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AMERICAN HERITAGE OF
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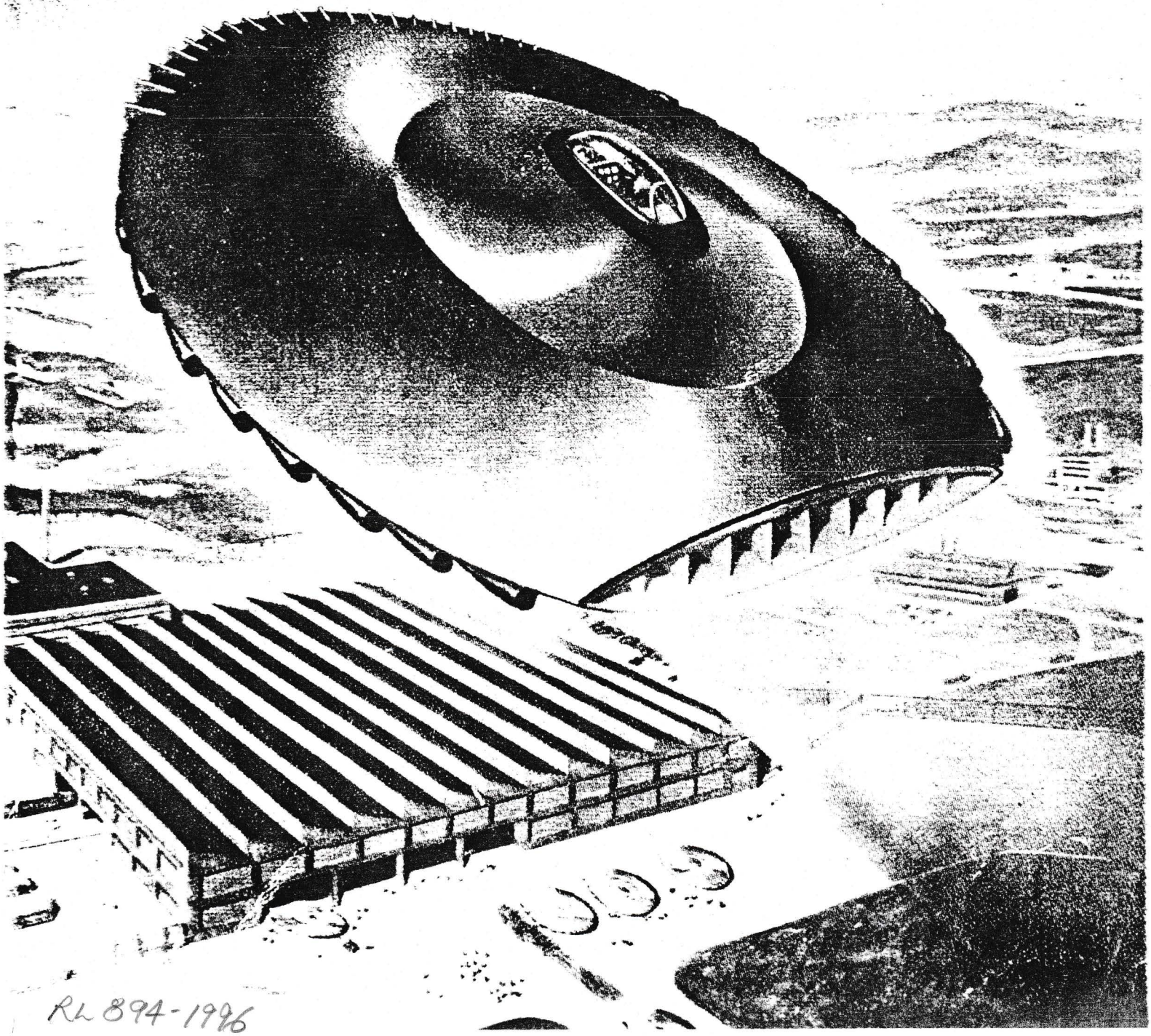
The U.S. Air Force's Flying Saucer



