guidance failure that made it necessary to destroy the rocket before it intruded into other nations' airspace. North Korea's position leaves it only two viable launch directions: eastward, toward and over Japan (which proved highly unpopular the last time North Korea tried and failed to launch a satellite to orbit), and southward, past and near South Korea and the Philippines. Precise control of the rocket's path was therefore essential.

The southern path from North Korea's northwest was chosen as the direction in which to aim the three-stage Unha (Milky Way) 3 rocket, ostensibly to place a Bright Star weather satellite into a 310-mi.-high polar orbit, though some suspect this was really a missile test in disguise.

But the rocket broke up about 90 seconds after launch and fell into the sea west of South Korea. This was the fourth failure of a major North Korean rocket since 1998—the country has not yet managed to place a satellite into orbit, although it has made claims to the contrary.

As with the earlier failures, this launch was timed to help celebrate a major political event—in this case, the 100th anniversary of the birth of the country's founding father, Kim Il-sung. Thus it was not a test so much as an intended demonstration of power. Moreover, a widely expected underground nuclear bomb test (the country's third) predicted soon afterward may well have been intended to mark North Korea joining the world's nuclear missile 'club.' Instead, the failed launching demonstrated a continuing lack of capability in long-range and orbital rocketry.

The exact cause of the April failure of North Korea's Unha 3 rocket is still unknown, at least to the West.

It is regarded as certain that North Korea will try again to launch a long-range rocket, probably in the next two or three years. The country's short-range rocket experience came from the former Soviet Union and was sold on to Iran (which had observers at the April 13 launch), but the North Koreans are finding it hard to shift to longer range rockets.

What is not certain is whether this impoverished country has the resources to begin, let alone sustain, the level of testing that would help bring reliability to its rocket program. Until or unless this happens, it seems likely that the U.S. can ignore North Korea as a source of nuclear missile threats. Even with a reliable rocket, the time taken to fuel it (Unha 3 and its predecessors were all liquid fueled) would allow so much warning that the

U.S. would be able to detect the process easily and take steps to nullify any potential threat.

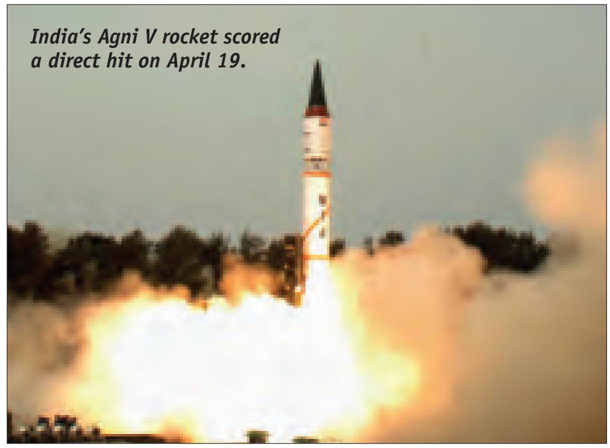
India's efforts

A similar calculus applies to India's achievement with its Agni V, a solid-fuel three-stage rocket that was fired from Wheeler Island off the country's east coast on April 19 and hit its target in the sea. Its maximum range is said to be 3,100 mi., enough to reach Beijing and Shanghai, though the April 19 firing was in effect a technology demonstration as the missile is not yet in production. It is expected to enter India's arsenal in 2014-2015.

Talk of women in space usually concerns female astronauts, but in India's case the woman under discussion is Tessy Thomas, who holds a doctorate in engineering and is the Agni V project director. Known as the 'Missile Woman,' she regards the rockets on which she works as "instruments of peace" because of their deterrent value. Having said that, she is currently working on guidance systems for multiple independent reentry vehicles, or multiple warheads delivered by one rocket.

Indian officials say China has no real need to feel threatened, and indeed they have made efforts to discount any such motive. China has a huge advantage in nuclear weaponry and missiles over India, and India's aim was not to achieve an overnight parity but to level the field somewhat for discussions. When you know you are stronger than someone else but that person is now capable of hurting you, any talks become less one-sided.

On the civilian side, India is having problems with its heavy-lift GSLV (Geosynchronous Satellite Launch Vehicle), intended for satellites weighing over 1 ton. Two successive launch failures in 2010 were attributed to different causes—one to the failure of a cable connector and the other to a problem with the India-developed cryogenic rocket engine used in the third stage.



India's Agni V rocket scored a direct hit on April 19.

Tessy Thomas, the Agni V project director, is known as the 'Missile Woman."

Earlier missions had used a Russian cryogenic engine. India's difficulties with its own version may cause long delays in developing the rocket sufficiently to participate in the lucrative satellite launch market, officials fear. The engine problem may also delay India's planned 2013 second unmanned lunar mission, Chandrayaan-2, in which the 2.6-ton spacecraft is intended to carry a 1.25-ton lander and rover vehicle.

