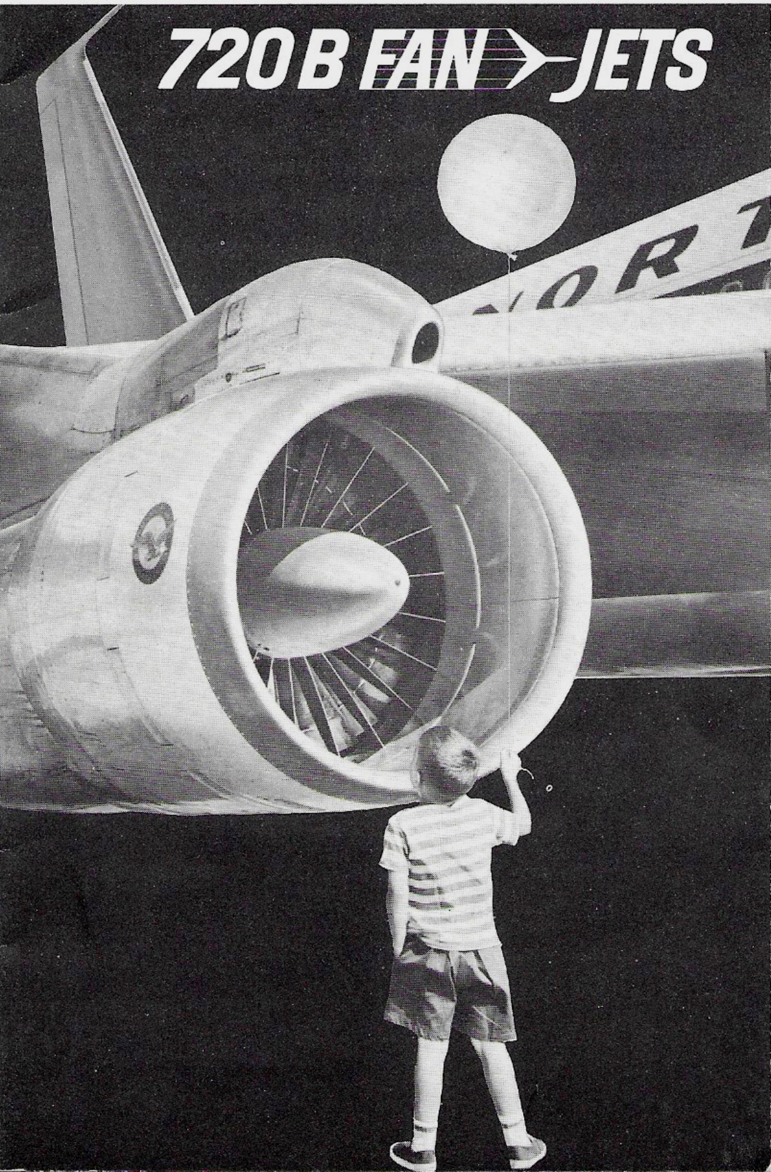
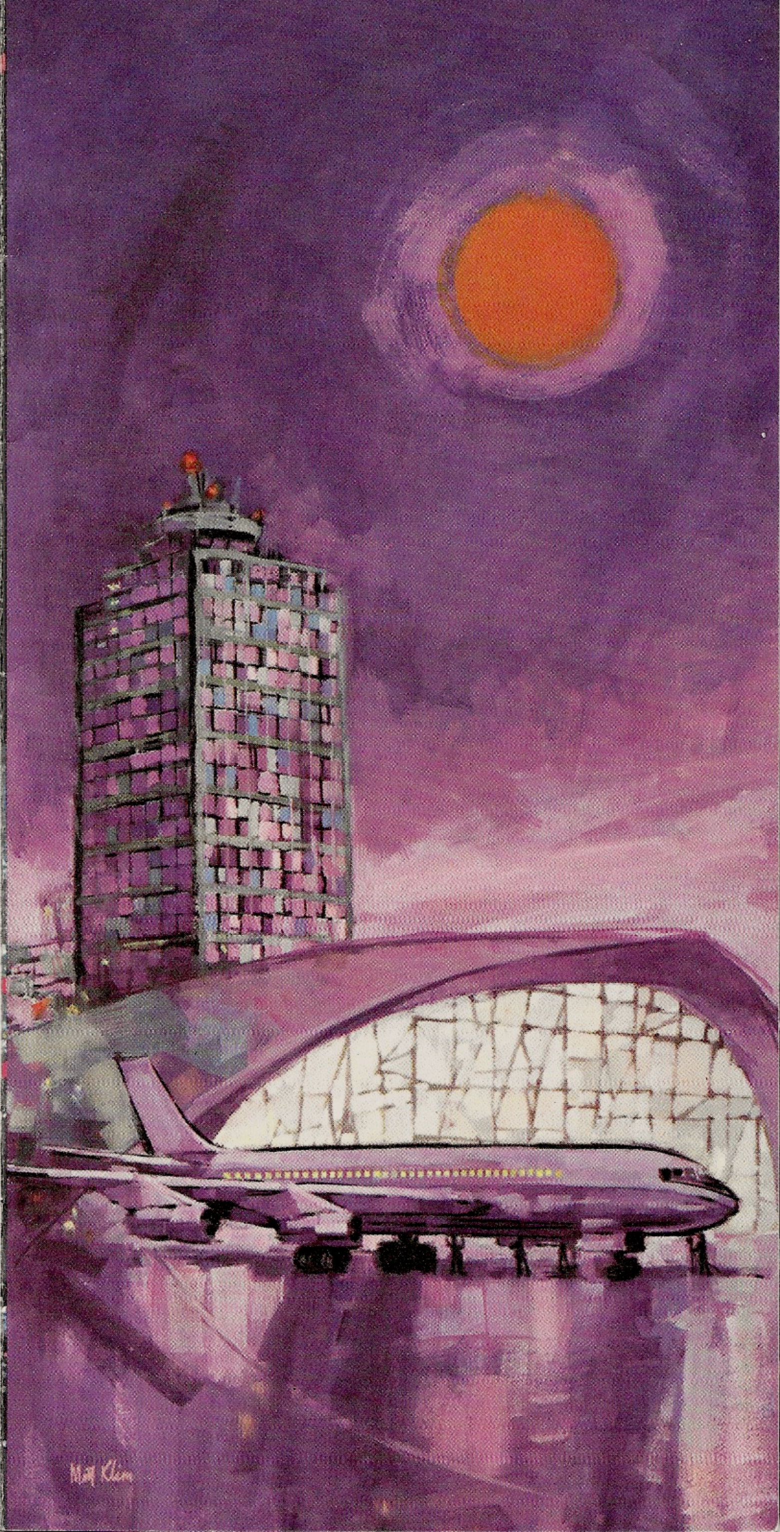
THE INSIDE STORY OF THE REMARKABLE ENGINES ON NORTHWEST *Orient* AIRLINES'

