Currently, operational demonstration tests are being performed and include operations off the desert, from an aircraft carrier, on sod and sandy soil, and from rapid site pads, aluminum and steel mat runways, and extensive tests on conventional runways. A cargo drop has also been performed.

One fundamental design problem encountered with the XC-142, which is typical of present tilt-wing configurations, is the design compromise between the VTOL and cruise flight modes. This compromise occurs in the relationship of propeller diameter, (disc loading) and wing chord or wing loadings. To obtain high hover efficiency, the propeller diameter should be large; to obtain high cruise efficiency the wing chord should be sized to produce optimum wing loading and aspect ratio. For good transition characteristics there is, at present, a minimum wing chord-to-propeller diameter ratio which must be adhered to and which is generally larger than cruise flight dictates. Thus, one requirement conflicts with the other, resulting in the need for compromise in propeller diameter and wing chord. Some methods appear to offer relief from these problems. A tilting thrust vector, that is tilting the propeller axis with respect to the wing should permit better optimization of the wing.

Since the XC-142 employs interconnected shafting among four power plants and propellers using a multiplicity of gear boxes, it cannot be regarded as an advance from the standpoint of simplicity.

Although this type of aircraft (high disc loading propeller/rotor) does not meet the criteria for satisfying 1985 VTOL needs, the XC-142 has an excellent STOL capability. Serious consideration is being given to limited production of a quantity of these aircraft. If they should enter the operational inventory in the early 1970's as V/STOL transports, they could provide valuable V/STOL operational experience.

## D. AVRO (CANADA) AVROCAR

The avrocar was an 18-foot diameter, disc shaped ("flying saucer"), ducted fan type aircraft powered by three Continental J-69 turbine engines which supplied gas flow to tip drive a large fan located in the center of the machine. The fan flow was conducted through internal ducting to the periphery where an annular efflux was produced. This produced a large beneficial ground effect. The Avrocar was a GETOL (ground effect take-off and landing) machine designed to take off vertically using the ground cushion and fly out of ground effect after attaining adequate forward speed.

Although the annular jet gave good "hovering" efficiency in ground effect, it produced significant "suckdown" characteristics out of ground effect. A later development of the Avrocar "focused" the peripheral flow inwards to provide its efflux as a column of air at the center and minimize this suckdown while retaining beneficial ground effect. For propulsion in forward flight, the annular jet was deflected rearward by control vanes around the perimeter of the machine. Control was

