

The Avrocar

While the Arrow was awaiting the cutting torches, Avro was continuing work on a novel project, the VZ-9Z Avrocar. This was a flying saucer-like aircraft, the result of research Avro had been doing into VTOL since 1951. Ottawa had at first backed the research, then both the USAF and U.S. Army came in to provide support.

Two Avrocars were built to research near-the-ground air cushion flight, level flight using the aerodynamics of the circular wing, and hovering at higher altitudes.

The machine accommodated pilot and observer. It was 18 feet in diameter and had an all up weight of 6000 pounds. Three small 1000 shaft horse power jet engines provided power. Gas from these propelled a large fan at the vehicle's hub.

First flight of the Avrocar was made December 5, 1959, by test pilot "Spud" Potocki. All flights were initially tethered ones. It was over a year later before actual forward flight was attained. It was soon apparent, however, that in flight above four feet the Avrocar became dangerously unstable. In December of 1961 the Avrocar development contract was concluded and the project abandoned. One of the Avrocars is now on display at the U.S. Army Transportation Museum, Fort Eustis, Virginia.

Avro Folds

During these post-Arrow times, Avro continued bidding on government tenders. It manufactured 300 wing-tip and pylon fuel tanks for the CF-104, but received no substantial orders. This forced the company to turn to other means of survival. It formed a partnership with the Richardson boatbuilding firm to produce aluminum hulls for cabin cruisers and even began turning out vending machines. This was forestalling the inevitable, and in 1964 the name Avro disappeared from the Canadian aviation scene.

The Avro plant was sold to de Havilland Aircraft, at the time in the midst of a boom. De Havilland contracted with Douglas Aircraft in California to manufacture major components for its new airliners: floors, wings, and tails for DC-8's and DC-9's. These were then shipped by rail to Long Beach for final assembly.

This project revitalized the Malton operation, but didn't turn out for the best for de Havilland. World airlines were

rushing to update their fleets and so many orders were received that it was hard for Malton to keep up. A solution was worked out in 1965 when Douglas Aircraft took over manufacturing there. Today the name McDonnell Douglas greets the passer-by at Malton, the sixth name to hang over the big plant since 1938.

De Havilland in the Mid Fifties

While Avro had specialized in costly sophisticated military ventures, de Havilland devoted its attention to more practical and marketable concepts. Beavers and Otters could be afforded by the least significant nation; not so the Arrow.

In the mid fifties de Havilland entered a new phase in STOL design with the DHC-4 Caribou, a large twin-engined transport. On July 30, 1958, test pilots George Neal

and D.C. (Dave) Fairbanks took the new plane into the air for the first time.

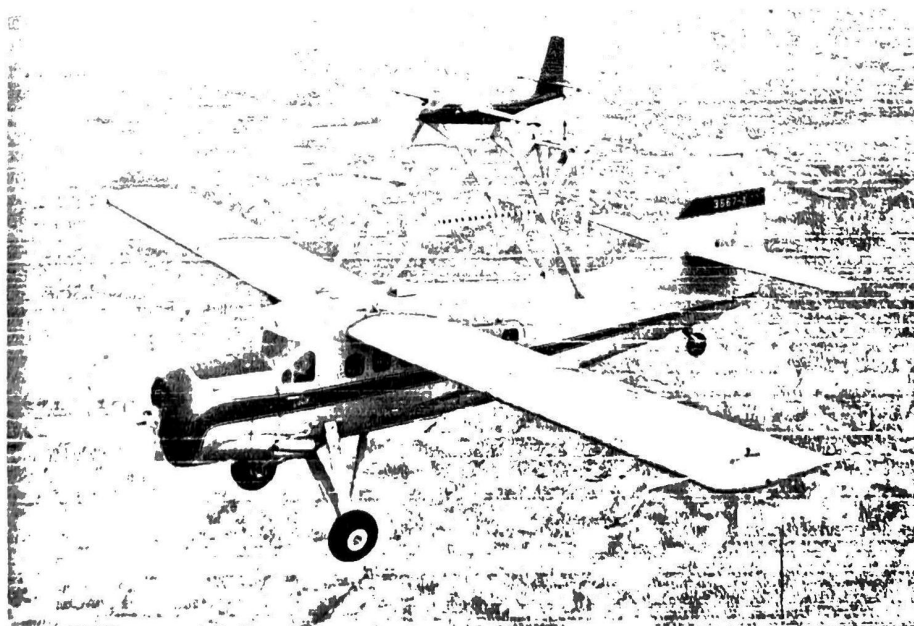
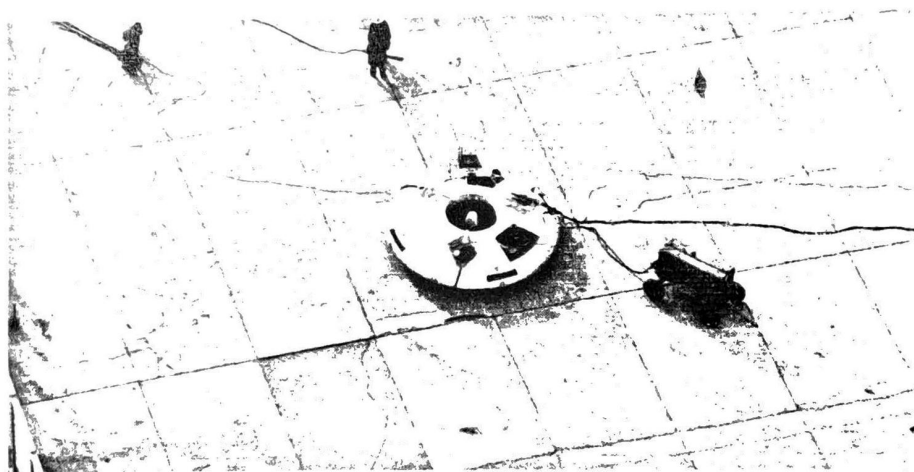
The Caribou was in the weight category of the DC-3, but fully loaded could become airborne in as little as 200 feet. Five were evaluated by the U.S. Army which was so impressed by their performance that it argued successfully for an increase in the gross weight of fixed wing aircraft it was permitted to operate. Over 200 Caribous eventually flew in U.S. Army colours.

Other Caribous were delivered to the air arms of Australia, India, Indonesia, Spain, Kuwait, Abu Dabi, Kenya, and Ghana. A few were sold to civil operators abroad and the RCAF received nine mainly for use with Canada's Middle East, Yemen, and Kashmir peace-keeping operations.

The Caribou has been proving its ruggedness and dependability around the world for nearly 20 years. One early operation of interest took place between February 2 and February 15, 1961, when Nordair chartered CF-LAN, the second

One of the Avrocars being readied for tethered flight. This photo was taken by Toronto Telegram photographer Les Baxter.

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An aerodynamic model of a Caribou mounted on a test rig atop an Otter. This model was used to evaluate various tail configurations before the Caribou design was finalized.

De Havilland Aircraft of Canada Ltd. (7283)


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U.S. home to Canadian 'flying saucers'

WebPosted Tue Apr 11 12:44:44 2000

WINNIPEG - Imagine a vehicle that drives like a car, hovers like a helicopter and looks like a flying saucer — and you have the Avrocar.

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The only two that were ever constructed are in the United States. They were made in Canada in the 1950s for the U.S. military.

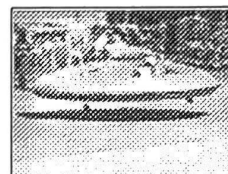
Bill Zuk of Winnipeg, who is writing a book about the vertical takeoff and landing aircraft, says it's time to bring at least one of these engineering curiosities home to Canada.



Bill Zuk

Almost 40 years after the project was abandoned, one of the flying discs is gathering dust in a Washington, D.C. space museum warehouse, while the other sits rotting away outside another museum in Virginia.

"It would be nice to have something that would represent Canada, and that period of time when we were at the forefront of aviation technology," says Zuk.



Reg Sherren reports for CBC TV

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Little was known about the Avrocar while it was being built by Avro's plant in Malton, Ont.



"This was a secret project, a highly secretive project, behind screened doors, with security guards that protected this," according to Zuk. Some research indicates the Avrocar project was cancelled after flight stability problems could not be overcome.

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A Science Policy for Canada - Report of the Senate Special
Committee on Science Policy

Chairman: The Honorable Maurice La Montagne, P.C.
Volume 1 , 1970 P.79

" One such example is Avro's Project Y or ' flying saucer " aircraft. In 1953 London's News Chronicle explained. ' Flying Saucer? This Could be IT. ' and quoted Air Vice-Marshal D.M. Smith, RCAF, as saying, ' We are giving preliminary consideration to a project of this nature.® The Times of London reported a Canadian design for a 1500-mile-per-hour ' flying saucer ' that was ' so revolutionary that when it flies all other types of supersonic aircraft will be obsolete. ' This was the beginning of a project that finished, many years later, as a much more mundane subsonic ' Avro Car ' built for study under a U.S. Army contract. "

® News Chronicle April 23, 1953

Malton, Ontario

May 20, 1958

W/C O. B. Waterman,
Avro TSD,
Malton,
Ontario.

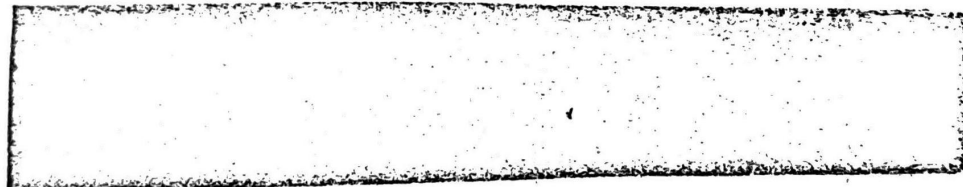
Dear Sir,

With reference to our conversation of this morning concerning the sighting of a flying object unknown to us, we are submitting this brief to you for your approval and furtherance to the RCAF Intelligence office in Ottawa.

We were situated on a northern lake in Haliburton county Ontario Saturday May 17, 1958 at 9.51 p.m. when we noticed a light in the sky that resembled a meteor coming from the north to the south at a tremendous rate of speed, as it approached us we noticed the light appeared to be a flood light of conical shape and great brilliance as it passed directly overhead. From first sighting on the northern horizon to its disappearance behind a low cloud bank on the southern horizon took approximately $2\frac{1}{2}$ minutes. It left a trail that we assume was a vapour trail that was clearly visible at a great height by comparison to vapour trails that were in the sky at the time assumably left by CF100's. As it passed overhead we could hear a faint muffled roar similar to a conventional aircraft jet engine.

Our main concern in this matter is the tremendous speed, height and light of this object, as the undersigned all have been associated with aircraft for some years and do not know of any conventional aircraft capable of these feats.

Yours very truly,



Copied by
GBW/fdr

40 Beacham Crescent
Agincourt, Ont. M1T 1N1
22/11/87
Tel. (416) 491 5387

Grant Cameron
649 Silverstone Ave.
Winnipeg, Man. R3T 2V8

Dear Grant,

By the time this letter reaches you Brian Fewster, on his way West to B.C., may have called you and passed on what information I had.