720 B FAN-JETS



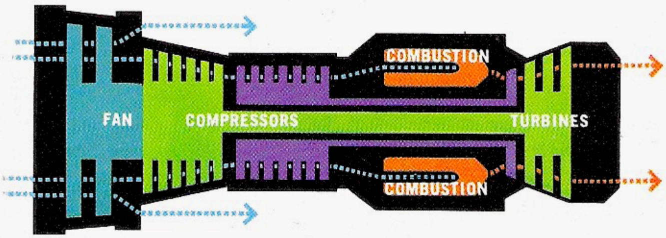
Most of us are familiar with the revolution which was wrought on the commercial aviation industry by the advent of the jet engine. A natural extension of this revolution has been the fan or, as it is known technically, the turbofan. Turbofan engines enjoy several advantages over other gas turbines. Their delivery of greater thrust for every pound of fuel burned is translated into longer range and shorter enroute times. Reduced take-off distances make jet transportation available to more airports, thus opening the benefits of the jet age to an ever-increasing number of air travelers.

Drawing on a knowledge gained in more than thirty-five years of building aircraft engines, Pratt & Whitney Aircraft, a division of United Aircraft Corporation, has engineered its product with primary emphasis on what an airline passenger values most — dependability. Pratt & Whitney Aircraft turbofan engines are the result of the most extensive testing and development program to which an aircraft propulsion system has ever been subjected. In total service, the engine family from which the Pratt & Whitney Aircraft turbofan evolved has accumulated tens of millions of flight hours, equivalent to hundreds of thousands of trips around the globe.

