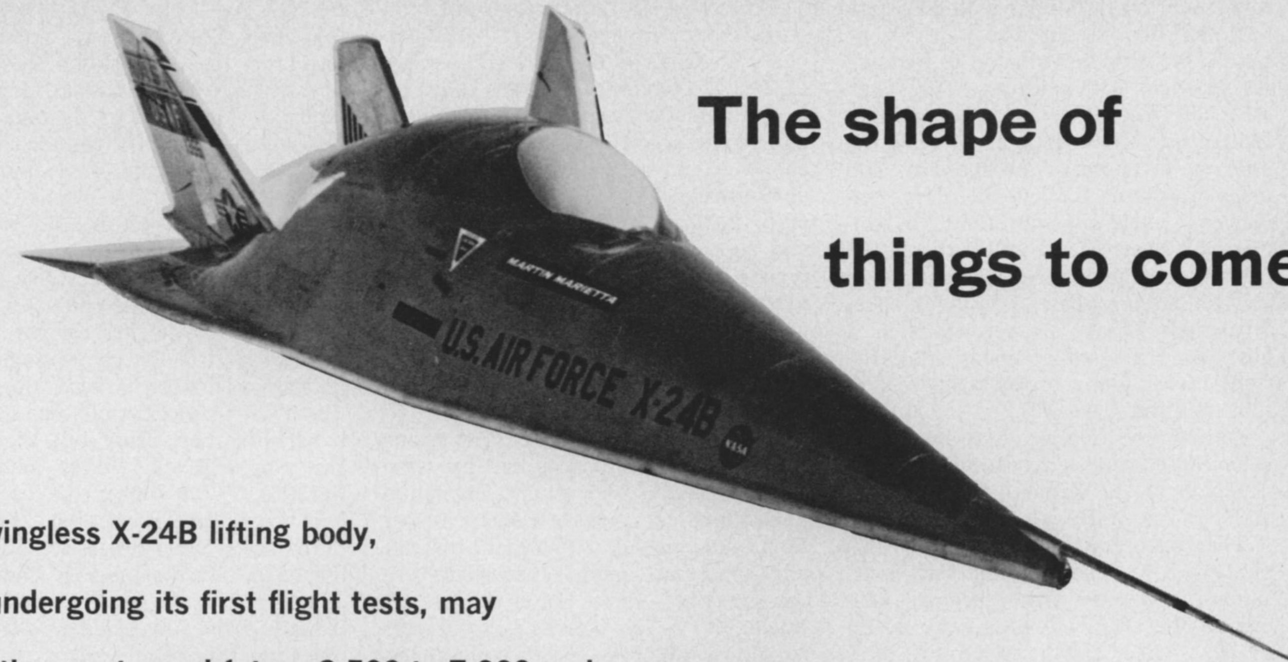

The shape of things to come?

The wingless X-24B lifting body, now undergoing its first flight tests, may point the way toward future 3,500 to 7,000 mph aircraft operating on the fringe of space

by Everly Driscoll

Streaking 350 miles an hour nose down toward a dry lake bed, John A. Manke flares, levels off, and eases down to a soft landing at 200 miles an hour. Within a mile and a half, the X-24B comes to a stop.

The new experimental space-aircraft Manke is currently flying at NASA's Flight Research Center (FRC) and Edwards Air Force Base in California has a most improbable shape—although it is less unorthodox than its predecessors. The X-24B is a second generation lifting body—what aerodynamicists think is the best of two worlds: it is the shape of a maneuverable reentry-type space vehicle and also the configuration of an airplane that can cruise at speeds between Mach 5 and 10 (3,500 and 7,000 miles an hour).

But it doesn't look like either a spacecraft or an airplane and that's the secret—it could be a glimpse of the shape and speed of things to come.

A lifting body is a craft that derives its lift from its body shape alone. The research program, funded by both NASA and the Air Force, used to be billed in support of the Gemini and Apollo space programs—then the space shuttle. But the presently envisioned shuttle has wings, and although the information base established by the lifting body program was funneled into shuttle technology, the present shuttle just doesn't look—or behave—much like a lifting body. The X-24B doesn't look—or behave—too much like the X-24A either. The new research is being done primarily in support of the Air Force for advanced military aircraft of the future capable of sustained cruise flight at hypersonic speeds—Mach 5 and above.

Manke, a NASA test pilot, considers the new shape a definite improvement over the X-24A. It handles more like a conventional airplane. He has been flying lifting bodies now for five years. Before that he was in the X-15 office. He has flown the M-2, the HL-10 and the X-24A—all first-generation lifting bodies. He began flying the X-24B unpowered last month. It was the first flights for the new craft. This week Manke will make his fourth flight to be followed by one more late this month. Then in October, if all goes well, he will fire up the XLR-11 rocket engine on the craft for powered flight.