To answer your questions in order; 1. Yes I still hold the dual positions with MUFON, Ont. Provincial Director & Canadian Regional Director.
2; I don't know of any individual who personally worked on the AVRO "SAUCER" or "Aero-car" but a number of years ago I did talk with one person who witnessed a very limited lift-off but no sustained flight. The Toronto Star newspaper, early part of 1953 ran an extensive article which was reprinted in the RAF Review. A new issue by Citadel Press of Frank Edwards book Flying Saucers: Serious Business has a good photo of the A.V. Roe craft on page 100. The A.V. Roe (now defunct) hangers are located in Malton on Airport Rd. which is now owned by McDonnell Douglas.

There are two groups in S.Ont. who publish newsletters that I keep in contact with,

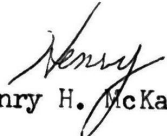
The Canadian UFO Reporting Network, edited by Larry Fenwick is published from P.O. Box 15, Station "A", Willowdale, NORTH YORK Ont. M2N 5S7. Larry is also a contributing editor for ESR. from England.

The Cambridge Ont. (60 miles W. of Toronto) UFO Research Group also publishes a quarterly newsletter, edited by Bonnie Wheeler. Their address is 2 Augusta St. Cambridge, Ont. N1R 1G1.

What type of information does the RCMP file consist of? If it relates to matters of UFO activity I would appreciate 5 or 6 pages as a sample as I may wish to purchase others.

On matters relating to Wilbert Smith & others May I suggest you contact Arthur Bray, 1187 Agincourt Rd., Ottawa, Ont. K2C 2H8, he has contact with Mrs. Smith & son.

Best regards,


Henry H. McKay

GRANT R. CAMERON
649 S. IVERSTONE AVE.
CHICAGO, ILL. 60608

May 26, 67

Dear Henry,

Many thanks for your letter of May 22. Appreciate your taking the time to write. No word from Brian Fawcett but then my phone number 369-6104 is unlisted.

Many thanks for the reference to the Toronto Star article. I will follow up on this. Don't know if you have read Steinman's last book. He tied the AVO deal into the renewed cancer program in the US. Checked him for some documents to back this up, and he said he had none - the conclusion just made sense.

Now from the field of M. Luvette in Montreal ^{document} that might back up this theory possibility. In response to the request for information on the Lavo-Success, then the President Johnson refused him to do Luvette's book.

The gov't has claimed they couldn't find any documents on the project. Perhaps to say I have this under appeal.

Also have my other 5 requests under appeal including the five page RCMP - see file. I still haven't seen them. They seem to think that I was to fly to Ottawa to discuss the file, after telling me on the phone they would allow them. I know there are about 8 pages which they refused to allow you see on the 1967 Falcon Lake incident. I'm now partially to sleep away from being there.

Have been in contact with M. Hay and the Smiths for years. I'm now trying to uncover the numerous others who were involved with Smith at the Fair Science Club.

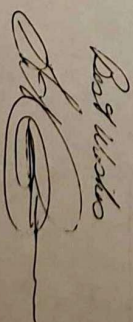
On this request I have an ongoing document I suspect.

to uncover from Wilbert Smith's files. It's importance is self-evident.

Received a long letter from William related to his involvement (or non-involvement) in early AVO research. Some interesting things such as the fact he had never seen the Smith memo which he acknowledged. Hopefully will get a second letter from him shortly.

Anything else came up on the AVO Success, especially related to the 35 US agents who visited the plant, I would appreciate hearing.

Again, thanks for your help.

Best wishes


Peregrine monoplane for the Royal Aeronautical Establishment (R.A.E.).⁸

The original plane was a light civilian transport carrying six passengers and with provision for two pilots seated side by side. After the internal structure was gutted, most of the top surface of the wing was recovered with perforated aluminum sheeting. Seven continuous very broad and shallow longitudinal canals, running almost the entire length of the half-wing, conducted the air that had been sucked in from the surface to the fuselage where a 10-HP Ford automobile engine ran the pump that sucked in the boundary layer.

The Miles rig was more or less the same as that of the contemporary German experimental plane, the Junkers AF-1 *Absauge Flugzeug*, designed expressly for the Aerodynamische Versuchsanstalt (A.V.A.) of Göttingen.

The data that the German experiment yielded are now well known from their publication by the American National Advisory Committee for Aeronautics (N.A.C.A.), but information about the British results has been kept restricted. Apparently all we know is that flight tests indicated that aerodynamic resistance was lowered by 22 percent.

The Miles firm did not really carry its researches on the possibilities of this very important principle all the way. After having worked out this brilliant stroke, for various reasons—the inherent difficulties in the pumping mechanism, the advent of wing flaps, the drying up of government funds—it returned to traditional designs. In this area, however, better equipped and more powerful companies competitively barred its road and finally drove it into bankruptcy.

On the other hand, the German researches prospered. In 1937 at the A.V.A. in Göttingen professors Betz and Ackeret and the engineers Stüper, Schrenk, Holstein, Schwier, and Wöchner, with the aid of a host of other experts, conducted a test flight of the AF-1, a light high-wing monoplane equipped with a 200-HP engine. It had only one slot for sucking in the dead air. Opposite the hinges of the movable wing surfaces, the slot ran along the entire length of the wing span. Inside the fuselage, directly under the point where the wings were attached to the fuselage, an auxiliary 20-HP engine ran a

propeller fan to suck in that part of the boundary layer that could improve lift.

Generally speaking, the flight experiments confirmed what had already been noted—that the lift of "sucked wings" increases in proportion to the quantity of air sucked in up to a lift factor of 4. The maximum value of the lift factor for a normal airfoil often does not exceed 0.5. After that the mass of air that must be moved grows more rapidly than the lift, making it impractical to reach factors above 6. In any case, even with the factor limited to 4, the lift of the original airfoil was increased by eight times!

An improved version, the AF-2, was powered with a 270-HP engine and equipped with a 45-HP fan run off the same engine. At full throttle the fan could suck in 250 cubic feet of air per second. This made it possible in 1940–1942 to achieve, efficiency being equal, a lift factor of 5, an exceptionally high figure for a low-powered single-engine plane.

Rapid calculations by the A.V.A. technical experts revealed that for a multiengined plane of thirty tons with a wing area of 1000 square feet and a lift factor of 4, approximately 2100 cubic feet of air per second would have to be sucked in on landing. In those days, when most people considered the modern air-eating turbojet a utopian vision, this was truly an impressive figure.⁹ Indeed, there was speculation to the effect that a huge 250-300-HP fan would have to be carried on the plane to suck in the dead air.

Complementary researches on thin airfoils, which were becoming more and more common with increasing speeds, especially in military planes, immediately made clear the practical difficulties of installing suction plants inside them. The slots on the top surface, the air collectors, and the channeling from wing to pump would in fact have had to share what little free space there was on the inside of the wing with the various complicated internal installations (retractable undercarriage, fuel tanks, weapons, ammunition, position lights, pipes, wires, and various trusses) that are generally situated even in the thinnest "razor-edge" wings of today's supersonic fighters.¹⁰

The AF models were very slow planes, however, and it was

decided to use them to study the behavior of suction during take-off and landing, operations that are performed at relatively low speeds by all planes. Those who backed the building of such planes were mostly trying to obtain high coefficients of lift, and in fact their hopes were not disappointed.

Nevertheless, it was known for some time that control of the boundary layer can also exercise a helpful influence on the penetration drag of the wings and indeed on all surfaces, fuselage included. This was to be translated into an increase in speed.¹¹

A.V.A. DEVELOPMENTS AND PROJECTS

In the test flights with the AF planes another finding emerged: the necessity to preserve the volumetric efficiency of the intake pump for flight speeds that were slightly above the minimum speed.

Suppose, the German technicians said, we increased the force of the suction slightly—reducing it to the proper amount at low speeds—couldn't we design a plane with a very small wing area that would offer little resistance and therefore be capable of very high speeds? Or perhaps add a hundred miles an hour or so to conventional planes?

Both at Göttingen and at the L.F.A.'s wind tunnel in Volkenrode, research on suction became definitely oriented toward high-speed flight.

For some time supercharging by means of a centrifugal compressor driven by the engine itself had been common practice with piston engines. By using the compressor as a suction pump, the Messerschmitt ME-109G modified fighter flew a number of experimental flights. The flights demonstrated, however, the difficulties in reconciling the different volumetric capacities required by the two devices, and this dissuaded the technicians from extending the principle to the production series.

In the meantime, it was experimentally established that suction through an opening placed to the rear of a transsonic shock wave could slow down the sharp increase in aerodynamic resistance by approximately Mach 0.1, so that a plane

designed to fly 900 kph would be able, the power installed being equal, to reach the fateful goal of 1000 kph. To attain this result a single-seater fighter would have to suck in from 565 to 812 cubic feet of air per second—a capacity that was of the same order as that sucked in by the first internal combustion turbines.¹²

In 1944 professors Prandtl and Busemann sketched out preliminary plans for a high-speed fighter—which never got beyond the design stage—in which the boundary layer was sucked in along the wing span and discharged against the sides of the fuselage through a narrow, half-moon-shaped orifice in such a way as to "blow" the tail boundary layer of the stabilizer area.

Gradually the Aerodynamische Versuchsanstalt technical experts of the L.F.A. reached different but interesting conclusions.

The first was that *it was not advantageous to transform ordinary aircraft into planes with a controlled boundary layer* because the suction principle was deprived of its best attributes and the difficulties of construction did not compensate for the limited advantages. (If this were not the case, we would not have today those special types of UFO commonly called "flying discs.")¹³

In addition, it was demonstrated that inasmuch as they were planning a special turbine-powered project, it would have been advantageous *to combine the two mechanisms into a single whole by feeding the turbine with air taken from the wing orifices* instead of by means of the usual forward-ram air intakes.

The outcome of the research is not officially known. This does not, of course, mean that there were no results! Whichever ally got it in his war booty may perfectly well be keeping it a secret today for some sound reason. It seems, in fact, that by reworking the old experiments on "potential frictionless current," the German technical experts may in the final days have succeeded experimentally in reducing aerodynamic friction on appropriately shaped bodies to very low values. And since it was known from results supplied by the Italian supersonic wind tunnel at Guidonia that while wave resistance to high

Mach numbers varies roughly in proportion to speed, frictional resistance increases almost as the square, certain rumors making the rounds at the end of 1944 about the imminent appearance of some new types of highly efficient and very fast planes, "moving through the air like a sponge through water and completely different from anything ever seen before," began to be listened to seriously.¹⁴

In addition, something less vague had already leaked out in France just before the German collapse in Normandy. There was talk of the feverish preparation of strange fighters powered by special turbines, without any wing or tail surfaces whatsoever and even without the usual air intakes, so that in scientific circles in Strasbourg it was thought to be a kind of new piloted rocket being prepared to take off from some well-hidden fastness in the Black Forest to send the Allied bombers scurrying off.

Similar rumors circulating among the higher-ups of the Luftwaffen-Motor Lager of Gallarate, in Italy, had it, however, that they were not rockets and that the planes would at first be radio controlled.

Does one have to be an experienced technical expert to recognize in all this certain details common to the sudden appearance of the *Kugelblitz* fighter as well as to the sightings of flying saucers in successive years?