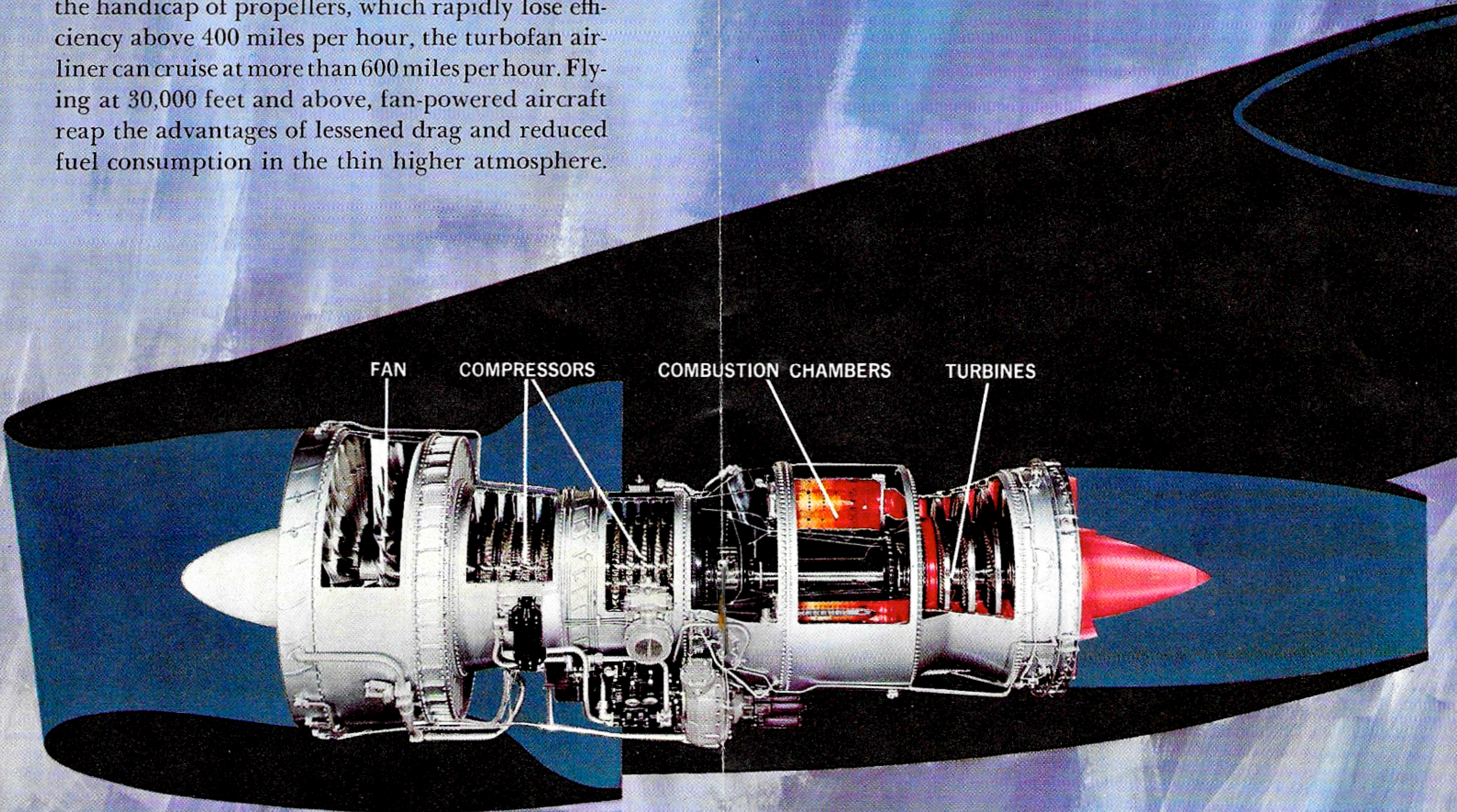


FROM A TOY BALLOON can be learned the basic principle of jet propulsion. Air under pressure in an inflated balloon pushes outward against the skin with equal force in all directions. If the balloon's stem is suddenly released a section of skin is, in effect, removed. The air continuing to press on the portion of skin directly opposite the opening causes the balloon to move. This motion will continue as long as high pressure remains inside the balloon. If air could be pumped into the balloon at the same rate at which it escapes, pressure would be maintained and the flight could continue. Turbofan, turbojet, and rocket engines all operate on this same jet propulsion principle. A compressor, which gulps vast quantities of air into the forward end of the turbofan, exerts high pressure against the engine's walls. This pressure, as in the balloon, is released to the rear through exit ducts. Obviously, nothing can escape in a forward direction because of the inflow of air.