The X-24B is launched from an Air Force B-52 flying at 45,000 feet. After launch, Manke puts the wingless craft through a series of maneuvers to evaluate its stability, control and its lift and drag at different speeds, heights and attitudes. The maneuvers include pushing the nose over and then pulling up (leveling off). Manke also "pulses" the craft. He turns off the automatic electronic stabilization system. He then moves the craft quickly—pitch up and down and yaw sideways—and lets go to see how easily the craft levels out again.

Pilot Manke after his first flight.

At 20,000 feet Manke begins a left turn into the 180-degree landing pattern. In this leg of the journey, he pushes the nose down again to increase his speed to 350 miles an hour. Then at 1,000 feet above the Rogers Dry Lakebed at Edwards AFB, he pulls the nose up to decrease the speed to 200 miles an hour (called the flare maneuver), levels out and lands. "It handles well," says Manke. "It is the easiest of the group to handle, especially during the landing phase. I just don't feel as though I have to get down in a hurry as I did with the earlier craft."

All this is done unpowered—and in four minutes.

During the flight, data about the vehicle are being telemetered over 210 channels to the ground from sensors all over the craft.

The maximum speed during this phase will be only 450 miles an hour. When powered flight begins next month, the craft will eventually fly up to 70,000 feet and at Mach 1.5. This will allow the engineers and aerodynamicists to evaluate X-24B in four flight regimes: subsonic, transsonic and supersonic, plus landing. (Subsonic is below Mach 1, or the speed of sound. Transsonic is from Mach .8 to Mach 1.1 when parts of the craft are going supersonic and other parts subsonic. Supersonic is Mach 1 to Mach 5. Hypersonic is above Mach 5).

"The X-24B is representative of optimum shape for hypersonic flight," explains Jack L. Kolf, project manager of the X-24B office at FRC. This research model will not be able to achieve hypersonic speeds (a larger plane and engine would be required), but it will demonstrate how a hypersonic-shaped craft behaves at subsonic, transsonic and supersonic speeds. The transsonic regime is especially crucial. "Most aerodynamic problems occur at this speed," notes Fred DeMeritte, chief of the lifting body program at NASA headquarters. "We are looking for surprises as we go through transsonic."

And surprises do come. The shape of the craft was determined by wind tunnel tests at the Flight Dynamics Laboratory at Wright-Patterson Air Force Base in Ohio. Different aircraft and spacecraft models are placed in wind tunnels, where air speeds reach Mach 50, to see how various designs handle at different speeds and angles of attack, and where the most air friction is. "It takes actual flight, however," says Kolf, "to verify the wind tunnel predictions." One surprise came with the HL-10 flights. The leading edge of the vertical fin had to be reshaped after flight because of adverse air flow over the fin.

To build the X-24B, NASA and the Air Force used the basic structure of the X-24A—"primarily to save money," says Kolf. Starting from scratch would have cost from $5 million to $10 million. (They got the X-24B for only $1 million.) Martin Marietta took the X-24A, flattened out the rounded, bulbous belly, stretched the nose and added strake ailerons. The result was the double delta shaped X-24B. It weighs 8,000 pounds empty and can carry 5,000 pounds of rocket fuel. It is 37 feet long, 9 feet wide and 10 feet high.

The new shape has improved ratios of lift to drag at hypersonic speeds compared with the earlier lifting bodies. The X-24A, for example, had 1.4 times better lift than drag, but the X-24B has more like 2.5 times better lift. Because of the higher lift to drag at hypersonic speeds, the sleek body has much better cross-range capability than the X-24A (cross range is how far an unpowered craft can be maneuvered laterally from any given point). Theoretically, from orbit reentry, the X-24A had a cross range of 950 miles. The X-24B has a cross range of 2,500 miles. The current space shuttle, which lands unpowered, has a cross range of only 1,100 miles. Thus the X-24B is more representative of a second- or third-generation shuttle, a craft that can perform in orbit, reenter and fly around. But it is also representative of the best shape for hypersonic cruising. A powered airplane with a high lift-to-drag ratio would use much less fuel. "We are getting a leg up on the future at low costs," says DeMeritte.

The logical question is why the Air Force and NASA are studying planes that cruise in the atmosphere between Mach 5 and 10, when they could go into earth orbit and do much of what they need to do and zip around at Mach 25. "The answer now is one of economics," explains one aerospace theorist. "While you are going one-third orbital speed, you are using one-tenth the energy. It just takes a hell of a lot more energy [which spells out more fuel and money] to get into orbit." □