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THE NATIONAL AERO-SPACE PLANE

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"Now leaving from gate 17, flight 392 to low Earth orbit." It may sound like something a long way off, but with the development of the National Aero-Space Plane, abbreviated NASP, that announcement may not be very far away. Utilizing advanced engine designs, like supersonic combustion ramjets, known as SCRAMJETS (shown in figure 1), and radical airframe configurations (figure 2), flights to low Earth orbit from conventional airports, and two-hour flights from New York to Japan, may be possible by the late 1990s to early 2000s. The SCRAMJET engine and airframe designs, required for the NASP to achieve these projections, will be made possible by supercomputers than can do up to 250,000,000 calculations per second. One such computer, the Cray 2, is now installed at the National Aeronautics and Space Administration's Ames Research Center.

The technology for this plane is not available yet, but it could be soon. Under the direction of the United States Air Force, companies are bidding on contracts to develop the technology for the NASP. The vehicle that will be developed to test this advanced technology was originally designated the X-31, but has been recently redesignated the X-30A. The reason for this redesignation is unknown to people outside of the Pentagon. It could suggest that the Air Force had previously been working on a similar aircraft, and had decided to combine the two programs into one. This design is now in Phase 2 of development and various companies will be bidding to design specific components of the vehicle, such as the engines and airframe. In April, 1986, the Defense Department and NASA awarded seven contracts to several aerospace companies for propulsion and airframe development over a 42-month period. Of the $450 million worth of contracts, awards for propulsion, of about $175 million each, went to General Electric (associating with Aerojet TechSystems), and Pratt & Whitney. Awards for airframes, of up to $32 million each, went to Boeing, General Dynamics, Lockheed, McDonnell-Douglas, and Rockwell International. Based on present advanced engine work, Aerojet TechSystems will be associating with General Electric, but will not have a separate contract of their own, due to the Defense Department's preference to work with companies established in defense development. The many airframe contractors will be reduced to two or three by a design competition held during the first year of the contract period, to allow the best selection of the many possible design configurations. At the conclusion of the 42-month contract period designed to validate the applicability of the new high-risk technology required for the development of the NASP, the Air Force will begin Phase 3 by assuming the management of the program to develop a flight test vehicle. At the same time as the Air Force is developing a flight test bed, the research program sponsored jointly by the Defense Department and NASA will continue.

The technology to accomplish the tasks set for this new craft lies mainly in the development of the SCRAMJET engine. This engine allows air to enter at supersonic speeds before being mixed with the fuel and combusted to produce thrust. Currently, vehicles with supersonic capability utilize turbojets, ramjets, or a combination of both. Turbojets generally operate at subsonic speeds, and need a compressor to generate the proper density and composition of air in their combustion chambers. To obtain supersonic velocity, turbojets often make use of an afterburner. Ramjets don't utilize a compressor, but need a high air speed to compress the air as it is rammed past the inlet, where fuel is injected directly into the flow. Compared to SCRAMJET engines, conventional engines operating at speeds above Mach 1 have to slow the air to subsonic velocity when entering the air inlet to allow the engine's compressor and/or fuel injector to work properly. This slows the exhaust velocity and ultimately the overall speed of the plane, and exposes several other problems. Air entering the inlet at high speeds exits the engine so quickly that conventional fuels don't have time to mix and combust before they are expelled out the rear of the jet. Additionally, the air heats the leading edge of the inlet to such high temperatures that current materials used in the design of aircraft, such as titanium, are unable to maintain their structural integrity. To overcome the fuel combustion problem, hydrogen or methane will be used, since their higher combustion rates will allow them to mix with the air and burn before it leaves the engine. Traditionally, heating problems have been overcome by using nickel alloys, but their high weight precludes any great use of these materials on aircraft. This problem may be solved by a DARPA-developed process called rapid solidification, combining the high temperature resistance of nickel alloys with the low weight of titanium. High speed flight through atmosphere also often causes the airflow through engine inlets to break down and become unpredictable. Variable geometry inlets, as shown in figure 2, alleviate this problem by changing shape to better direct the airflow as the craft reaches higher speeds.

Many different airframe configurations are being considered for the Aero-Space Plane. Currently, there are probably over a dozen designs being looked at for the optimal performance of the plane, and the media are littered with them. Several are based on the lifting body principle, which was well tested during the military's experimental aircraft program, now revived with the X-29 and X-30A. Lifting bodies use the shape of their hull, instead of wings, to generate lift. Other designs are similar to the abandoned Super Sonic Transport, or SST; canceled because of public pressure. The SST design was criticized for being too noisy; something that will not be a problem with the NASP, since it flies at such high altitudes. Still other designs resemble nothing currently in the air, or on the drawing boards. These may be the designs most likely to be chosen, because, with the radical new engine designs, current airframe concepts just can't be adapted to the requirements demanded of them. One such design is the British concept called HOTOL, for Horizontal Take Off and Landing. The HOTOL has small wings located far aft along the fuselage, canards, and an air intake slung beneath the body of the craft at the rear. Another major difference is that the fuel tanks are located in the body of the craft, rather than in the wings, taking up all of the interior space not used for payload, avionics, or engines.

The National Aero-Space Plane is an extremely versatile and adaptable aircraft. It can be developed into an Orient Express that would dramatically improve trade with countries in Asia and elsewhere; a commuter transport to ferry men and materials to space, an advanced tactical fighter or bomber, and an unparalleled high altitude spy-plane to observe troubled spots all over the globe. Utilizing the technology developed by this pilot program, it will be possible to quickly and easily get to low-Earth-orbit, go halfway around the world in a fraction of the time it previously took, and lead the world in the development of advanced technology to improve our lives and the lives of many others.