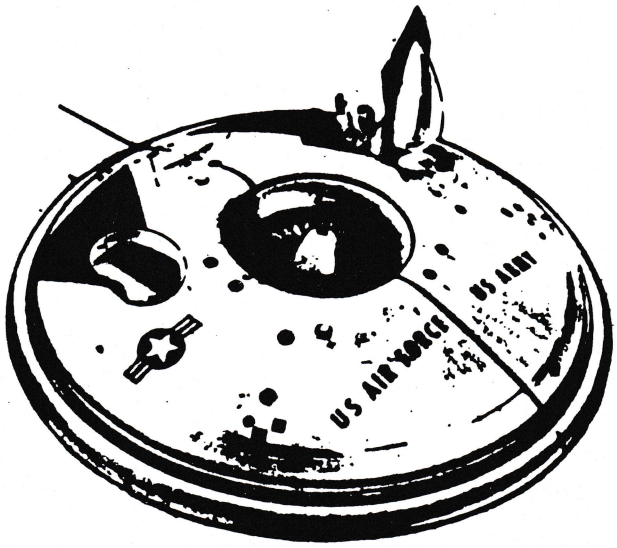


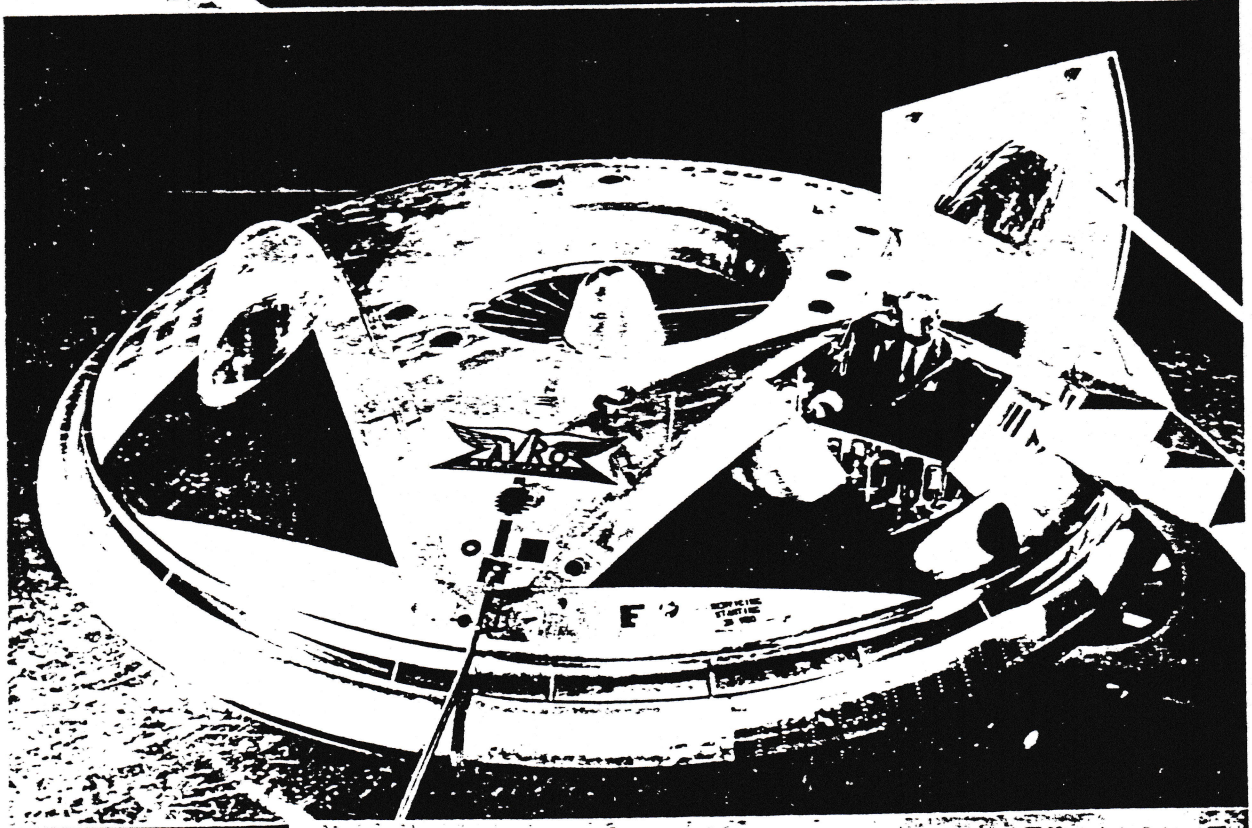

Figure 7. Ducted-Fan (Avrocar)

accomplished by the peripheral control vanes; the fan was mounted in gimbals and used as a control gyroscope to stabilize the aircraft. This was an all-mechanical system and had many problems. The early version of the aircraft had an annular peripheral air slot, open at the upper surface, which was intended to induce secondary flow and increase vertical lift. This did not achieve the expected benefits, however, and the upper opening was sealed off in later developments of the machine.

One basic problem of a disc-shaped VTOL aircraft such as the Avrocar is its inherent instability in forward flight. In hovering flight the center of gravity must be near the center of vertical lift, that is, near the center of the disc. In forward flight, the center of lift moves toward the front of the disc, ahead of the center of gravity, making the aircraft longitudinally unstable. It is possible that the instability can be handled through artificial stabilization in powered flight, but considerable flight risk may be involved in depending upon such a system.

The avrocar was intended as a low speed research machine that could be used to check the conceptual principles in flight, and also as a machine that might be suitable for certain Army uses without much further development. This aircraft was not successful. It was never flown out of ground effect, partly because of the aforementioned reasons but mainly because it did not produce enough vertical lift. The out-of-ground effect hover thrust produced was less than that generated by the three uninstalled J-69 engines. This was due to large internal flow losses.

Avro (Avro) "Aircar"


## アブロ“エアーカー”発表さる

真中に小型ターボ・ジェット1基をつけ、大きなファンを回わし、円盤のまわりにエアー・クッションをつくって飛行するもので、WS－606 Aと呼称されている。愛称はジェムといわれ、2人乗りで最大速度480 km／h、航続距離 1,600kmの性能をもっている。