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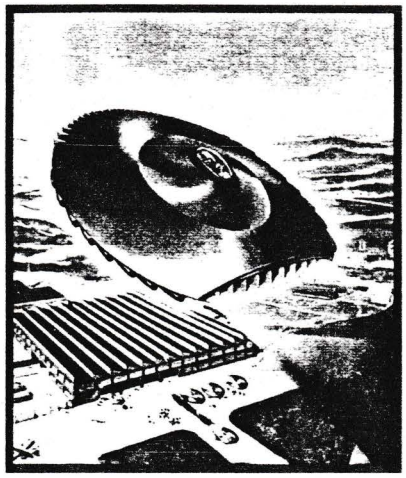


COLLECTION OF ROBERT G. DOUGLASS

THE COVER: A 1953 illustration from *Fate* magazine looks like the lurid product of an artist's overheated imagination, but in fact a disk-shaped aircraft seemed quite plausible at the time. Backed by a combination of French theory, Canadian design, and American money, the idea of flying saucers was very much in the air during the 1950s—a lot more than the saucers themselves. For more on the flying saucer, see page 58.

THEY'RE A STAPLE OF B MOVIES AND pulp magazines, but in the late 1950s the U.S. government was seriously interested

FLYING SAUCERS FROM CANADA!

BY ROBERT G. DOUGLASS

THE EARLIEST KNOWN JET AIRPLANE flew—briefly—almost twenty-nine years before the Luftwaffe's famous Heinkel He 178. One December morning in 1910 a young inventor-pilot named Henri-Marie Coanda was testing a crude turbojet attached to a plywood aircraft, both of his own design, at Issy-les-Moulineaux, a suburb of Paris. When he throttled up his engine, a ball of flame ignited the plane as soon as it became airborne. It climbed steeply for a few seconds, barely clearing a stone wall, then turned on its side and slid earthward. The pilot fell out, and the plane crashed and burned to cinders. Coanda was shaken and perhaps a little singed, but he escaped serious injury.

The plane's avant-garde engine was equipped with a slotted flap at its rear—yet another Coanda discovery. The inventor had been searching for a way to bend, or "steer," the flow from the jet nozzle attached to the wing. Placing a flap directly in its path would do the trick, but unfortunately such a flap would also quickly burn up. When he placed the flap just under the nozzle, however, the jet flow adhered to its surface and could be made to deflect downward at varying angles. The flow also pulled outside air along with it, creating a vacuum above the wing, which added lift. This phenomenon became known as the Coanda effect.

Forty-five years later Coanda, by then a respected scientist, was addressing the Wings Club in New York City. He summed up his speech with these words: "In aviation we have allowed ourselves to be hypnotized too long by the principle of the kite. . . . Since 1909, I have wanted to go forward in a different direction. . . . The only future in the air is in the 'flying saucer.'"

Coanda was born to a French-Romanian family in Bucharest in 1885 and studied an assortment of subjects at schools in Jassy, Romania; Berlin; Liège, Belgium; and Paris. Aeronautics was his passion, and after working under A. G. Eiffel on aircraft-wing design (in the course of which research he took a nighttime ride on a locomotive's cowcatcher), he developed his primal turbojet. Following its fiery crash, he could not find funding to rebuild it. He continued his aviation researches, served in the French army during World War I, and then pursued numerous other interests in and out of aeronautics, including a failed venture building Edison-style poured-concrete houses. By 1933 he was applying his Coanda effect in circular form, exhibiting a working flying-disk model.

