

# Arrows *in the* Abyss

BY ELLE ANDRA-WARNER



Shipwreck divers and marine archaeologists are scouring the depths of Lake Ontario to recover nine one-eighth-scale test models of the CF-105 Avro Arrow which have been lying on the lake floor for over four decades.

Right: A crewmember helps Mike Fletcher affix his dive helmet. Inset: A one-eighth-scale CF-105 Avro Arrow free-flight test model is prepared for launch aboard a Nike JA TO XM5 booster rocket.

RL 863-2004





**Arrow free-flight test model number 7 blasts off from the Canadian Armament Research and Development Establishment (CARDE) missile and rocket testing range facility at Point Petre, on the shore of Lake Ontario.**

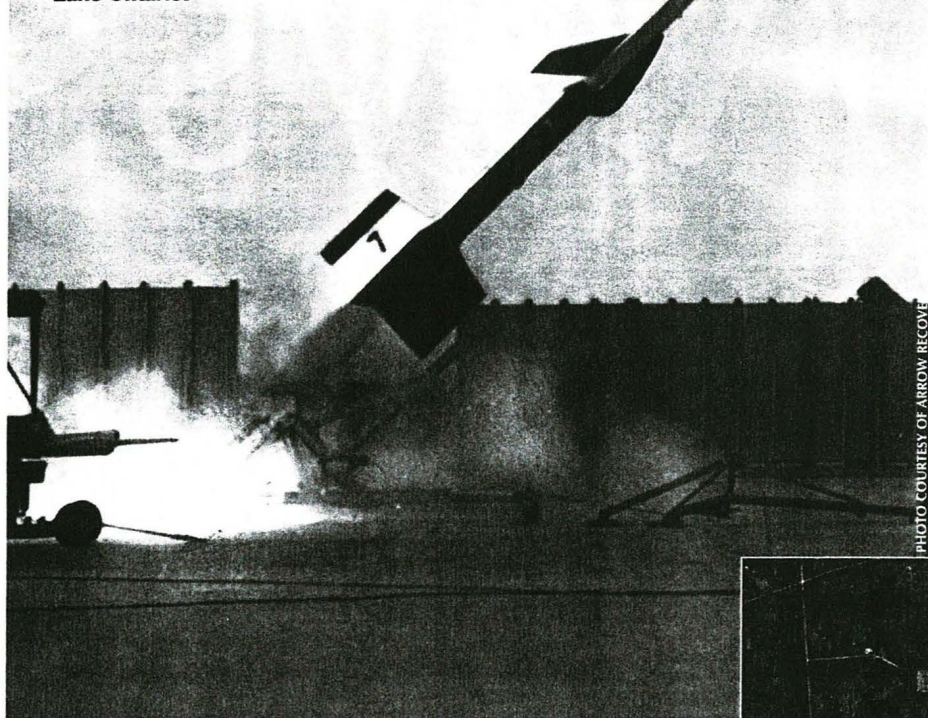


PHOTO COURTESY OF ARROW RECOVER

Anyone familiar with the Avro Arrow saga knows the project was cancelled by the Diefenbaker government on February 20, 1959, throwing 14,525 people out of work. Everything associated with the airplane — blueprints, dies, moulds and parts — was ordered destroyed. The existing airplanes were cut into pieces and liquefied in a Hamilton smelter. At the time, the only aspect of the Arrow program not slated for destruction were nine discarded free-flight test models lying on the bottom of Lake Ontario near the rocket testing range facility at Point Petre, Ontario.

## MODEL HISTORY

The story of the Avro Arrow goes back to the early 1950s at the height of the Cold War when the RCAF needed an all-weather supersonic jet interceptor to counter the threat of Soviet bombers attacking North America via the North Pole. To meet RCAF requirements, A. V. Roe (Avro) Canada designed the CF-105

Avro Arrow. It was a large delta-winged, twin-engine all-metal plane designed to fly at Mach 2, or faster.

In the early developmental stages of the Arrow, aerodynamic measurements of the pitching, yawing, and rolling planes and aircraft drag were required before the Arrow could go into full production. So, between 1954 and 1957, Avro built 11 one-eighth-scale Arrow supersonic free-flight test models for the purpose of gathering performance data to use in the design of the CF-105. (No prototypes of the Arrow were ever built, only production aircraft.)