STATIC INTAKE JETS

In the immediate postwar period Professor M. Sedille examined the question from a scientific point of view and at the first Congress of French Aviation gave a talk that was rich with original observations.¹⁵

In sum, Sedille declared that it would be advantageous to *expel the air that had been sucked in after having charged it with a speed equal and opposite to that of the flight of the plane, increasing thereby the propulsive force, for in this way the expenditure of energy required for flight would be reduced to one third.*

"Naturally, the necessary substitution of ram air intakes

with static intakes would make the advantage nonabsolute," he went on, "because supplementary mechanical compression of the air in exchange for the spontaneous one supplied by ram intake would be required in jet planes. *Besides, it would be very difficult with planes of conventional shape to extend suction to the entire external surface of the plane.* However, the method could make the use of jet propulsion worthwhile even at very low speeds, by replacing, that is, present very costly forms of 'jet lift.'"

Other theoretical calculations relative to the basic case of the flat sheet lowered the amount of energy required for propulsion to one-seventh. Now the game was indeed worth the candle!

But French plane designers paid no attention to Sedille's proposals. They continued developing conventional planes, and two years later, in 1948, in the *Comptes Rendus de l'Académie des Sciences* of Paris, Professor Maurice Roy "demonstrated," likewise mathematically, how illusory the proposal was.¹⁶

The negative conclusions of Professor Roy, a genuine aeronautical luminary, were based on the well-taken premise that if the aerodynamic resistance of the other parts of the plane not subject to the suction process (fuselage, rudder, cockpit) were to be balanced, such great quantities of air would be required that it would have to be taken from the free air well beyond the boundary layer of the wing. That was and would remain costly and difficult. For example, the wings of a modern single-seater fighter produce no more than 35 to 40 percent of the total resistance developed by the entire plane, and they are so thin that they do not permit moving large quantities of air with an internal velocity advantageously reduced with respect to that of the movement of the plane.

Would it now be necessary to give up the idea of "macro-suction," i.e., *suction extended to all the surfaces brushed by the wind of the flight?*

The answer is *no, certainly not, provided that everything that is not a "wing" or a surface with equivalent functions is eliminated by hiding or fusing it with the wing in the manner of "flying-wing" planes.*

We note that, except for the transparent dorsal bubble, flying saucers do not expose any non-wing element to the "apparent wind" in their high-speed flight.

A COMBINATION

At the time of the last prewar researches on control of the boundary layer, which were very promising in view of the reduction of the internal space required, a combination of suction and blowing appeared. It was also tested with modest success at the Italian aeronautical experimental center in Guidonia, where full-scale experiments had begun when the Italian surrender on September 8, 1943, interrupted all remaining research work.

In Germany, during the war, only the Arado and Dornier firms made experimental bombers (the AR-232/A and the DO-24) with short take-off and landing runs and with high lateral stability obtained by means of the "combined" system. The boundary layer was sucked in through continuous slots near the hinges of the ailerons (the A.V.A. method) and the air was then blown onto the ailerons by a small electric pump located in the wing.

After the war the American firm of Grumman reduced the landing runs of F-9 and F-4 planes on aircraft carriers by 50 percent by using the combined system. Cessna built a large number of light touring planes by applying the same principle in a more simplified form.¹⁷ One of these, a two-seater engaged in taking aerial photographs in the vicinity of Pasadena, California, on January 3, 1956, encountered three circular planes having a diameter of about fifty feet, giving off a shiny orange glow from their undersides.

Dropping down to the altitude of the Cessna (about 4000 feet), within thirty seconds they flew around it in a wide circle, maintaining a distance of three or four miles. From a quick calculation, they were flying at an average of not less than 1800 mph. After widening the circle, one of the UFOs encountered a long, thin cloud layer as it was flying away and cut it almost exactly in two, producing a very clean break.

"It left a hole as if it had sucked up the cloud!" the pilots said. In fact, for a few moments the wake of the ship became visibly vaporous.

Could anyone deny that intense aerial suction was employed in the flight of the mysterious aircraft?

Two types of aircraft met that day, both using the same principle. Rudimentary in the Cessna, highly advanced in the UFO. The caterpillar and the butterfly ...

NOTES

1. See Sir Roy Fedden, "Inquest on Chaos," *Flight* (London, November 29, 1945) pp. 575-578.
2. For example, the planned missions agreed on between the B.I.O.S. and the M.A.P. envisaged at the beginning of 1945 visiting some fifty-two German aeronautical research and production centers. In practice, it was possible to "explore" only thirty-three of them because the postwar distribution of areas of military administration excluded the British from certain areas of interest to them.
3. Somewhat bigger than the Brabazon, the Hercules had eight Pratt and Whitney Wasp Major engines for a total of 28,400 HP, a 300-foot wing span, weighed 226 tons fully loaded; and was to carry 700 passengers. The plane was conceived in 1942 as air transport for thirty- to sixty-ton tanks, heavy artillery, or entire troop formations. When the expenses for the original project exceeded \$18 million, the American government canceled the contract. The builder—the capricious Howard Hughes, a very wealthy flyer and movie producer—then decided to continue the project at his own expense. By 1947 the Hercules had absorbed a total of \$25 million. The newspapers reported as follows: "In American aviation circles the final word on the largest airplane in the world is anxiously awaited. There are two groups: one thinks that the M-4 will never get off the water or at the best, after a hop of a cou-

The switch for the electric installation was centrally located and easily accessible. The propulsion of the machine was obtained via diergolic (*i.e.*, two-liquid) propulsion: liquid C (34 liters of methyl alcohol with a 30-percent solution of hydrazine hydrate and 20 percent of water) and liquid T (54.5 liters of hydrogen peroxide with 20 percent water)—generally used in the German antiaircraft rockets. The combustion chamber was a light metal cylinder seventeen and a half inches long and four and three-quarters inches in diameter. In order to eliminate the necessity of cooling the walls, they were lined internally with a layer of carbon cement two inches thick, mixed with a special ceramic binder. The thickness of the cylinder was further increased at the rear end in such a way as to form the narrow section of the exhaust nozzle. When the construction was completed, the weight of the craft was about 500 pounds dry and about 800 pounds fully loaded. Parallel with the small series of rockets for the Royal Aeronautical Establishment (R.A.E.), Vickers also prepared different types of fuselages and wings for their own experiments toward achieving the best wing shapes and arrangements, according to eighteen different dispositions arrived at in the design stage. In addition, there were also “V” or “butterfly” wings (in technical parlance, frontal dihedral wings), to which the firm’s experts attached a great deal of importance. It seems that it was also intended to equip the devices with a remote control of the type perfected for air-launched guided projectiles for precision fire against targets fifteen to eighteen miles away. This gave origin to a type of self-propelled projectile midway between planing bombs and flying bombs, but it had no practical results. In 1950 the Supersonic Division of the Flight Section of the Royal Aeronautical Establishment compiled in report A.R.C. No. 2,835 all the data furnished by the “flight trials of a rocket-propelled transsonic research model: the RAE Vickers Rocket Model,” which remained a classified document until 1954.

7. During that long period of time the Göttingen “school” and the aeronautical faculty of the University of Cambridge stood

out above all. A systematic series of physical and mathematical investigations was carried out between 1919 and 1936 at Cambridge under the direction of Professor Melville Jones and with the assistance of Professor G. J. Taylor. The fresh ideas that were produced resulted in several patents. Some were by the noted German designer Lippisch, the Canadian engineer Stenstone, the British firm of Bristol (1936), and one by Air Commodore Whittle (1938) based on the adoption of a rudimentary gas turbine. There were still others but none of them ever became a reality. The main reason for their failure—apart from the aircraft industry’s lack of interest—was that they used the residual energy in the exhaust gases of a piston engine (for blowing) or the slight vacuum developed during the intake stroke (for suction). But the few patents envisaging the use of turbines always ran into the ever present problem that there was absolutely no usable turbine orifice with long-wearing qualities and the ability to function with an acceptable degree of thermal efficiency. Another insurmountable barrier was the minimal advantages offered by limited application of the principle. The limitation still holds today within the range of conventional aircraft, for reasons that will shortly become clear.

8. See F. G. Miles, “Sucking Away the Boundary Layer: Results of some Full-Scale Flying Experiments,” *Flight* (London, No. 1,570, January 26, 1939), pp. 82b–82d. For some time the Royal Aeronautical Establishment had a staff of specialized researchers in suction at its disposal. After the R.A.E. had completed and then filed the researches conducted with the Miles firm, it took up the wind tunnel studies again with reduced-size wing sections. In one of the most successful experiments—on a symmetrical airfoil derived from the National Advisory Committee for Aeronautics’ development, NACA-0020, but with a single suction slot on the top surface that extended along 50 percent of the chord—a 60 percent reduction of aerodynamic resistance was achieved. (Cf. A.R.C., Report No. 1,913, published in 1943.) The long series of studies on “humped” airfoils—of which we shall have more to say—having failed in practice, together with the ever higher speeds reached by jets,

then focused the attention of government experts on the problems of swept and delta wings. A reawakening of interest in the problems of suction—based, however, on traditional concepts—has been shown in more recent times with the work of Dr. Lachmann of Handley-Page Ltd. In the spring of 1956 the left wing of a DH-113 night fighter was modified with the application of a perforated “glove” along the center line of the top surface. In flight, a local reduction of 82 percent in the surface-friction drag was obtained in this way and consequently *the drag of the wing was reduced to less than one-fifth*. Nevertheless, the energy gain rapidly fell off with the increase in speed, because of the dropping off of the degree of kinematic viscosity, once again confirming the axiom that the conformation of present-day aircraft does not lend itself to the full exploitation of the principle. For a concise examination of the most recent developments see S. Caldara, “*Le ricerche in Gran Bretagna sul controllo dello strato limite*,” *Alata Internazionale* (Milan, July 1967), pp. 31–32.

9. To give an example, the powerful Wright 18-BD “Cyclone” twin-radial of 2500 HP at take-off aspirates eight to nine pounds of air per second at full throttle, equivalent in round figures to not more than 100 to 125 cubic feet.

10. Now as then, between the powerful and violent suction of the jet engine and the removal of the boundary layer (especially if continued and extended) there is a series of not insignificant difficulties that are epitomized principally by the need to work with more rows of slots along the chord. These slots would have to be opened or closed as needed in order to make the suction zone coincide with the transition point; in other words, suction would have to take place where the actual separation of the fluid vein is observed—and this point, moreover, shifts with the angle of incidence. The slots would in addition have to be rather narrow—not exceeding 0.031” —otherwise the volume of the sucked air would be excessive at the expense of the efficiency of the installation. The “velocity of suction” and the quantity of “dead air” sucked in would, however, have to increase in direct proportion to flight speed.