As the Germans rolled across Europe in 1939 and 1940, Coanda was in touch with the British. He made several trips to England from his laboratory in Poitiers, France, to confer on the subject of guided missiles. But when Poitiers fell, instead of fleeing to Britain, Coanda went to occupied Paris to devote himself to Red Cross work. It was whispered that the Nazis made use of Coanda's expertise, and it does seem unlikely that they would allow an inno-

A fleet of Avrocars slaloms through the forest in a rather optimistic artist's conception of the craft's intended use.

vative aeronautics scientist to spend the war folding blankets. But if he did work with the Germans, his contribution does not seem to have made much of a difference. The rocket and space expert Willy Ley, who fled the Nazis in 1935, gave Coanda the benefit of the doubt in a 1956 article: "There was no evidence that the Germans ever used the Coanda effect in any of their aircraft. In all fairness to this talented man, he had never made a secret of the effect that is named after him."

In 1947 and again in 1951 Coanda was brought to the United States to confer with Air Force scientists at Wright Field near Dayton, Ohio. They were interested in what he was calling his "lenticular aerodyne," but not enough to put him on the payroll. By mid-1952 others had begun to investigate the possibility of a circular craft utilizing the Coanda effect. The Canadian government started talking saucers with Avro Aircraft Limited, which had initiated a disk design program it called Project Y. Avro was an offshoot of the British firm A. V. Roe and Company, a member of the Hawker Siddeley Group. Coanda himself probably never had any direct dealings with Avro, but his lenticular aerodyne was certainly a primary inspiration.

PROJECT Y WAS THE BRAINCHILD OF JOHN C. M. FROST, a visionary Briton who had come to Avro's special-projects group from De Havilland Aircraft. Frost started out investigating a spade-shaped design, but by 1953 he had switched to a circular saucer, to be driven by a single flat turbojet. He wanted to build a vertical takeoff and landing (VTOL) aircraft that would ride an air cushion at low altitudes but be capable of high-performance conventional flight at high altitudes. He had become convinced that the disk shape was the key to what he saw as a radical new generation of aircraft free from the need for runways, able to zip along hugging the ground over rough terrain or streak off into the sky in supersonic flight. A saucer, Frost realized, could efficiently produce a ring-shaped jet cushion for ground-effect hovering, while a properly configured circular wing should also be able to perform well in high-speed aerodynamic flight. In addition, the simplicity of the saucer shape would be a structural and production advantage.

After spending more than $400,000 on Project Y, the Canadian government dropped its support late in 1954. By then, however, the United States was getting interested. In September 1953 the U.S. Air Force had sent a team to the Avro facilities at Malton, Ontario, the site of Toronto's airport. What they saw was convincing enough to result in an unusual development contract between Avro and the U.S. Department of Defense: The flying saucer would be built in Canada, but instead of the red maple leaf of the Royal Canadian Air Force, it would bear a white U.S. star. In 1955 Project Y became U.S. Department of Defense Weapon System 606A. Avro sent a scale model to Wright Field for wind-tunnel tests.

The Avro 606A wasn't the U.S. military's first experience with a saucer-shaped vehicle. In the late 1940s Chance-Vought had built an experimental fighter called the XF5U "Flying Flapjack." The XF5U was not a pure flying saucer; it had a flat fuselage combined with a traditional tail assembly in back and propeller booms up front, making it look like a regular plane whose midsection had been squashed. Despite its euphonious nickname, the Flying Flapjack was not a success aeronautically or aesthetically, and it never got past the development stage.

Both the Army and the Air Force were involved in developing the 606A, and they turned out to have different goals in mind. The Army was mostly interested in an all-terrain reconnaissance and troop-transport vehicle, something rugged and adaptable rather than a high-performance dazzler. The Air Force's hopes were considerably more ambitious and similar to those of John Frost: a VTOL vehicle that could hover along the ground under enemy radar and then shoot off into the stratosphere at supersonic speed. As if this were not enough, the Air Force also envisioned high hovering, out of the ground effect, and even a hypersonic orbital-velocity craft. A mighty tall order, perhaps, but to Frost no problem seemed insurmountable; the saucer shape would be the key to all these fantastic capabilities. Ernie Happé, a British design draftsman who joined the 606A project in 1956, recalls that Frost "had wonderful ideas of developing it to become a passenger machine later on . . . carrying something like a thousand people as a hovercraft across the ocean. He also had ideas to take it up and bounce it off the layer of air around the earth . . . he was full of bright ideas like that."