Avro contracted the Canadian Armament Research and Development Establishment (CARDE) to test nine of these models at the missile and rocket testing range facility at Point Petre on the shore of Lake Ontario. The

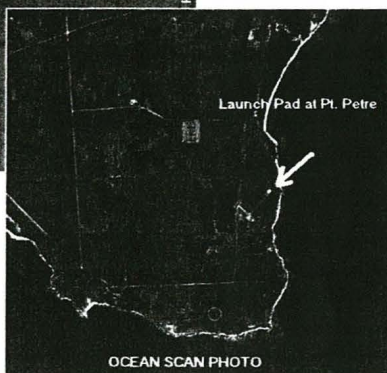
first free-flight Arrow model tested at Point Petre was launched on December 14, 1954, and tests continued on the remaining eight models until January 1957. Two other models were tested at the NACA rocket range on Wallops Island, Virginia, where they were launched into the Atlantic. These two models have been badly corroded by salt water, but researchers believe the nine other models fired into Lake Ontario would have been well preserved by the cold fresh water.

Constructed of magnesium alloy, steel, aluminum alloys, wood and fibreglass, the models were approximately nine feet long with a six-foot wingspan and weighed approximately 478 pounds. They were ground launched aboard Nike booster rockets to achieve supersonic speeds, thus simulating flight of the full-scale Arrow at high altitudes. (The models were ground launched because it was considered a more consistent form of data retrieval than air launching an

aircraft or ballistic firing from a large-caliber gun.) Each scale free-flight model was installed with instrumentation and 23 sensors which would measure performance and stability. At Mach 2, the model would separate and then transmit telemetry data to the engineering team at the ground station.

The first successful booster rocket produced in the United States was the

Nike JA TO XM5. Its standard design provided 262.45 kN (59,000 pounds) of thrust, making it capable of reaching Mach 3. This was more than Avro engineers wanted, so the Nike booster's thrust was modified using a smaller solid propellant charge which provided 220.17 kN (45,000 pounds) thrust. This provided a burn time of 2.3 to 3.0 seconds, with a top speed between Mach 2 and 2.3, though most models were released at Mach 1.7. After travelling at supersonic speed for a few seconds, the booster rocket would expire and the free-flight model would plunge into the waters of Lake Ontario to join



**An aerial view of the CARDE missile and rocket testing range facility at Point Petre, Ontario.**



hundreds of other spent missiles fired from the Point Petre missile test range.

Ultimately, the free-flight test model project successfully verified wind tunnel data received from NAE and Cornell labs, and played an integral role in the preliminary design of the Arrow. Analysis of the data acquired from the combined test models resulted in a number of aerodynamic modifications to the Arrow design, including changes to the cockpit canopy and the leading edge of the wings, specifically the notched leading edge of the wing.

### FALSE ALARM

For the past 15 years, several small groups of adventurer-searchers have been competing to find the remains of the Arrow test models.

In June 1999, shipwreck hunter Dave Gartshore of Trenton, Ontario, identified a target in Lake Ontario which appeared to be an Arrow model. CBC News ran a headline reading "Avro Arrow Model Found in Lake Ontario." Gartshore hoped to recover the object, but he ran into a problem: the Ontario government barred him from diving to the site because he didn't have a recovery licence.

In the end, it mattered little as the target proved to be false.

### A SEARCH WITH MUSSEL

Meanwhile, another group, the Aerospace Heritage Foundation of Canada (AHFC), had its own endeavour to locate and recover one of these models, see it restored and made available to the public.

The AHFC's recovery effort began about 15 years ago when Robert Saunders, an aircraft mechanic, scuba diver and director of the AHFC, became interested in the fate of the models. Working with Jim Garrington, owner of Shark Marine Technologies, Saunders started preliminary work on locating the test models. Ten years ago Saunders

called a special meeting of people interested in the Arrow test models and formally launched the Arrow Model Recovery Program (AMRP). (The project is dedicated to Saunderson's father, the late Gerald T. Saunders, and to the project's recent president, the late Ian Farrar.)

