The Ramjet and the Rocket

If someone ever comes up with a need to fly at Mach 6, this 1990s technology could be the answer.

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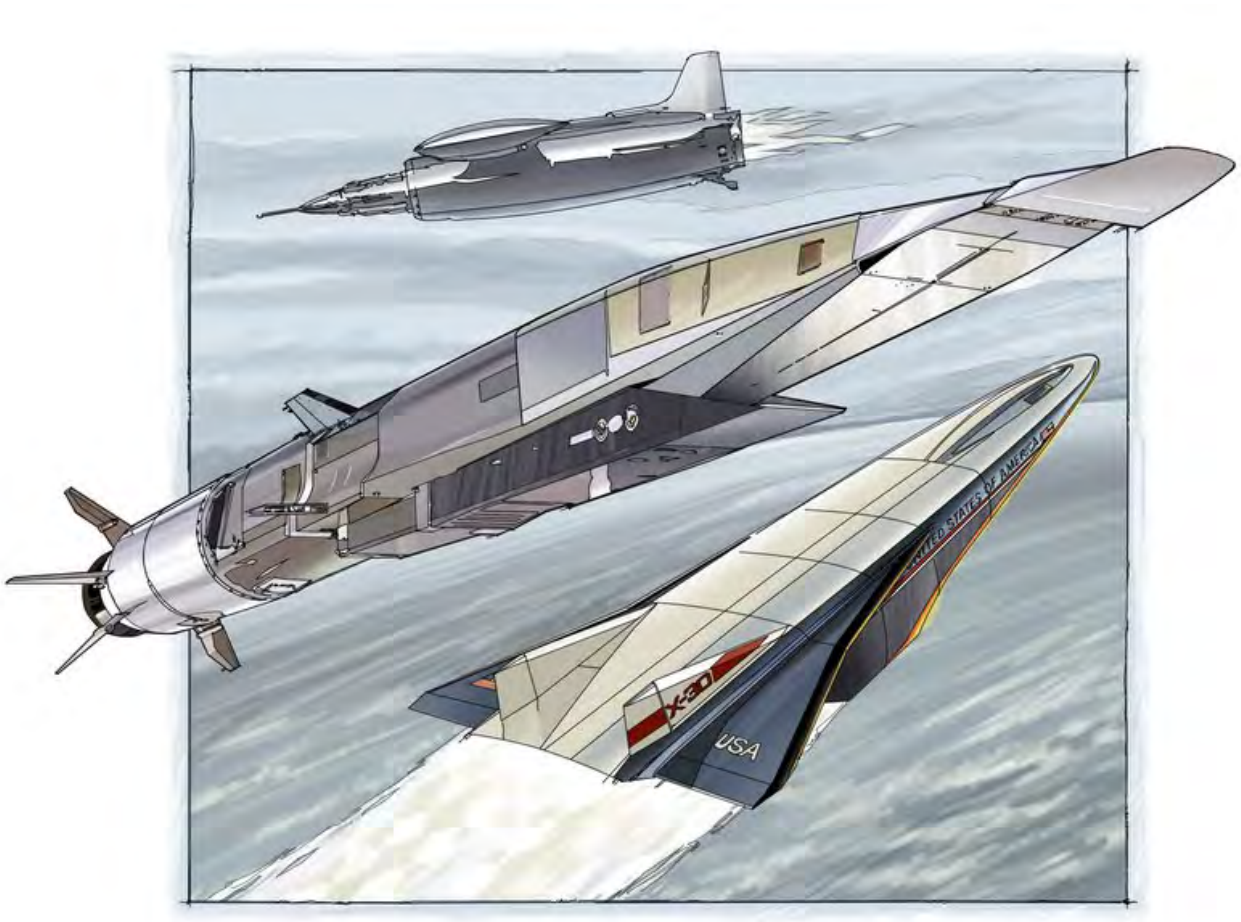

Engineers have been experimenting with ramjets since the 1930s. From top: The French Leduc 0.10, test flown in 1949; the Boeing X-51 Waverider, which flew in 2009; the Rockwell X-30 NASP, cancelled before it could fly. (Illustration by Harry Whitver)

A dozen years ago, bulldozers leveled a unique test facility on the west side of Van Nuys Airport in California's San Fernando Valley. In its 1950s heyday, it shook to the roar of enough J47 engines for a squadron of F-86 Sabres. The jet engines drove pumps and impellers to replicate flight conditions above 80,000 feet and close to eight times the speed of sound.

The Marquardt Corporation built the test rig because the ramjet engine—a simple tapering duct that inhales, slows, and compresses air as it moves—was expected to take aviation to

Mach 8 and beyond. It did not happen that way. Today, ramjets are only used to power missiles, and most are quite small.

The first time I visited the Van Nuys site, in the mid-1980s, I toured the back lot between the site buildings and the airport's wire fence, a place of secrets and mysteries. There was a boron-fueled engine that (I was told) ran with a vivid green flame. And a ramjet known only as the "schoolhouse engine"—after a rented building where the design team had been sequestered—that had to have been built for some kind of flying vehicle, because it was too big for the Marquardt ground-test rig or any other test site in the United States.

The next step up in speed is the supersonic combustion ramjet, or scramjet. At speeds around Mach 8, the airflow inside the ramjet is so hot it is not possible to add energy to it. The scramjet does not slow the air down so much, so it can still produce power at hypersonic speeds.

Until the last few years, the scramjet had an unbroken history of disappointment. The Reagan administration spent big money on the scramjet-powered National Aerospace Plane, designed to fly from a runway into orbit, as a way to dominate near-Earth space. But the NASP's aerodynamics could neither be tested on the ground nor modeled on a computer. Even if it could fly, there was no guarantee that it would reach its design speeds. Budget cuts killed the program in 1993. Its shape, however, lived on in two small test vehicles, the NASA X-43 and U.S. Air Force X-51, which have managed a few seconds of scramjet flight.

The simpler ramjet, however, can still fly faster than a turbojet. Most people will argue that it, too, has a fatal drawback—it needs another engine or a rocket booster to get it moving fast enough to run.

But when I next visited Van Nuys, in 1997, there was a new engine in the test cell at what was then called Kaiser Marquardt. It was commissioned by a low-profile startup called Space Access, which wanted to use it to power a 747-size supersonic aircraft to an altitude of 150,000 feet, where it would open a nose hatch and eject a spaceplane, or a simple rocket to boost a satellite into orbit.

The new engine was an ejector ramjet—a ramjet with a ring of small rocket engines in the duct. The rockets ran fuel-rich and their high-velocity exhaust drew outside air through the inlet to burn the extra fuel. The rockets would burn hydrogen and oxygen, with the oxygen flow diminishing as the vehicle accelerated and shutting off at about Mach 2.5. Tests at Van Nuys, the project's backers said, showed that the rockets could propel the aircraft from standstill to high supersonic speed. Global Technology Partners, a group headed by Bill Perry (defense secretary during the Clinton administration and the "godfather of stealth"), looked very hard at the project. One team member told me later that they had found no reason why it would not work. What killed it was the failure of the space launch market to boom in the 1990s as people had expected.

So what really happened to ramjets? Sputnik and Robert McNamara. The space race diverted U.S. space science into rocketry, and President John Kennedy's defense secretary and

his whiz-kid advisors backed intercontinental ballistic missiles over air-breathers, expecting the latter to be easily shot down by bigger enemy missiles. Thereafter—unless there was a secret project hidden somewhere—only the impractical NASP received any serious money.

But if ever someone decides that there is value—military value, most likely—in flying at Mach 4, 5, or 6, that simple ejector ramjet is ready for duty.