A cutaway view shows the central fan and air ducts inside the triangle, with seats and cargo compartment outside.

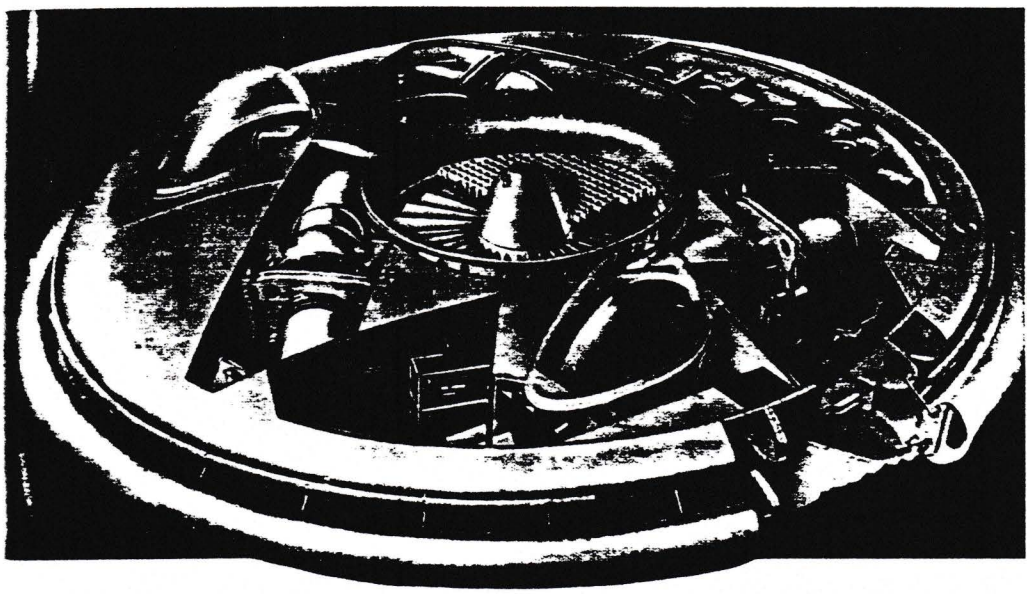
> COANDA SAID, "WE HAVE allowed ourselves to be hypnotized too long by the principle of the kite. . . . The only future . . . is in the 'flying saucer.'"

Unfortunately, Frost's "bright ideas" were about to take a big hit. The Wright Field tests had seemed to confirm his high hopes, but a re-examination of the results indicated serious calculation errors. Corrected data showed that the jet cushion on which he had based his design grew increasingly unstable at altitudes of more than a few feet. The problem could be solved, but at the cost of design compromises that would impair the craft's high-end performance. The saucer would probably never be supersonic.

The Defense Department decided to stick with the project, which still promised to fulfill the Army's goals, if not the Air Force's. In 1957 the Army formally defined its requirements to Avro. It wanted a two-man craft "to perform the tradi-

tional cavalry missions of reconnaissance, counter-reconnaissance, pursuit, harassment, etc. by means suitable to modern warfare." The saucer would have to be capable of carrying 1,000 pounds, including the crew, with the ability to hover in and out of the ground effect and travel at speeds of up to twenty-five knots for at least thirty minutes. The goal was to combine the mobility and maneuverability of a jeep and a helicopter, without the former's vulnerability to rough terrain or the latter's awkwardness around ground-based structures. The specifications seemed eminently achievable to the ever-optimistic John Frost. His latest version, which he thought of as a "flying Jeep," was dubbed the Avrocar by the company's sales department.