(That is, in the jargon of the technical experts, it is necessary to strengthen the aerodynamic effect of the “downcast shaft.”) Unfortunately, as speed increases the wings become proportionately thinner and their slight internal volume does not lend itself well to the installations of the wide, straight, hermetically sealed channels necessary for the undisturbed, slow removal of the air that has been sucked in. To improve a plane’s total coefficient of aerodynamic penetration, it would be necessary to extend the suction of the boundary layer to the entire upper surface of the wing and to the first third of the fuselage. (The rear portions, including the tail assembly, could be blown.) But even this solution entails cumbersome installations, all of them essential: cockpit, engine, main fuel tank, heavy arms and ammunition, radio, radar, a profusion of tubing and wires, from which it is clear that the “integral” solution is practically impossible with the present types of cross-shaped planes with wings and tail assemblies.

11. In 1932, for his researches on “sucked wings,” the engineer Oskar Schrenk had constructed a model of a wing about nine and three-quarters inches thick, containing tiny fans operating on three-phase asynchronous motors, at first with a single slot on the upper surface and later with multiple slots. The second approach gave the German scientist the first confirmation of the fact that the movement of the air current along the wing for a determined value of suction was almost identical with the theoretical shape of the “potential frictionless flow.” The same deductions were later extended by analogy to the moving bodies (three-dimensional) differing from the airfoils (two-dimensional).

12. The German turbojets of the Junkers-Jumo 004 series—mounted on the famous ME-262 fighters—when static sucked in about forty-four pounds of air per second. In 1946 German aerodynamic researches, especially the studies on combining turbojet propulsion with control of the boundary layer, were demonstrated to British experts by Professor R. Smelt during an interesting lecture at the Royal Aeronautical Society, in which part of the German illustrative material, which had been

restricted for reasons of military security, became public. (See *Flight*, London, October 17 and 24, 1946.)

13. This observation remains valid today, having been proved by the results of a recent American experiment. See A. Gattin, "Un esperimento ancora troppo costoso: l'aereo con ala aspirante," *Nuove Ali*, Rome, XVIII (1966), No. 5/6, pp. 35-37. In the experimental Northrop X-21A—a complete transformation and adaptation of the Douglas WB-66D Destroyer, a light bomber—a double installation enclosed in two pods under the wings removes 60 percent of the boundary layer from the 1216 square feet of wing area by means of two low-pressure compressors, while the remaining part is sucked away by back-up high-pressure compressors (which also receive the mass of air sucked away by the low-pressure compressors) and carried to the internal combustion turbines which drive the compressors and whose exhaust contributes to the propulsion of the plane (which is principally taken care of by two J-79-13 turbojets located in the tail). This complicated process is matched by considerable complexity in the structure of the wing, which requires almost three miles of very fine slots in the wing with a width of from .003" to .009" (very difficult to make with current machinery) and about 800,000 holes ranging from a quarter to a sixteenth of an inch in diameter to move the air from the collection channels underneath the slots to the main piping bringing the air to the intakes. All this in order to guarantee—at a cruising speed of Mach 0.85 at 27,000 feet—a 60 percent increase in range or a 19 percent increase in gross take-off weight, which is about thirty-six tons. Interesting improvements, but not compelling. Indeed, despite the fact that the plane is in itself a mechanical jewel, not a single significant step has been taken to put the formula in actual production since April 18, 1963, when it was first flown.

14. Cf. B. Regenscheit, "Drag Reduction by Suction of the Boundary Layer Separated behind Shock Wave Formation at High Mach Numbers," *NACA Technical Memorandum No. 1168* (Washington, 1947), p. 13; and D. W. Horder, H. H. Pearcey, and G. E. Gaddy, "The Interaction Between Shock

Waves and Boundary Layers," *Aeronautical Research Council Current Paper No. 180* (H.M.S.O., London, 1955), p. 50. See also *NACA Technical Report No. 3223* (Washington, 1954). The importance of reducing aerodynamic friction is especially evident in prolonged supersonic flight and even more so in hypersonic flight. By lessening the overheating of the wall resulting from the kinetic effect, it would be possible to employ metal alloys lighter and less costly than stainless steel and titanium, thereby contributing as well to the most economical solution to the complex problem of supersonic commercial air transportation.

15. See Prof. M. Sedille, "Propulsion par réaction en combinaison avec l'aspiration de la couche limite," *Technique et Science Aéronautique* (Paris, No. 4, 1946), pp. 229-302.

16. Cf. Prof. Maurice Roy, "Sur la propulsion par régénération de la couche limite," *Comptes Rendus de l'Académie des Sciences* (Paris, November 8, 1949).

17. In the Cessna 170 monoplane there are in fact no mechanical pumps to remove the "dead air." The removal is effected by mixing ducts fed by a compressed hot air generator installed in the fuselage behind the pilot. The trailing edges of the outboard wing are "blown," while those of the inboard wing are "sucked." The principle is obviously original, but it is limited to only one-sixth of the wing surface and therefore does not lend itself to intense suction over the whole wing. However, it can give some idea of the complexity of the problems related to the "control of the boundary layer."

A Time of Spectacular Possibilities

It is certainly no exaggeration to say that the so-called UFO question literally exploded in the United States in 1952.

Five years had passed since the first sightings, but no substantial change had taken place in the situation. Indeed, the Air Force's continuous denials had ended by confusing even those who were determined not to be hoodwinked.

In the concert of conflicting opinions there were those who remembered when Captain Ruppelt took over the A.T.I.C.'s commission of inquiry. In one of the press conferences that accompanied the event, Ruppelt had hesitantly brought up the hypothesis that the Russians might have discovered such completely new aerodynamic concepts as to make the fantastic performance of the discs possible. But Ruppelt had so hedged his statement with ifs and buts that the hypothesis was rendered almost unacceptable from the start. He overdid it, men-

tioning the panic in Air Force circles toward the end of the summer of 1947 that arose precisely because of the growing suspicion that "someone" (the Russians were first choice) had found some new principle or method of aerial propulsion lying ready-made in Germany or had invented or accidentally discovered something radically new.

In actual fact, the "new" principle, as we have seen, was an old veteran of the mechanics of flight, nearly half a century old if we go back to its first elementary formulation. Moreover, in the past, American experts themselves had more than once underlined the alluring possibilities that control of the boundary layer offered to aviation.

In 1931, during some wind-tunnel experiments on various types of hyperlift wings, the engineer Millard J. Bamber obtained for the first time negative drag coefficients because the air flowing out of the top surface slot (in this case by "blowing") took such an active part in the aerodynamic process that it pushed the wing model against the wind.¹ In September 1936 R. B. Maloy summed up the various aspects of the question in the following five points:

1. Planes more efficient than those of today will soon be required and only control of the boundary layer can give them to us.
2. The power required is not prohibitive.
3. On the basis of experimental data thus far available the suction method is superior to blowing.
4. Control of the boundary layer in substratospheric transport planes and in military aircraft operating between 30,000 and 50,000 feet is rich with promise for the future.
5. Further experiments are required, however, to determine the distribution and the dimensions of the orifices for the suction and of the relative accessories.

Finally, how can anyone ignore or undervalue the conviction that the celebrated Theodor von Karman expressed in the spring of 1937, when at a conference of the Institute of Aeronautical Sciences in New York he placed control of the boundary layer first in the list of the aerotechnical conquests of the immediate future?²

In America these objectives were crushed under the heavy

yoke of the war, which demanded from industry mass production rather than pioneering research. When the war was over, the scales of aeronautical innovation (turbines, rockets, radar, and suction) leaned heavily in favor of the Old World, and, indeed, the situation threatened to grow worse. American political leaders were lulling themselves into a Nirvanic state—although marred somewhat by the unexpected Russian awakening and the unfavorable turn of events in China—because they mistakenly believed that they had started an Anglo-American version of the famous thousand-year Pax Germanica that the Führer euphorically promised the world as he contemplated his “secret weapons.” But meantime a great mass of scientific documents discovered in Germany, far in advance of anything that was going on in the New World, were flowing into Moscow and, above all, into London.

When America's leaders realized that although their aeronautical industry was indeed very strong it was likely to fall behind if it did not take full advantage of the new ideas developed in Europe during the final phase of the war, their interest in revolutionary developments abruptly ceased to be lukewarm. But by then, despite the zeal and insight of a few far-seeing officers in the Air Force and Army, a considerable portion of German scientific booty had already ended up in other hands.

In England, for example, the Ministry of Aircraft Production had hurriedly cornered and translated all the secret papers concerning the most promising German experiments on the boundary layer and the aerodynamics of supersonic flight at high altitudes. Meanwhile, Russia had cornered the market on missile experts and materials, which subsequently led to the Sputniks.

THE AERODYNAMICS OF POROUS SURFACES

When the war ended and the British experts were able to integrate their own experiments on the boundary layer with the heavy contributions of German investigations, the watchword became: “New aircraft designs for new forms of propul-

sion!” Taking the *Feuerball* as the main model, they gave a perfectly symmetrical form to the “suction” aircraft, making it circular and wrapping the wing around the suction pump like a ring. Enlarged and flattened, the pump was transformed into a single rotor turbojet engine; thus it could also, indirectly, perform the functions of a jet engine.

Then the British got rid of every vestige of control surfaces, because since 1939 it had been established that the suction of the boundary layer could be used advantageously for maneuvering in place of the normal empennage and movable surfaces, or they could be integrated, making the movements of the craft quicker and more responsive. With the entire top surface of the aircraft made aeropermeable, or porous, they extended the suction to include the mass of air above the actual boundary layer with the aim of putting a large volume of air to work and thereby also improving the efficiency of the engine.³

The keystone of this new suction system was, finally, the replacement of the slotted or perforated skin panels used in the old experiments with a pitted covering in “porosint” and its derivatives. These are materials that possess among their numerous advantages (and some inevitable defects) that of being able to withstand continuous temperatures in the neighborhood of 500° Centigrade, despite the fact that there is a large proportion of aluminum in their composition.

An extensive series of experiments had, in fact, made it possible for the British to establish that the removal of the boundary layer by suction, especially when practiced on a large scale, was much more effective if it was done through a highly porous surface rather than through drilled and slotted panels.

Beginning in 1944 they developed a special branch of aerotechnical research that the researchers called “porous sheets aerodynamics.”⁴ Born in the hail of flying bombs and torpedo rockets, this branch of research seemed to reach its zenith in 1946, falling off—apparently—to the simple rank of an auxiliary technique for improving the lift of wings—rather sadly coming full circle. . . .

Officially, all these detailed experimental investigations came to no more than a few unpublicized test flights with models—

apparently certain mysterious television-guided flying models were experimented with in the winter of 1945-1946—and then to a complex series of wind-tunnel measurements on wings of various shapes and sizes.

After years of study and dedicated and costly research, there was not even one plane, not even an experimental one. Does that seem too little?

Too little indeed; and not believable. Especially since, as a number of qualified witnesses have unanimously declared, the top surface of the mysterious flying discs normally shows no visible air intake for propulsion, as could be seen on all jet planes built before then and in the twenty years since.⁵

SEMIOFFICIAL ADMISSIONS

In December 1946, during a conference on the future of British aeronautics, Sir Ben Lockspeiser declared that he was a partisan of the system of suction. Thanks to suction, "the plane would then slip through the air in the same way a piece of wet soap slips through the fingers . . . it is hoped eventually to obtain a wing drag of not more than about one-third of what is now common."⁶

Before that, during the thirty-fourth Wilbur Wright Memorial Lecture, held at the Royal Aeronautical Society in London on May 30, 1946, Professor E. F. Relf, one of the best British aerodynamics experts of the old generation, declared: "Recently a further system of regulating the boundary layer by means of suction through minute holes heavily distributed over the surface touched by the apparent wind, rather than through one or more slots as has been done until now, has been taken under study at the National Physical Laboratory. This idea, too, is not new. What is new is the production of the right porous material—sinterized in the form of spongy bronze—that possesses very small and very regular interconnected interstices.⁷ Dr. Preston has studied this problem from the theoretical point of view and is convinced that it is very promising."