The Indian Space Research Organization is partnering with Russia's Federal Space Agency in designing Chandrayaan-2's lander and Moon rover.

India's GSLV bursts into a ball of fire as it ascends into the sky. The rocket has suffered two successive failures. Photo: V. Ganesan.

The plan is for the rover to drive over the lunar surface, pick up soil samples and rocks, analyze them chemically, and transmit the data back to the orbiter.

China's aspirations

It is expected that China will soon attempt to advance its own level of space-related technology with the manned docking of a space capsule called Shenzhou (Divine Vessel) 9 and an orbiting module named Tiangong (Heavenly Peace) 1. The three-person mission will likely take place between now and August—two rendezvous rehearsals in November were conducted using automatic systems and ground control. Tiangong 1 has been in orbit since last September.

The event is part of China's efforts to set up its own space station and enlarge its pool of astronauts, which may for China's first time include a woman as one of the crew. Six Chinese male astronauts (taikonauts in Chinese parlance) have flown in three manned missions so far.

The country is also slowly and quietly reducing its dependence on foreign technology in satellite navigation by setting up its own constellation of satellites to rival the U.S.-controlled GPS. China's Beidou (Compass) system began operating in 2000 and now covers China and immediate surrounding areas, say Chinese officials. Six satellites are to go up this year to give coverage of Asia and the Pacific, with the full set of 35 to be in place by 2020 for worldwide coverage.

Japanese activities

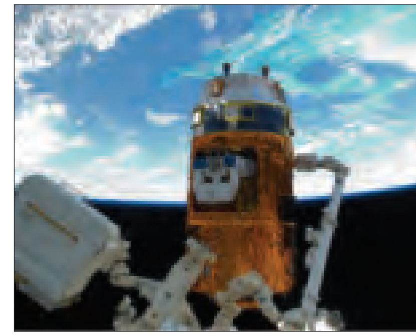
Having no human-rated launcher of its own, Japan has relied on sending its astronauts via U.S. or Russian spacecraft to work as payload or mission specialists on Spacelab, the ISS, or the space shuttle. (The country had 11 astronauts, although one woman and two men have retired.) In July engineer Akihiko Hoshide is due to start a four-month stint at the ISS, reaching it via a Russian Soyuz—his second space mission.

Japan's main space interest at present centers on Kibo, a pressurized human-rated module that is part of the ISS. It accommodates four astronauts conducting space medicine and life and materials science experiments.

Has JAXA been able to show any concrete benefits from the money that taxpayers have invested in it? Yes, says Keiji Tachikawa, the space agency's president. For example, during last year's earthquake and tsunami disaster, he says, "At JAXA, although facilities at the Tsukuba Space Center and the Kakuda Space Center incurred damage, we had just implemented a Business Continuity Plan as a disaster measure, so we were able to set up a response headquarters an hour after the earthquake struck and react quickly. I also felt yet again that space technology is effective at times of disaster, because JAXA was able to contribute to the disaster response and assistance effort by providing satellites for communications and other needs."

Is Japan likely to build its own manned rocket to reach orbit? If so, it is some way off, but it really is a matter of necessity, Tachikawa feels. "We also have to think about how we are going to transport people to the ISS in the future," he explains. "We must continue sending astronauts to the space station, because it is a very useful asset shared by all of humankind.

"Now that the space shuttle has been retired, our only way to send astronauts to the ISS is the Russian Soyuz spacecraft, so if the Soyuz has an accident then we'll have no means



Japan's Kounotori (also known as the H-II transfer vehicle, or HTV)could be converted into a manned spacecraft.

of transporting astronauts at all. As we discuss how to secure transportation redundancy, people are looking to Japan's Kounotori [robotic] space station supply ship (also known as the H-II transfer vehicle, or HTV), which could be converted into a manned spacecraft.

"After the space shuttle's retirement, Kounotori became the sole transport vehicle capable of carrying heavy cargo to the ISS; but currently it is a single-use vehicle, burning up when it reenters the atmosphere.

"So Kounotori cannot bring back samples from completed space experiments or anything else. That's why we are currently proceeding with research on a [heavy transport vehicle] with additional retrieval function—HTV-R—which we plan to have ready in about five years.

"If we can make the HTV retrievable, then it must be expected for us to turn it into a manned spacecraft, too. However, the decision on whether or not Japan goes ahead with this rests with the Japanese government. So before we move in that direction, the government has to give us the go-ahead. Personally, I think that if we continue to cooperate with the international community in space, our partners will ask Japan, a country with a highly developed space program, to help build an infrastructure for manned space transport. This is another reason why I believe that we should develop a made-in-Japan manned spacecraft."

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