Henri Coanda's lenticular-aerodyne idea had involved the use of four jet-powered Coanda-effect generators in the surface of a disk, creating a vacuum above and a jet cushion below. In the original version of the 606A, the single flat



engine of Project Y was abandoned in favor of a large central turbofan turned by six Viper jet engines. After assembling a prototype, Avro engineers dropped the "Viper 6" plan in favor of one having three Continental J69 turbojets within the hull, pointed at turbine blades around the edge of a central fan. As these engines spun the turbofan compressor, air would be drawn in from above the craft, combined with the jet exhaust, and ducted to the saucer's edge. Around the rim was a continuous peripheral nozzle, where the flow would be bent downward with flaps to create the annular air cushion that would lift the vehicle.

By drawing in air from the saucer's upper surface, the Coanda effect would help keep it aloft in two ways: augmenting the air cushion below the craft and creating a partial vacuum above it. To move forward, the jet stream from the aft section would be deflected outward rather than down. The craft could be steered left or right by similar means; the Avrocar's circular symmetry would make it easy to veer in any direction. With enough speed, it was hoped, the craft could rise above its air cushion and make the transition to aerodynamic flight, with the disk acting as a wing.

As the design department started to produce working drawings, technicians in the factory across the road began assembling scale models, along with a full-size plywood mockup. The Avrocar was to be a saucer (or, in company terminology, a "circular planform") five feet high and eighteen feet across. A circular frame would hold the five-foot-diameter turbofan, which was being built by Orenda Engines, a sister company. Three beams around the fan frame formed a triangle, with points at the saucer's perimeter. Three 120-degree sections of framing connected the points into a circle, with engines and fuel tanks inside the triangle and pilot, passenger, and cargo compartments on the outside. The remaining space within the hull was used to duct the jet flow out to the rim. The framing was covered with the same stressed-aluminum skin conventional aircraft wore.

A model of the new Avrocar went to Wright Field for tests in 1958 while the factory began tooling up to build a working prototype. Security was extremely tight. Happé remembers: "If we wanted to see or discuss anything with the people building it, we had to get a special pass. It was deadly secret." Employees were not supposed to talk about the details of the project with anyone, even family members. Curiously, in the midst of all this secrecy, the Avro sales department was busy preparing elaborate brochures touting a whole line of "Avromobiles" based on the Avrocar. The Avrowagon and Avrocruiser were to be family vehicles: Mom and Dad could pack up the kids in their VTOL and float off to the Little League game. There was to be an Avrotruck, an emergency vehicle called the Avroangel, and, to replace commercial airliners, the Avrocoach. Military applications included the Avrodrone, a surveillance craft, and the Avropelican, which would cruise above the oceans searching for enemy submarines to bomb.

The press had first learned of Avro's saucer research when the company was discussing it with the Canadians. After the United States came on the scene, the resulting secrecy brought a wave of speculation about the project. All quarters of the press, from aviation to popular news to saucer-buff publications, saw in the mysterious Avrocar an imminent breakthrough in aeronautics and even space travel.

Frost and his designers came up with novel solutions to some of the engineering problems they encountered along the way. To decrease wobbling, the gyroscopically stabilized rotor of the turbofan was allowed a small amount of free tipping movement on its shaft bearing. When the vehicle pitched and rolled, this tipping was mechanically magnified and transmitted to controls around the peripheral nozzle,

which made corrective changes in the jet flow.

The pilot's control column also incorporated some original thinking. Air pressure, rather than cables or electronics, connected it with the flaps and vanes at the periphery of the craft. Attached to the base of the "stick" was a disk six inches or so in diameter, which was allowed limited rocking movement in any direction. Below it was a circle of small upward-pointing air nozzles, each one connected to an air line leading to a different jet-flow control at the saucer's edge. The disk acted as a stopper, with movement of the "stick" blocking one or more of the little nozzles. The resulting pressure backup in those lines operated jet-flow controls at the rim to steer the saucer.