Promising from the point of view of aeronautic progress. But, according to the official story of this line of research, this progress was only an empty promise. So they say . . .

In introducing his heavily documented talk, which contained many significant disclosures, Relf stated that recent aerodynamic experiments on "suction" seemed rich in possibilities for the future. "I feel we are on the verge of discoveries and advances almost as spectacular as that flight of Orville Wright's, forty-three years ago."⁸

That is enough for the moment, for we will soon find this final concept—linked with certain truly portentous developments—fully confirmed.

Comparing the cautious but still rather euphoric tenor of these declarations with the equally compelling news quietly given to the British press at the same period concerning certain extraordinary ultra-high-speed aircraft being perfected at the government laboratories in Bedford, we will have to agree that a few simple wings and several large flying models cannot justify the loss of traditional British self-possession, notoriously sparing in superlatives and empty promises.

Something really exceptional was secretly boiling on the back burner of British aviation.

LUFTSCHWAMM

The development of the aerodynamics of porous materials is clearly creditable to the British experts who worked on the problem during the last two years of the war. But historically, it is equally clear, the original idea took form just before the outbreak of hostilities. It was, in fact, in 1937 that Perring and Dispose of the National Physical Laboratory tried unsuccessfully to repeat in full-scale size the old experiments of the German engineer Schrenk on "frictionless air flow," the concern and hope of all students of flight.

The same problem was successfully tackled by Professor Ackeret, who was in the dark as to the Englishmen's work and its failure, since they never published the complete results of their investigations.⁹ His experiments, which were completed on the eve of the war, made clear from that time on that it would be necessary to create an "ideal surface" consisting of microscopic holes. But these aeropermeable surfaces would be very difficult to manufacture with conventional methods.

When the British experts learned of these conclusions (the last exchanges of technical information among the European countries before the curtain of military secrecy fell), they decided to look for some synthetic material. After all, the chemical industry had been using porous ceramic filters for about twelve years.

At the Applied Physics Laboratory of the National Physical Laboratory preliminary tests were made on the suction flow through a single orifice measuring .01 of an inch in diameter. With a long, almost imperceptible whistle the prescribed quantity of air repeatedly passed through the small orifice in the prescribed time without developing appreciable wave patterns. The principle worked!

This minor event was destined to give a new course to aeronautical progress, but no one foresaw it at the time. The event took place, it seems, in 1939; and from then on, the new aerodynamics began to take shape in both England and Germany.

The porous ceramic baffles were, however, soon replaced with materials that were stronger from a structural point of view but equally permeable.¹⁰

The British worked with a great variety of sheets: asbestos, phosphor bronze, glass textiles similar to Fiberglas, duralumin and various alloys.¹¹ During 1943-1944 the Germans also initiated a long series of researches on the sinterization of light alloys based on aluminum and magnesium and on both solid and porous aluminum bronze.¹² In Göttingen and Volkenrode the experts in the new techniques of flight gave these sintered porous materials the felicitous name of *Luftschwamm* (aerosponge) and proposed to revolutionize the laws of resistance to the forward motion of airplanes.

We still do not know whether they achieved any practical results. We do know the significant fact that in the autumn of 1945 Professor Thwaites of the Aerodynamics Division of the National Physical Laboratory brought together in an internal technical report—A.R.C. No. 9672: *Notes on German Theoretical Work on Porous Suction*—all the notes taken from the examination of German researches on porous materials (for which a special team of investigators had been formed), comparing them with what had been done up to then in England and with what the British intended to do in the near future.¹³

Needless to say, the report still bears the label "top secret." Nevertheless, a very small part of that information, unfortunately restricted entirely to the physical and mathematical fields of research on wing surfaces, came to the knowledge of the Americans. Professor Dryden of the National Advisory Committee for Aeronautics mentioned it publicly at the sixth International Congress of Applied Mechanics, which took place in Paris in September 1946.

In the first German experiments the velocity of the flow from suction was very low (not more than 2 percent of the velocity of the apparent wind) and the quantity of sucked air was therefore modest. But later on, by using more powerful pumps and improved porous sheets, they began to experiment with the dynamic pressure gradients developed at higher flight speeds, and 497.10 mph was now considered an "optimum" for the cruising speed of suction flight at altitudes between 20,000 and 40,000 feet.¹⁴

THE RELF LECTURE

The history of British postwar researches on suction is rather complicated—quite understandably, given the concatenation of circumstances.

The dissolution, or, better, the metamorphosis, of the M.A.P. into the Ministry of Supply coincided with Sir Melville Jones's resignation as secretary of the Aeronautical Research Council, the largest British government body concerned with the planning and development of aeronautical research.

In giving the news of his resignation—said to be for reasons of health—the technical publications referred briefly to the fact that in the last three years he had exercised "a great influence on the direction of government research, having successfully reorganized the old Committee and made it a council that was more in tune with the new times." In addition, he had laid down the plans for equipping the new experimental center at Bedford and for setting up the aeronautical college at Cranfield—a sort of scientific academy for the use of the R.A.F. and industry. A forty-two-year-old professor of applied mathematics at the University of Manchester, Sydney Goldstein, took Sir

Melville Jones's place. Goldstein was indefatigable in his research on "Frictionless Flow" at the National Physical Laboratory.¹⁵

The stature and work of this new personage would have been confined to the small world of specialists in the field if Professor Relf had not briefly explained the work of the Teddington staff in his Wilbur Wright Lecture, which was covered by reporters from all the major newspapers. Relf had been superintendent of the aerodynamic division of the National Physical Laboratories in Teddington until December 31, 1945.

Professor Relf began his interesting report by saying that although during the war they were particularly interested in bringing research on problems that were useful to the immediate war aims to completion, "the war years have produced some new ideas and discoveries that bid fair to open up revolutionary lines of progress in aeronautics. Some of these new ideas are still veiled in secrecy, but the veil has now been lifted. . . .

"I think it is fair to say that although aerodynamic research has always been full of interest, and even excitement, there never has been a time in which so many spectacular possibilities have been displayed before our eyes."

Ten years before, in 1936, during the proceedings of the James Forrest Conference, Relf had called the attention of experts to the usefulness of extending control of the boundary layer over as much of the surface of the aircraft as possible, since the evidence indicated that aerodynamic resistance could under the best of circumstances be reduced to about 10 percent of the current value—though this would not, of course, be easy to achieve.¹⁶

Like the experts listening to him, he surely could not have imagined at the time that the day would come when substantial progress in that direction would be made right there in England.

"HUMPED" AIRFOILS

During the war, but before the Anglo-American military agreement on reciprocal exchange of scientific information went into effect, rumors were circulating in American aeronautical circles

about certain strange wing shapes with pointed trailing edges; and the Americans wondered what in the world was the purpose of them.

These new aeronautical shapes resulted principally from theoretical investigations worked out mathematically by Professor Goldstein, who had succeeded in defining "by points" the form of a two-dimensional body (an airfoil) developing a given distribution of the fluid velocity and hence of lift.¹⁷

On the basis of the theoretical premises, experts in the aerodynamics section of the National Physical Laboratory at first studied and designed elliptical airfoils with a tapering trailing edge and subsequently a new series or "family" of exceedingly strange, thick airfoils, generally having a roundish or lobate leading edge and a concave-convex trailing edge that came to a point and that had one or more suction slots where the concave-convex profile began. This family derived from an idea of Dr. A. A. Griffith. In 1942, it occurred to him to extend the Goldstein theory to the field of suction, by following the principle of "adapting the airfoil shape to the process of suction." In other words, Dr. Griffith tried to create true "suction airfoils," which in laboratory jargon were called "humped" airfoils because of their thick, curved upper surfaces that seemed like meaningless deformations to the layman.

Dr. Griffith experimented with several such profiles, differing in thickness, shape, or the position of the tail hollow, at the compressed-air tunnel of the National Physical Laboratory. He found that a "humped wing" easily developed lift coefficients on the order of 2.5 and that lift was about quintupled in comparison with the best wings of the period. The enthusiasm raised by these early results was, however, destined to be short-lived, for the aerodynamic resistance of the "humped wings" considerably exceeded the theoretical estimates. Furthermore, the studies conducted by the National Physical Laboratory experts to bring the grade of efficiency of those otherwise highly advantageous airfoils to at least an acceptable level came to nothing. In addition to Griffith, Richards, Lighthill, and Glauert also had a crack at the difficult problem. They designed a number of new airfoils of different shapes and thicknesses but did not get at the root of the trouble.¹⁸

To explain the long series of failures, it was finally concluded

that turbulence in the wind tunnel altered the results of the phenomenon, which was really more favorable than the test results suggested since it had, after all, been promised by a theory that, also from the mathematical point of view, was flawless.

Since it had proved impossible to establish the actual level of efficiency of the humped airfoils through wind-tunnel tests, it was suggested at the Commonwealth conference on aeronautical research held in London in June 1946 that it might be a good idea to try them in flight tests on full-sized models by adapting an existing plane for the purpose.¹⁹

The Division of Aeronautical Research of the Australian Council for Scientific and Industrial Research undertook the job. Working in close collaboration with the National Physical Laboratory, they modified a large De Havilland G-2 troop transport glider. The humped wing was built with three slots along the back; a centrifugal fan powered by a Ford V-8 engine in the fuselage sucked the boundary layer through the slots and the hollow rectangular spar (the A.V.A. system). This air was then exhausted out the rear of the plane, developing sufficient thrust by reaction to maintain the craft in line of flight but not enough to enable it to take off by itself.

At the beginning of October 1948 the glider was shipped to the Royal Australian Air Force airdrome in Laverton, Victoria, where the tests took place, the glider being towed to its test altitude by a Dakota.

After the glider's first flights, Professor Coombes declared with obvious disappointment that all the mechanical problems had been clarified but that the usefulness of the new sucked airfoils still remained "to be proved"—a simple euphemism to mask a complete failure.

OTHER PLANES WITH "NO TOMORROW"

In October 1948—when the UFOs already had a good sixteen months of aerial incursions to their credit (it was the other branch of research on suction that had for some time surpassed

the stage of technical and operational maturity of the formula)—the "humped" wings that had been so theoretically brilliant but practically inefficient joined the supersonic M-52 plane in the government files of abandoned projects, along with sketches for subsonic "flying wing" transports with "humped" wings and two laminar "flying wings." The two latter had actually been built and flown, to a great public display of optimism, one in 1942 and the other in November 1947.