This is where the analogy to the balloon ceases. In the turbofan engine, air is drawn in, compressed, and passed back to the combustion chamber where heat energy is added by the burning of kerosene. A turbine in the exit path, turning like a water wheel, taps energy from the escaping exhaust gases, and transmits this energy forward through a shaft to drive the compressor. The fan, serving as the front element of the compressor, handles all the air taken into the engine. Some of this air passes aft to the combustion and turbine sections, but the greater portion is partially compressed and immediately ejected through rearward-facing ports near the front of the engine. This relatively cool fan discharge air represents the greater thrust-generating potential of the turbofan engine as compared to its predecessor, the turbojet. Thus, for longer flight range, greater cruising speeds, and shorter take-off distances, the trend is *TO THE TURBOFAN.*

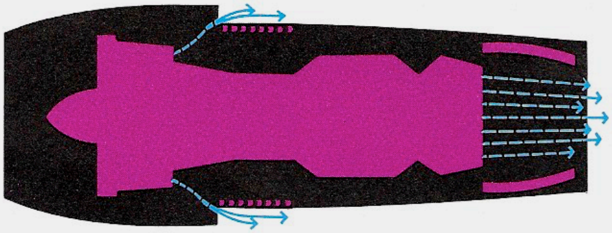


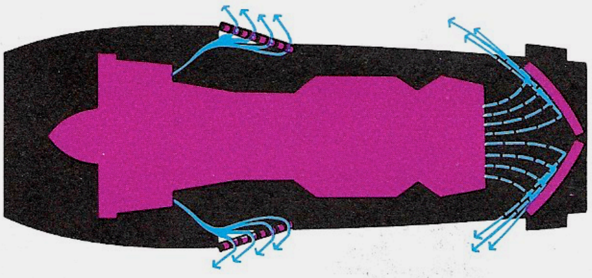
The location of the engines below and in front of the wing permits the thin knife-like airfoil to slice through the air at near sonic speeds while admitting an uninterrupted flow of air into the engines. Turbofan engines also lend themselves to installation alongside the fuselage or even in the tail. Each of the turbofans in these "pods" produces 17,000 to 18,000 pounds of thrust, about three times the equivalent power of the biggest piston engines. More important, this power can be delivered at high speeds and high altitudes. Without the handicap of propellers, which rapidly lose efficiency above 400 miles per hour, the turbofan airliner can cruise at more than 600 miles per hour. Flying at 30,000 feet and above, fan-powered aircraft reap the advantages of lessened drag and reduced fuel consumption in the thin higher atmosphere.



Most of us have seen piston-powered aircraft pulled up short on the runway by the reversed pitch of their propellers. The turbine powerplant, since it uses no propellers, introduced the problem of slowing the aircraft by other means. The solution was achieved by utilizing the movement of the air mass as a braking force. Thus, today's airliners are equipped with thrust reversers which deflect the exhaust gases forward along the outside of the engine. These reversers operate in both the fan and the turbine exit paths. The resultant deflection helps to slow the aircraft to taxi speed.