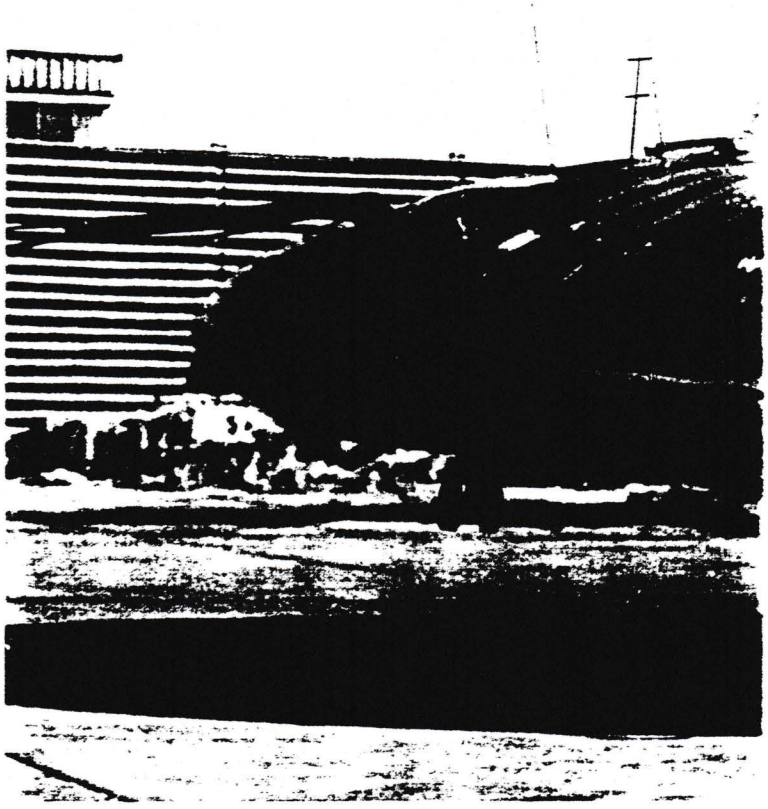
IN THE FALL OF 1959 THE FIRST AVROCAR PROTOTYPE, weighing 5,650 pounds, was rolled out onto the apron at Malton. A second unit was already under construction in the factory. Preliminary tests with the vehicle suspended in a static rig led to immediate modifications in the nozzle design. The original plan had included a ring around the saucer's edge, dividing the peripheral nozzle outlet in two (presumably to allow the influx of Coanda-effect air from above), with adjustable spoilers above and below the ring. This divided nozzle did not provide enough lift and had to be reworked. The upper channel was closed off, and the spoilers were eliminated in favor of a movable "focusing ring," a sort of circular flap around the underside of the nozzle, below the lower channel.

With its reworked nozzle, the Avrocar prototype was packed up like an oversize dinner plate and shipped to NASA's Ames Research Center at Moffett Field, California, which had a wind tunnel big enough for full-size testing. The second Avrocar, meanwhile, was finished at Malton and began hovering in tethered flight tests in December 1959, with Spud Potocki, an Avro test pilot, at the stick. The first free flights occurred later that winter, as Potocki gingerly picked his way around an ice-covered concrete apron, fenced off from prying eyes.

By April 1960 the first series of full-size wind-tunnel tests had been completed, and the news from California was not good. The vehicle was underpowered and unstable, and "apart from low speed flight (35/mph) at low heights above the ground, no region for useful flight existed." The problems were not deemed insurmountable, though, and the engineers drew up a laundry list of design changes, adding more control vanes and modifying the nozzle again. A rear fin with a ten-foot-wide tail plane (what an indignity to Frost's pure "circular planform"!) was ordered for testing, but it was never installed. The modifications were completed for a second round of tunnel tests in February 1961.