These were prototypes of an all-wing glider (AW-52-G Bat) and two examples of a twin-engined all-wing jet (AW-52 Boomerang), made by the Armstrong Whitworth Aircraft company.²⁰

On November 13, 1947, one of the powered AWs successfully completed its first flight at the R.A.F. experimental station at Boscombe Down, with chief test pilot A. G. Franklin at the controls. About ten months of frequent test flights followed, then the Ministry authorized its presentation to the public. By tradition, this took place at Farnborough during the annual review of British aircraft production, September 7 to 9, 1948.

Roaring and shrieking, the plane performed its evolutions for a considerable time, demonstrating unusual maneuverability for a machine of its type, a clear indication of easy control, quick response to the controls, and excellent stability. Nevertheless, this was its farewell flight.

One of the planes crashed into the earth a short time later and the pilot saved himself by using the ejection seat. Little by little news about the remaining AW-52 became scarcer and scarcer, even in aeronautical circles. Then it stopped completely, and even though there was talk of the future preparation of "flying wings" of ninety tons for transatlantic transport, the model had no successors.

This could have been foreseen for a number of reasons, not the least of which was the failure of the "humped" airfoils, but above all for the following reasons, here summarized from the manufacturer's technical report:

a) because of difficulties in manufacturing and repairing the airframes. In fact, the technical report states that the first impression the wing gives is the extreme smoothness of the surface and the general care in construction. In order to insure

Summary of Accomplishments of Dr. Stephen T. Possony During 1951 and 1952,
6 March 1953

Paragraph 4. During the past two years, this directorate has been directly concerned with "flying saucer" problems. Throughout this period Dr. Possony has maintained a close contact with the collection and analysis programs undertaken by the various intelligence agencies. Dr. Possony's contributions have been outstanding in that he has explored all possibilities as to saucer explanations. He also has been able to demonstrate that several "solutions" advanced by scientists and other experts have been inconclusive and, in some cases, false. This information not only provided the D/I with a sound basis for interpreting the saucer program to the American public, but also has been extremely fruitful in clarifying a host of confused problems in the field.

REPORT - Constraints, Undated

The only real possibilities of avoiding detection during these later time periods, therefore, require the development of vehicles which are either technically undetectable by radar, or of such unusual design that the radar signals they yield will be unrecognizable. The Cambridge Research Center has made a preliminary exploration of both of these possibilities for the Development Planning Office. They found that radar absorbing materials could not be used in aircraft or missiles without sacrificing their aerodynamic qualities, and they concluded that the only vehicle that might confuse a radar net would be one in the shape of a flying saucer or a flying sphere. (Balloons might meet the latter requirement, but the altitudes they can achieve are such that they would be visible during the hours near dawn and sunset.)

*Maybe related to AVRO
From AF Intelligence Files*

Avro-Car

INTERCEPT BUT DON'T SHOOT / 252

duction remains unaffected, for the factories are all well-heated. Even the hangars are kept at a temperature of 70°, avoiding drafts in a way that seems miraculous. The working conditions, for example, are better than those in the average British factory, and it is common practice to work in shirtsleeves during the winter, both in the offices and in the shops. The cold, however, makes it necessary that all the planes be kept under roof."¹⁰

AVRO SAUCERS FOR THE FAR NORTH?

At the beginning of 1953, when no one was thinking about flying discs, they suddenly began to appear in the columns of Canadian newspapers.

On February 11, the *Toronto Star* announced in a banner headline that flying saucers should no longer be confined to the realm of fantasy, because they were actually being developed in one of Avro-Canada's hangars at the Malton airfield. Two columns of details and the news that the device was supposed to have a top speed of 1500 mph gave the clear impression that the writer had obtained his information from a very well-informed, if not completely candid, source that obviously worked somewhere in the powerful company.

Certain government experts who were immediately interviewed by reporters from the nearby capital sought to extricate themselves from the awkward situation by evasively declaring: "The Defense authorities are examining all ideas, even revolutionary ones, that have been suggested for the development of new types of supersonic aircraft, *also including flying discs*. This, however, is still in the beginning phase of research and it will be a number of months before we are able to reach anything positive and seven or more years before we come to actual production."

According to the *Star*, on February 16 C. D. Howe, minister of defense production, told the House of Commons that "the government was constantly studying 'new concepts and new designs' for fighters . . . adding weight to reports that Avro is even now working on a mock-up model of a 'flying saucer'

Renate Vase
Grove Press Inc. NY 1971

Nothing to Give in Exchange / 253

capable of flying 1500 miles per hour and climbing straight up in the air."

On February 27 the company involved also joined the chorus of "surprising" revelations. The president of the firm, Crawford Gordon, Jr., wrote in its house organ: "Like all aircraft companies who want to stay in business, we are directing a substantial part of our efforts towards new ideas and advanced designs.

"One of our projects can be said to be quite revolutionary in concept and appearance. The prototype being built is so revolutionary that when it flies all other types of supersonic aircraft will become obsolescent. This is all that Avro-Canada are going to say about this project."

After this vague and inconclusive statement, there were almost two months of relative calm. It seemed that the story was about to starve to death from lack of further specifics and that it would go the way of other journalistic revelations. But this was not to be. On April 21, the *Toronto Star* published the following: "Field Marshal Montgomery . . . became one of a handful of people ever to see Avro's mock-up of a 'flying saucer,' reputed to be capable of flying 1500 miles an hour. A guide who accompanied Montgomery quoted him as describing it as 'fantastic.' . . . Security precautions surrounding this super-secret are so tight that two of Montgomery's escorts from Scotland Yard were barred from the forbidden, screened-off area of the Avro plant."

This news, which was much more authoritative since a noted military personage was involved, gave rise to the strangest deductions. Later, on April 22 and 23, even the austere *London Times* opened its columns to news from the distant *Dominion* concerning those flying saucers, which it had hitherto severely banned from its cautious news columns.

On April 24, the *Toronto Star* confirmed its February story, adding that some of Canada's most noted aeronautical engineers were secretly working on a mysterious flying disc made of metal, wood, and plastics, which would allegedly be the "weapon of the future." For some time, said the *Star*, there had been rumors that an aircraft of this type was being built in Malton, but no one had got definite confirmation on it.

According to Air Vice Marshal D. M. Smith, what Field Marshal Montgomery had seen was the preliminary study of construction plans for a *gyroscopic fighter that could take off vertically and fly at a speed of 1500 mph. A gas turbine would revolve around the pilot, who would be positioned at the center of the disc.*

A SYMPTOMATIC SILENCE

For some time the leaks continued along the same lines, although without adding anything new, favored by the fact that the organ of British military aviation, the *R.A.F. Review*, reprinted almost the whole of the original Canadian inquiry, thereby conferring, so to speak, a semiofficial status upon the news.¹¹

As a precaution, however, the review felt obliged to state that "none of the opinions expressed in the article" had been confirmed by the Air Ministry. In fact, all during the period that the news was breaking, the Ministry carefully kept its lips sealed. The Canadian flying saucer (the one in the newspapers) did not concern the Ministry, since, luckily for it, the truth about the real flying saucers of the R.C.A.F. was not even touched.

At this point began the discussions that played directly into the hands of the authorities that were directly interested in keeping the secret.

At the beginning of June, the daily information bulletin of the Swiss review *Interavia* reported that on the basis of inquiries made by its Canadian correspondent, the A. V. Roe flying disc was probably not in fact an airplane in the shape of a disc but, more simply, a delta-winged jet fighter-interceptor, that is, it had the shape of a triangle. In other words, it was a further development of the well-known Avro 707 heavy fighter and the Avro 698 Vulcan bomber powered with four jet engines.

The correspondent of the review was mistaken (or had he been deliberately misled?), since the firm had for some time been working on at least a third example of a delta-winged plane: the supersonic CF-105 Arrow, a twin-jet all-weather

fighter of thirty-five tons, the testing date of which had, however, been scheduled at the earliest for the end of 1955. Evidently this project had nothing to do with the discs, which were several years in advance of it and had a radically different shape. And the proof of it is that when the press had completely forgotten the subject, a new, very brief story that appeared in Toronto on November 1 unexpectedly brought the subject up again.

The story read: "A mock-up of the Canadian flying saucer, the highly secret aircraft in whose existence few believe, was yesterday shown to a group of twenty-five American experts, including military officers and scientists."¹²

Further news on the Avro pseudo-disc, which had in the meantime been officially baptized the Avro Omega, came on the following October 21, when the press declared that the aircraft had been under study for at least two years and that the cost of the prototype was reported to have been in the area of \$200 million.

According to the papers, the Canadian government was planning to form entire squadrons of flying saucers for the defense of Alaska and the frozen reaches of the Far North. Their claimed low cost of manufacture and maintenance, their ability to intercept any high-speed plane in operation and to take off vertically, made them the ideal weapon for operations in wooded areas of Canada and in the subarctic and polar regions, for they were "completely independent of vulnerable runways or any fixed special equipment."

The press of the Western world naturally received the news with a great sense of relief, and it unreservedly proclaimed: "The flying discs are real!" But waiting for the production-line Omegas (not to mention the prototype) began to drag out. A number of months passed. The summer came, then autumn, and still the Omega did not fly. Other saucers did fly, however, those that had been well known for a number of years.

UFOS OVER ENGLAND

The story began as follows. Sergeant Harry Waller of the 256th Anti-aircraft Regiment was setting up a radar installation

of sending the whole project to the United States, which would receive the honor, not to mention obligation, of building it and other projects that were under study and might replace the original model, which had "proved rather inefficient." The name of a certain aeronautical engineer, J. C. M. Frost, who had been identified as the principal designer of the project, began to appear with greater and greater frequency.

Finally, in March 1954, the American press described both Frost's hopes and the project in complete detail. The start of this new story was rather unusual.

Concerned about the marked progress that Soviet scientists had shown in the fields of jet aircraft and guided missiles, the United States Air Force had allocated a large sum (the exact figure was a military secret) for building within three years a prototype of the flying saucer that had been so well publicized in the press.

According to rumors circulating among military experts, U.S.-Canadian joint defense authorities had agreed to build the craft. "This is a ship that will be able to take off vertically," declared those who enthusiastically believed that the Western hemisphere could be defended by flying discs, "to hover in mid-air and to move at a speed of about 1850 mph. That is, it would be capable of performing all the maneuvers that flying discs are said to be capable of. This astonishing craft is the brain child of the English aeronautical engineer John Frost, who worked for the large De Havilland factory in England during the war and who later went on to A. V. Roe, in Malton, Canada. The aircraft that will be built for the U.S. Air Force is not, however, the first of this type that Frost has designed. Two years ago he had designed and submitted to American experts an aircraft which was called the Flying Manta because of its behavior on take-off. It more or less resembled the present disc, but it could not take off vertically.¹³ In addition, its top speed did not exceed 1430 mph. The Manta had interested the American General Staff, but in view of these operating deficiencies, it was decided not to build it."

Month after month of 1954 went by without further news from Canada, either official or semiofficial.¹⁴ By now people

were expecting to see the Frost discs, with a combined emblem of the United States star and the Canadian maple leaf painted on them, flying through the skies by the dozen. Instead, on December 3 the Canadian Defense Ministry suddenly and officially announced that the project was being abandoned because, although a number of sub-assemblies had been built and it was believed that the machine would fly, *it was agreed that it would have served no useful purpose.*

When he was interviewed by reporters, Minister of Defense Howe confirmed the decision, adding that perhaps four or five million dollars had been spent on the Frost disc, but that the project had been given up without being carried to its final development because that would have involved a total expense in the neighborhood of 100 million dollars on something that was highly speculative.