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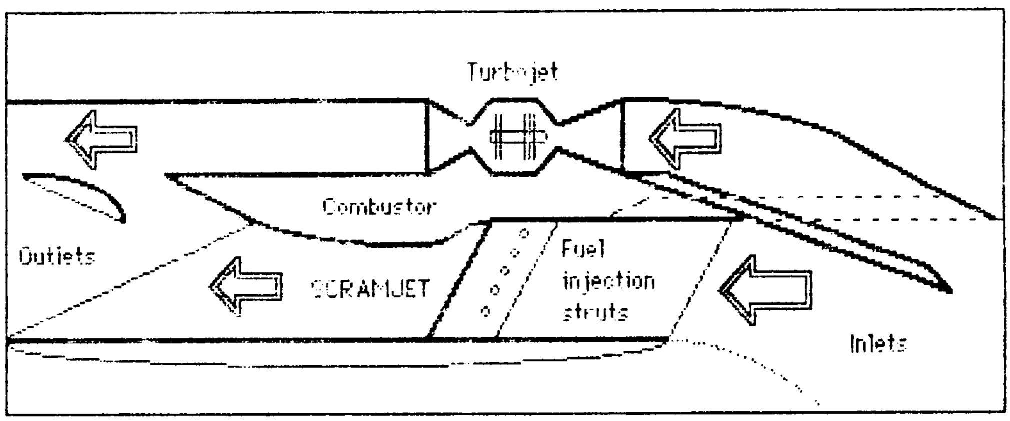

Figure 1.- Combined turbojet/SCRAMJET engine.

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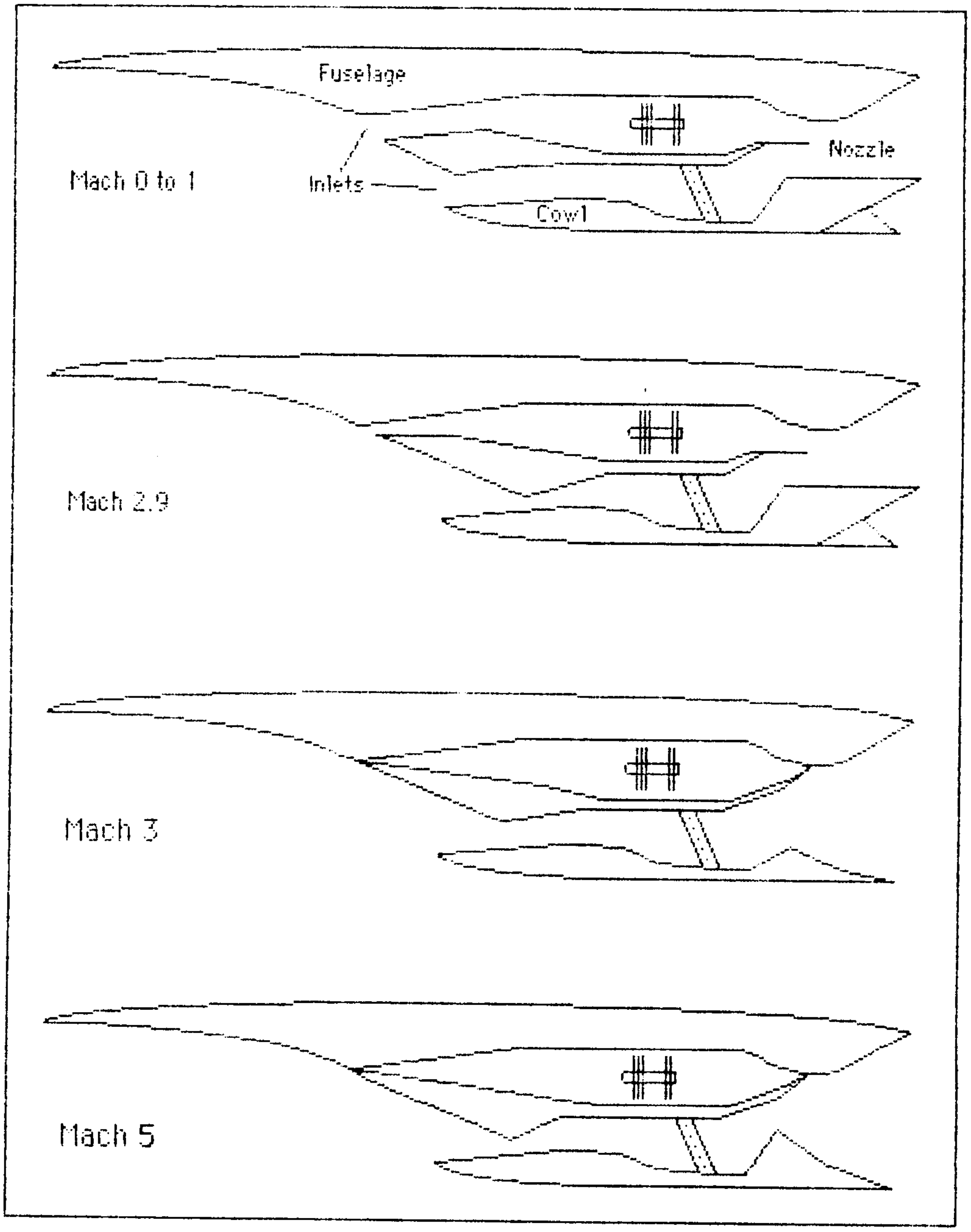

Figure 2.- Variable geometry engine design.