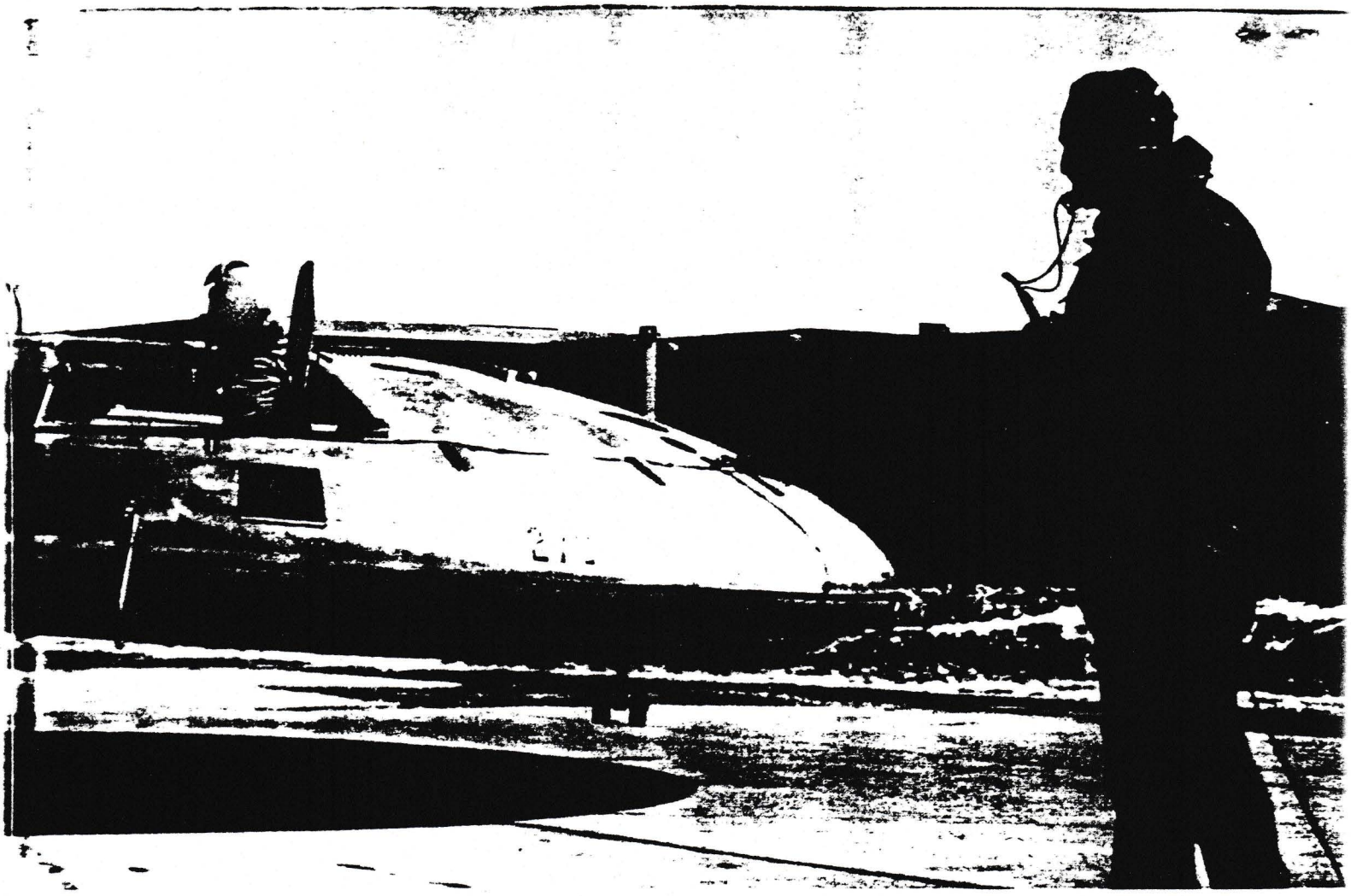
Changes were made on both Avrocars, and flight tests continued at Malton, with the saucer bobbing along at speeds of up to thirty-five miles per hour around buildings, over ditches, and into muddy fields. A U.S. Air Force pilot came up from Wright Field to put the Avrocar through its paces. By all accounts, flying the Avrocar meant sitting in a hellish hot seat: the deafening whine of the jet engines just inches away from the cockpit was accompanied by heat so intense it roasted plastic instrument parts brown. Yet the pilots' suffering was in vain, as all the testing in Canada and California pointed toward an awful truth: The Avrocar as it was configured and powered could not make the hoped-for transition from ground-cushion hovering to aerodynamic flight. At heights greater than four feet it became dangerously unstable, and in any case, the three-jet turbofan was just too anemic to get the saucer moving fast enough to fly.