THE QUARLES STATEMENT

On October 25, 1955, Air Force Secretary Donald Quarles released a statement through the press office of the Department of Defense, permitting the A.T.I.C. to divulge some of the conclusions it had reached after its investigation of the UFOs. Among other things, Quarles declared:

"We are now entering a period of aviation technology in which aircraft of unusual configuration and flight characteristics will begin to appear. . . . The Air Force will fly the first jet-powered vertical-rising airplane in a matter of days. *We have another project under contract with AVRO Ltd., of Canada, which could result in disc-shaped aircraft somewhat similar to the popular concept of a flying saucer. . . . While some of these may take novel forms, such as the AVRO project, they are direct-line descendants of conventional aircraft and should not be regarded as supra-natural or mysterious. . . . Vertical-rising aircraft capable of transition to supersonic horizontal flight will be a new phenomenon in our skies, and under certain conditions could give the illusion of the so-called flying saucer. The Department of Defense will make every*

effort within the bounds of security to keep the public informed of these developments so they can be recognized for what they are. . . . *I think we must recognize that other countries also have the capability of developing vertical-rising aircraft, perhaps of unconventional shapes.* However, we are satisfied at this time that none of the sightings of so-called 'flying saucers' reported in this country were in fact aircraft of foreign origin."¹⁵

Whether it was deliberate or merely a slip (even the newspapers failed to catch it!), Quarles got his tenses all wrong. He was talking about aircraft of the near future, while the flying discs belonged to the past and not a very recent past at that.

According to news stories in the American papers, the new Avro project was the latest Frost project and was described as an aircraft resembling a plate turned upside down (finally!) with 180 adjustable nozzles distributed around its perimeter that would make vertical take-off possible and then, by changing the angles of the nozzles, enable the craft to move forward, sideways, or backwards.

Even leaving aside doubts about the seriousness of the project, it is at least astonishing that for the first time in the history of flight an aircraft (and a pioneering, supersonic plane at that) promised to take shape solely according to suggestions of the public at large!

In any case, the first reliable news came in February 1959. It was then called "a revolutionary type of vertical take-off plane based on the principle of the 'ring jet' that promises a 100 percent or more increase in lift at take-off through the 'ground effect' as compared with the 15 to 20 percent obtained by helicopters." In other words, an aeronautical adaptation of the physical principle behind the Vickers Hovercraft that was conceived in 1953 in order to exploit the so-called "air cushion" produced by a jet aimed at the ground: a curious machine of considerable utility that is in current use and is also being produced in the United States. Its field, however, is limited, for it cannot in practice fly any higher than six feet or any faster than 300 mph.

In fact, semiofficial statements later described it—without, however, adding any noteworthy details—as "a type of air-

craft that combines the characteristics of air cushion machines and airplanes, the development of which is being jointly undertaken by the U.S. Army and U.S. Air Force and the Canadian government because the project promises to result in a machine that could revolutionize all the ordinary methods of aerial reconnaissance."

The American papers did not, of course, fail to feature this latest bit of news. For openers, Field Marshal Montgomery was involved again: it was said that he had been given a model of the new machine. A few weeks later another "well-informed" (but anonymous) source baldly declared that England had a considerable fleet of flying saucers at the ready in Canada and that Field Marshal Montgomery had been present at recent, highly secret maneuvers of these craft. "These machines," the cautious reporter wrote, "were built by A. V. Roe and then shipped to a special secret airfield in the center of the country."

In reality, Avro was going through a bad period.

THE END OF THE "AVRO-CAR"

After stating that the potential air threat to Canada had diminished because the Soviets had only a limited number of intercontinental bombers, the Canadian government used the statement as a pretext for canceling the contract for the CF-105 (the Arrow), a heavy bomber, and for its power plant, the Iroquois turbojet, thereby forcing Avro to lay off a large portion of its personnel.¹⁶

These decisions by the government and the company threw almost 10,000 people out of work, most of them specialists, for the Avro Saucer project—renamed the Avro-Car and financed by the United States (for the simple reason that, according to official sources, "there was as yet no comparable project in the United States")—could barely keep the technicians and skilled workers of the main plants fully occupied.

On April 14, 1959, General Frank Britton during a short press conference in Washington restated the facts, implying that the first test flight of the aircraft would soon be taking

place and cautiously declaring that the new type of airplane was "perhaps" destined to revolutionize traditional aeronautical concepts but that there had been some difficulties in developing the idea.

Again a number of months passed without any news, but finally, in August 1960, the American authorities decided to allow reporters to see the prototype, which in the meantime had been changed from a single- to a two-seater. The difficulties had not disappeared. Even though masked by optimism for the occasion, the results were not very encouraging. Quite the contrary. The official report ended, in fact, with the obvious observation that "even for this type of V.T.O.L. plane (vertical take-off and landing) the principal problem is low speed stability. Tests with a full-scale model have been made at the large forty by eighty foot wind tunnel at the Ames Research Center, belonging to N.A.S.A., but they were not completely successful. It became clear, however, that the various problems inherent in a circular aircraft of this type are not insurmountable."¹⁷

While ufologists jumped with joy on learning of the serious shortcomings of these phony earth-made discs (shortcomings that, according to them, our Brothers from Space had brilliantly overcome several centuries, or perhaps even several millennia, ago), the first model of this type continued in its period of gestation for yet more months, occasionally rising clumsily above the cement runway at Malton. Finally, in December 1961 the United States Department of Defense decided to withdraw from participation in the development of the Avro-Car on the grounds that the formula had failed. It was another plane that definitely had "no tomorrow."

Here ends the *official* story of the Canadian flying saucers. An endless series of half-truths and manipulation of facts, perhaps agreed upon at the highest levels, in order to deliberately muddy the already dark waters of the whole affair.

In any case, the significant fact is established that the only country that has publicly stated that it was working on plans and actually building aircraft having some resemblance (at least externally) to the "notorious" flying discs has been Canada.

GRATIFIED AMBITIONS

The Canadian desire to do something big and new in the field of aviation was first manifested in 1942 when the government had a large military airfield, with room for expansion, built near Arnprior, about forty miles from Ottawa.

The aeronautical circles of the capital made no bones about their plans to transform the Arnprior Airport into a Canadian Farnborough (or, better, into a Canadian Royal Aeronautical Establishment) for the Canadian National Research Council. Requests for technical and financial assistance to carry out these plans were made to the British government at the time of the Commonwealth Conference of 1944.

A duplicate of the Royal Aeronautical Establishment? It would only be extra work and expense. The wooded mountains of southwest Canada offered much solid possibilities and guarantees for the erection of a large experimental center that could develop not only the types of aircraft that everyone was familiar with but also types of aircraft that *no one* should know about, at least until some indefinite time in the future.

With the help of the most close-mouthed civil servants in the Canadian Department of Mines and the Technical Surveys Mapping Branch, conditions in four selected zones in the southern part of the country were examined. This was a vast mountainous and almost deserted region (over seventy-five square miles) situated astride the boundary between British Columbia and Alberta, bordering the state of Washington on the south and reaching the Peace River District in the north.

The location was ideal: a few mountain roads and all of them easily controlled. Virtually nonexistent local traffic in the area round about. Not a single agglomeration of houses that could be called a city. An extensive string of islands and islets off the coastal zone. A thin network of railroads far to the north and to the south: the spur of the Canadian National Railway that links Prince George with Edmonton and the spur from Vancouver that runs along the United States border. One single large automobile artery—the Alaska Highway—

At that first meeting of Project Second Storey back in April 1952, Solandt had countered Smith's extraterrestrial hypothesis and spoke of the work of John Frost of A.V. Roe. Frost was hoping to build a flying saucer using conventional technology based on information obtained from Nazi Germany.

On June 7, 1952, the following article appeared in a German newspaper, the *Duesseldorfer Nachrichten*, entitled "Flying Saucers German V 7?" It quoted *France Soir*, a Paris newspaper, as stating that flying saucers were the result of German designs towards the end of the war.

chief design engineer for special projects at A. V. Roe Canada Limited (later Avro) in 1952. Those who knew him describe him as a somewhat unorthodox individual, with an intense interest in the subject of flying saucers. It is said that he carried a scrap book of flying saucer sightings, and he likely knew Wilbert Smith because their mutual supporter was Dr. Omond Solandt of the Canadian Defence Research Board.

In April 1952 Frost co-authored a paper with T. D. Earl entitled "Proposal for a Gas Turbine Propelled Aircraft of Circular Plan Form." He followed this in July of that year with "Project Y: An All-Wing Supersonic Aeroplane."² His goal was to design, build, and fly a flying saucer. Oddly, in spite of the fact that the Canadian government expressed minimal interest in his project, Frost noted that Solandt was instrumental in interesting the United States Air Force, through General D. C. Putt, then head of the USAF Air Research and Development Command.

In addition to finding out if it could in fact be done, the USAF, or perhaps Dr. Vannevar Bush's secret group, may have had other reasons for seeing the saucer built. Writing in Ideal's UFO magazine in 1978, Lieutenant Colonel (USAF) George Edwards (retired) claimed that the saucer was being developed as a cover, not as a supersonic, man-made saucer:

Although we were not cut in on it, we know that the AF was secretly test-flying a real alien spacecraft. The VZ-9 [Frost's saucer] was to be a "cover," so the Pentagon would have an explanation whenever people reported seeing a saucer in flight.³

Major Donald Keyhoe expounded this theme in his 1960 book, *Flying Saucers: Top Secret*. He cited an incident that occurred on August 1, 1955. A witness in Ohio reported a large, circular

Avro
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Palmira Campagna

object with a red light on the rim. At one point the object stopped in mid-air and shone two beams of light to the ground. It made no noise as it then proceeded to pass over the witness's house and speed away.

In 1956 a friend of the witness who was told of the encounter made a report to the Air Technical Intelligence Center (ATIC). Shortly thereafter, a military man with the rank of major visited the witness and his family. The major showed them what appeared to be a picture of a flying saucer and said it was built at A. V. Roe in Canada. It was the Avro craft they had seen, he assured them. He even tried to persuade them to sign a statement to that effect. They did not sign and instead reported the incident to the National Investigations Committee on Aerial Phenomena (NICAP), a civilian organization of which Keyhoe was to become director. In a subsequent book Keyhoe noted that the Avro saucer as cover story was again brought up by the air force in 1965 just before a House Armed Services Committee hearing into the whole subject of UFOs and the air force's handling of reported sightings.

Whether it was a ruse for hiding the true secret behind the saucers or not, news of Project Y was eventually leaked to the press. The Toronto Star carried a feature article on February 11, 1953, under the headline "Takes Off Straight Up Report Malton 'Flying Saucer' to Do 1,500 MPH":

Highly secret reports of a Canadian "flying saucer" are circulating among British and U.S. defence scientists . . . the craft is designed to take off vertically, fly horizontally at about 1,500 miles an hour, and make use of the gyroscopic effect of a revolving power plant to acquire stability . . . Western scientists must consider the possibility that Soviet Russia has carried similar developments to a more advanced

Tactical Air Command, Langley AFB, visited Avro and was given a thorough briefing on Project Y2. Before he left he expressed his desire to join the venture.