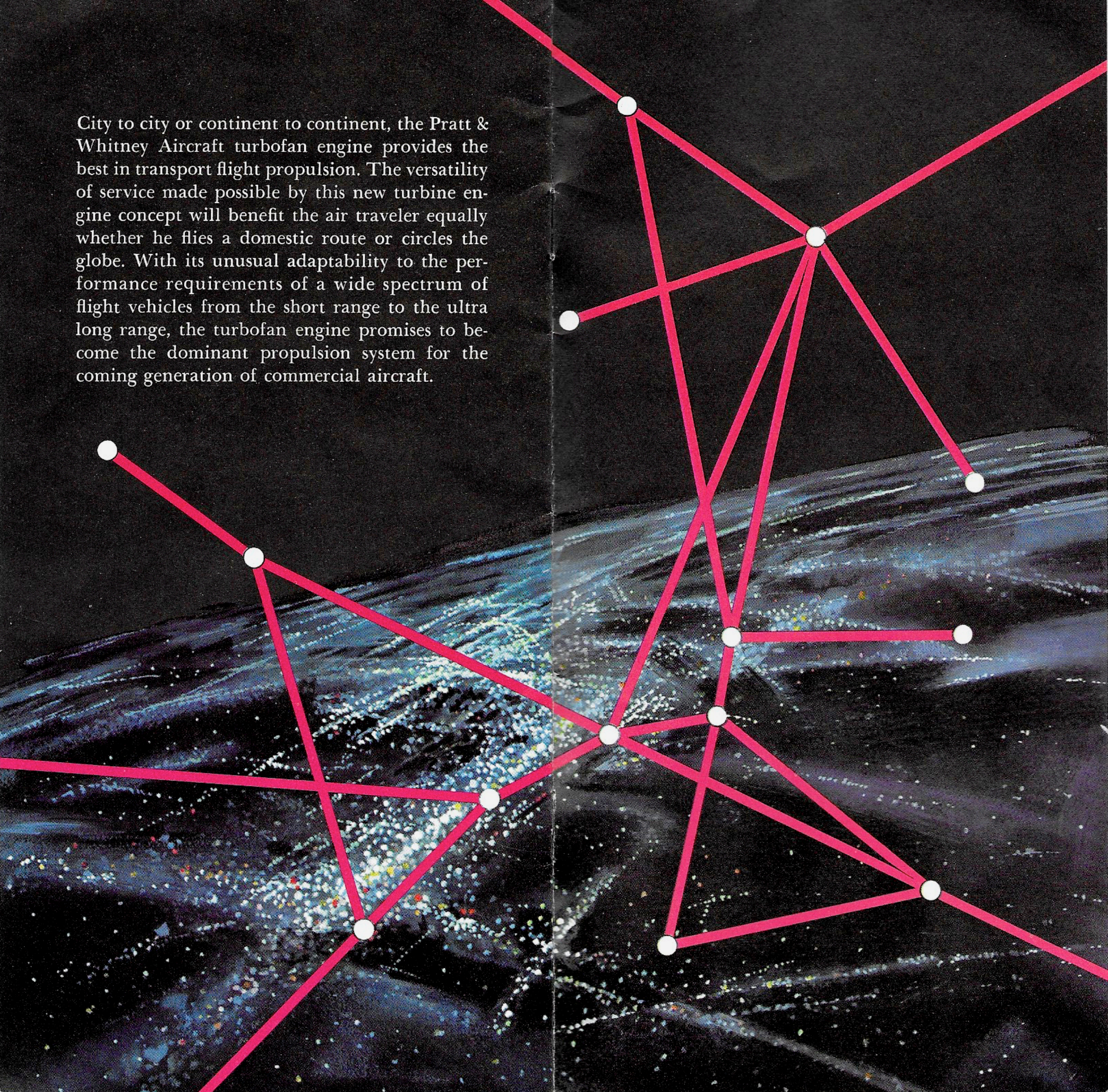
FORWARD THRUST POSITION





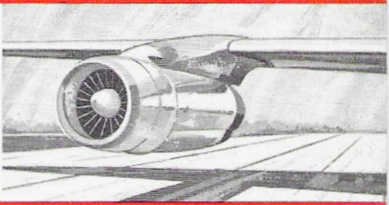
REVERSE THRUST POSITION

City to city or continent to continent, the Pratt & Whitney Aircraft turbofan engine provides the best in transport flight propulsion. The versatility of service made possible by this new turbine engine concept will benefit the air traveler equally whether he flies a domestic route or circles the globe. With its unusual adaptability to the performance requirements of a wide spectrum of flight vehicles from the short range to the ultra long range, the turbofan engine promises to become the dominant propulsion system for the coming generation of commercial aircraft.

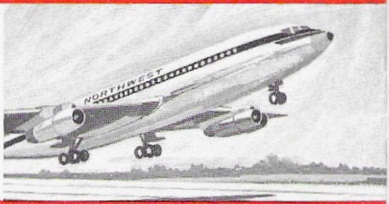


Why the **NORTHWEST FAN-JET** is the most relaxing jet yet...

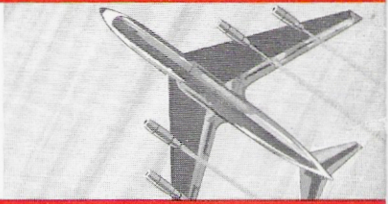
42% more powerful than ordinary jets—thanks to the remarkable turbo-fan engines.



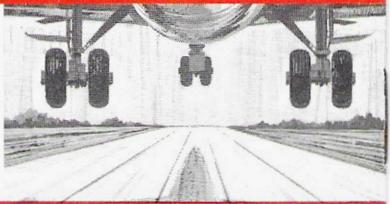
Takes-off in ⅓ mile less runway than a jet with ordinary engines.



Climbs up to smooth air quicker—up to where the sky is always blue.



Lands in less space than any ordinary jet (thanks to more **stopping** power).



THE FAN-JET AIRLINE

NORTHWEST *Orient* AIRLINES

COAST TO COAST • FLORIDA • CANADA • ALASKA • HAWAII • THE ORIENT