Avro Aircraft put a brave face on things, producing an Avrocar promotional film that emphasized the vehicle's all-terrain ground-cushion possibilities. The Army and Air Force were less enthusiastic; after the second round of Ames tests, they began losing interest in the project fast. When



Spud Potocki takes the modified Avrocar prototype on a tethered test flight at Malton in December 1959.

AT HEIGHTS GREATER THAN four feet the Avrocar became dangerously unstable; its turbofan was just too anemic to make it fly.



Avro's development contract ran out at the end of 1961, the Defense Department cut its losses at $7.5 million and abandoned the project.

Termination of the Avrocar project was one of several blows that killed the once-mighty Avro Aircraft. On February 20, 1959, Canada had canceled its contract for the Avro Arrow, which showed every sign of being one of the world's great fighter aircraft. Company scuttlebutt had it that Avro's general manager had gone to Ottawa to discuss cost overruns and gotten into a big fight with Prime Minister John Diefenbaker, who called off the program the next day, putting 15,000 employees out of work. In what many saw as a personal vendetta on Diefenbaker's part, all six completed Arrows were cut to pieces, and every vestige of the project was destroyed: tooling, parts, drawings, and even records. This proved to be crippling to the Canadian aircraft industry in general, and in combination with the Avrocar cancellation two years later, it was fatal to Avro. The company lingered on for a few more years, finally going belly-up in 1965.

As yet, no vehicle has been developed that fulfills the hoped-for performance of the Avrocar. Jump jets like the Harrier can take off vertically and fly at high speed, but they cannot prowl along hills and gullies and between trees at single-digit altitudes and velocities. Helicopters can take off and land vertically, hover at will, and transport troops, but with their protruding rotors they are decidedly vulnerable around power lines, trees, and buildings. Likewise, hovercraft can perform some of the functions envisioned for the Avrocar, but they cannot fly.

The original Avrocar, following its last tunnel tests at Ames, wound up at the U.S. Army Transportation Museum at Fort Eustis, Virginia, where it can be seen today. The second Avrocar was scrapped, along with a partially completed third vehicle. John Frost departed for Australia in 1961 when the project was canceled. The Avrocar's chief aerodynamicist, T. Desmond Earl, later tried to develop a derivative aircraft that could take off and land as a skirted hovercraft.

Will the circular planform ever be resurrected as a shape for aircraft? Its aesthetically pleasing profile certainly continues to bewitch inventors. A Russian company has exhibited a saucer-shaped lighter-than-air craft that can supposedly lift 650 tons. A Florida engineer recently patented a helium-assisted heavier-than-air saucer with eight turbojet engines that he says could transport eight hundred passengers with ease. Whether these will be successful or go the way of the Avrocar—and dozens of other saucer designs through the years that never got past the paper stage—remains to be seen. As with the flying wing, the bird-shaped aircraft, and other flights of fancy, the flying saucer all too often is an attempt to make the laws of aerodynamics conform to a design idea, instead of the other way around. The idea of U.S. Air Force pilots skittering into the space age in silvery saucers may have died in 1961, but it seems safe to say that the form's classic simplicity will lure inventors as long as humans dream of flight. ★

Robert G. Douglass is a writer and archeological illustrator in Sonoma County, California.