Further discussions were held with General Putt through the DRB. The result was the award of a \$758,000 contract from the USAF in early 1955. The contract was to extend through to August 1956 and the project title was changed to Project 1794. The contract allowed for supersonic testing at the wind tunnel of the Massachusetts Institute of Technology, subsonic and hover tests at the wind tunnel at the Wright Air Development Center, and various other tests back at Avro. As the test results proved favorable, Avro established another project, Project P.V. (Private Venture) 704 in January 1956. This project allowed for development of the propulsion and control system test rigs. P.V. 704 was to extend into 1958 at an estimated cost of \$5,000,000.

While work was progressing, United States Secretary of the Air Force Donald Quarles noted in a public statement on October 25, 1955, that the USAF was engaged in the design of a circular craft with Avro Canada Ltd. Quarles indicated that such craft might "give the illusion of the so-called flying saucer"⁷ and that the government would endeavor to keep the public informed of such developments, within the bounds of security. Quarles seems to have been preparing to explain away any flying saucer sightings as being those of the Avro craft.

In March 1957 the USAF continued its interest by extending Project 1794 through into October 1958. The project name was now changed to Research System 606A (Weapon System 606A in some papers) and the contract was to be worth \$1,600,000. In fact, the Canadian government had supplied \$300,000 between 1952 and 1953, Avro had provided \$2,500,000 up to March 1958, and the USAF had contributed \$785,000 in 1954 and now \$1,815,000 in 1957. The new contract included further studies

in the subsonic wind tunnel, development of the combustion system for supersonic flight, and studies involving operational considerations. Approximately 1,000 hours of tests had been completed in the wind tunnels and ground cushion tests using upwards of seventy-five models had all been completed at Avro. As well, testing had begun on the propulsion system.

Also in 1957, members of the U.S. Army visited Avro on September 26 and 27. The army required a craft with greater mobility and was interested in vehicles that could fly close to the surface of the ground — as Project Y could in ground cushion mode. They explained that development contracts totaling \$1,700,000 had been given to various companies, including Chrysler, Aerophysics, Goodyear, Piasecki, and Hiller, but that the army was not happy with any of the designs. They were hoping Avro could provide the required vehicle. *Putt*

Avro personnel were then invited to brief General Gavin at a meeting at the Pentagon on November 29, 1957. What Avro proposed was a subsonic vehicle based on the Project Y design. The craft was featured in a report entitled "U.S. Army Requirement for a New Family of Air Vehicles," dated November 26, 1957. *Gavin*

By April 1958 the USAF, the U.S. Army, and U.S. Office of the Secretary of Defense had agreed to establish an integrated USAF/U.S. Army program with joint funding but under the management of the air force. The program would satisfy the army's subsonic requirement and be a first step towards realizing the supersonic USAF flying saucer. It was agreed that Project 606A would be reoriented to study the simpler, subsonic army vehicle and that Avro would therefore stop work on the supersonic P.V. 704 in favor of first completing this one. The U.S. Army would arrange funding to procure two vehicles for completion of the full test program. The value of the joint USAF/U.S. Army contracts for fabrication and testing of the prototype vehicles was set *Walker*

other government agencies. Examples of such programs include the U-2 spy plane of the 1950s, its successor, the SR-71 Blackbird, and most recently the Stealth aircraft such as the F-117A and the B-2 bomber. Undoubtedly, the atomic-powered aircraft mentioned by Bremner was being developed as a black program as well. Personnel working on such programs are not only sworn to secrecy but may also have their human rights threatened in an attempt to silence them. Did the Avrocar evolve?

In the early nineties speculation was rampant that a new "black," hypersonic aircraft was being test-flown by the United States Air Force. This speculation was based on reported sightings of incredibly fast-moving, triangular-shaped aircraft with unusual engine noises and strange contrails of smoke resembling knots along a string or "doughnuts on a rope." The speculation was further fueled by a 1985 Pentagon budget document requesting funds for a number of programs, including one called "Aurora." It has been presumed that Aurora is, or was, the code name for this hypersonic aircraft, the successor to the SR-71 Blackbird.

Interestingly, evidence for the existence of this new aircraft also came from a U.S. geological survey, which picked up unidentified sonic booms across southern California. Naturally, the USAF and all concerned have denied the existence of such aircraft. As explained in *Jane's Defense Weekly*, however, "The USAF's credibility is undermined by the fact that the DOD authorizes disseminating misleading information."¹¹ In other words, to keep information secret, the USAF is authorized to orchestrate a disinformation campaign. An example of the effectiveness of such a campaign occurred during the development of the U-2. For years, while the U-2 aircraft was overflying and spying on other countries, most governments and the public believed the cover story that this plane was simply involved in weather mapping and related meteorological work.

One of the ways such programs are disguised, for the purpose of obtaining government funding, is through the use of multiple-project code names which are not easily tracked. Or, such projects are sometimes hidden as part of the development of other projects. For example, it was noted in *Jane's* that the National Aero-space Plane (NASP), a project to develop a commercial hypersonic passenger aircraft, may have been used as a cover for the development of Aurora.

According to *Jane's*, NASP was an unclassified program focusing research on Mach 8 performance, a difficult goal to achieve. Therefore, initial work on a propulsion system was aimed at achieving speeds somewhat lower than Mach 8 but much faster than anything else. This was not unlike the decision to develop a subsonic Avrocar first, before moving on to the supersonic Project Y.

Jane's points out that the lower-speed aspects of the propulsion system development for NASP were in fact classified and not open to public scrutiny like the rest of the project. In other words, the lower-speed development might in fact have been for the Aurora but under the auspices of the NASP project. With a lower-speed Aurora completed, NASP would be allowed to "fizzle" out as currently unattainable. Meanwhile, Aurora would be flying, unknown to all but a privileged few. Granted, its speed might not be Mach 8, but Mach 4 or above would best anything else flying.

Such state-of-the-art aircraft would require advanced methods of propulsion. The "combined cycle" engine, which combines the elements of a ramjet engine with those of a rocket and turbine engine, was what was speculated for Aurora. It is said that such an engine can power an aircraft at any speed up to Mach 6. Combined cycle engines were invented in the late 1950s and further experimented with in the 1960s by Dr. Fred Billig of the

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Weekly
"Disinformation
U.S. Info Group
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applied physics laboratory of Johns Hopkins University. Billig noted that these engines were most efficient, being able to recover and utilize energy that conventional engines would lose. It is conceivable that while John Frost was using conventional engines and was ironing out the stability problems with the Avrocar, the USAF was fully intending to carry on the development of Project Y using the combined cycle engine or some other experimental means of propulsion.

The declassification on March 29, 1995, of technical report TR-AC-47 from the Air Technical Intelligence Center at Wright-Patterson Air Force Base, Ohio, illustrates that Project Y was part of a black program development. The report is titled "Joint ATIC-WADC Report on Project Silver Bug," listed as Project No. 9961, and dated February 15, 1955. Before the release of this document, the project code name "Silver Bug" had not appeared in any other correspondence or literature dealing with Project Y or the Avrocar. The Avro flying saucer development program, then, has carried the following names: U.S. Army VZ-9 AV or Avrocar for public consumption; Weapon System 606A or Project 1794 for dealings with Canada on the supersonic model; Project Y, Project Y2, and P.V. 704 for aspects of the project internal to Avro; and finally, Silver Bug or Project 9961 for the supersonic version internal to the United States Air Force.

The Silver Bug report is essentially a copy of Frost's Y2 report with some interesting added discussion. It indicates that the project was not connected in any way with flying saucer stories even though the craft had a circular shape. The circular design resulted from engineering investigations to solve a specific problem. The report says a circular design would solve the requirement for "achieving dispersed base operations."¹² That is, with the craft's vertical takeoff and landing capability the need for special runways would be negligible, so that launch

areas could be established anywhere, including the decks of submarines.

The report continues with the following:

The ultimate purpose . . . is to correct the distorted picture presented in previous releases, both classified and unclassified, and to acquaint the intelligence community with the current state-of-the-art facts thereby alerting them to any air intelligence information which may become available indicating Soviet interest in this specialized field . . . There appears to be no fundamental reason why this proposal should not ultimately result in a weapon system . . . The technical information on this project should be followed by direct liaison between WADC and ATIC personnel . . . A collection effort should be initiated to determine whether the Soviet Bloc is or has been conducting research efforts on a similar project, when this work began, and the present state of the Soviet development.¹³

It appears that the United States was interested in seeing the advancement of Silver Bug but was also intent on finding out if the Soviets were in possession of similar or more advanced technology. Sightings like the one from Russia described below, as well as reports from people like Goy, may have been driving the Americans' interest in Soviet technology.

On October 5, 1955, three American officials, Senator Richard Russell (Republican, Georgia), Lieutenant Colonel E. U. Hathaway, the U.S. Army staff officer assigned to the Senate Armed Forces Committee, and Reuben Efron, consultant to the committee, witnessed two circular objects while traveling through Russia. The disks took off almost vertically and seemed to be emitting sparks. Their outer surface appeared to rotate slowly and they

had two stationary lights on top. The U.S. officials believed they were witnessing secret Soviet aircraft based on the German wartime designs.

By the time the Avrocar project was terminated, the USAF may have either developed Silver Bug into a flying model or believed that enough information was now available to carry out a separate development. Alternatively, the difficulties encountered during the Avrocar experience may have persuaded them that the saucer design was unworkable. In either case, the publicity surrounding the Avrocar development appeared to deflect attention away from other U.S. developments and alien disks, at least for a short period.

In 1967 it was allegedly discovered that Project Silver Bug did achieve an advanced stage of development. Jack Pickett, a publisher of the *NCO Club* and *Officer Club* magazines, claims he saw four disk-shaped aircraft at Mac Dill Air Force Base: "Seen head-on they all appeared as the classic, so called flying saucer shape with the pilot/crew compartment appearing as a bubble, dead center."¹⁴ Pickett said the craft were of varying sizes, ranging from 20 feet to anywhere from 50 to 75 feet across. They had air intake slots on either side of the crew compartment and exhausts underneath. He was told by the officer in charge that they had a very high airspeed, in excess of Mach 1, and that their altitude capability was extremely high, although no figures were mentioned. He was shown photographs of different formations in flight. The four craft he was allowed to view were awaiting a decision to be destroyed or sent to a museum. He was told that due to some maneuverability problems and the achievement of more practical designs, their development had been discontinued. These aircraft have been collectively dubbed "Lady Bug," but no further information on them has yet come to light.

It is an intriguing prospect that a flying saucer may have been

built and is perhaps flying today. Still, that would not explain the thousands of sightings reported to Wilbert Smith and others over the years, nor does it answer Dr. Robert Sarbacher's assertions about crashed disks and alien beings. An examination of some of these reports, and of the continued efforts of Canada's Department of National Defence at collecting them even while telling the general public that the Department had no interest in the subject, is worth examining further.