## The free-flight test model project played an integral role in the preliminary design of the CF-105 Avro Arrow.

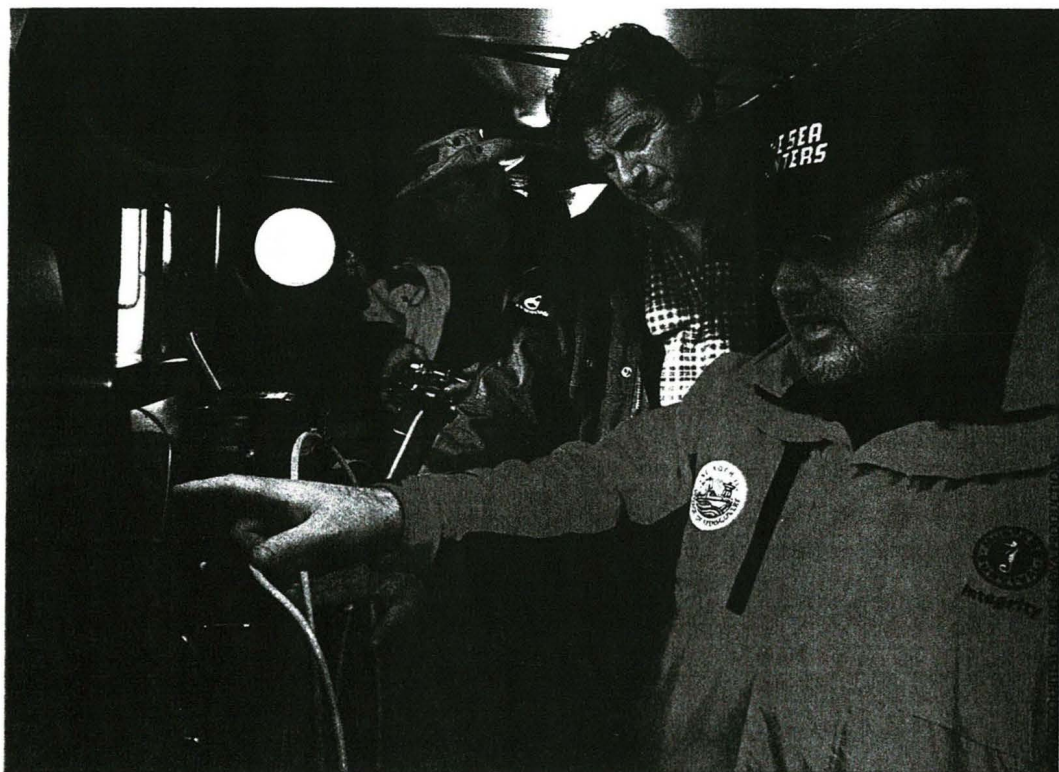
The stated goal of the AMRP is to recover, restore and display free-flight test models for the Toronto Aerospace Museum, the RCAF Museum in Trenton, Ontario, and the Canada Aviation Museum in Ottawa.

In the mid-1990s, Saunders and the AHFC assembled a team to collect data, analyze the launch area and determine the expected trajectories of the models. Over the next few years, several meetings were held and trips made to the site.

While Garrington calculated the trajectory from the available data and established the target search area. Saunders and AHFC set out to procure funding for the search and recovery. There was considerable interest in locating the lost models, but many sponsors were hesitant about investing because multiple licences had been issued to search for the models.

The AHFC says they legally purchased the models from the Canadian government in 2003 and became the sole registered owners of the nine Arrow test models resting in Lake Ontario. Saunders also says the AHFC is working with the support of the Ontario government. The organization hoped this support and title to the models would convince potential sponsors that no matter who located the models, it would be AHFC who would own and recover them.

In August 2003, the AHFC team spent two days using side-scan sonar to identify possible targets. Garrington says the main search area is located in a depth of 10 to 20 fathoms, with the extended areas reaching one to 30



The Sea Hunters' marine archaeologist, Jim Delgado (right), and crew study sidescan images from the bottom of Lake Ontario, near Point Petre.



## Free-flight Test Model Dimensions

Average mass: 478 lb. (217 kg)

Length: 9 ft. 2 in. (2,794 mm)  
(without antenna)

Antenna: 2 ft. 6 in. (762 mm)

Wingspan: 6 ft. 3 in. (1,905 mm)

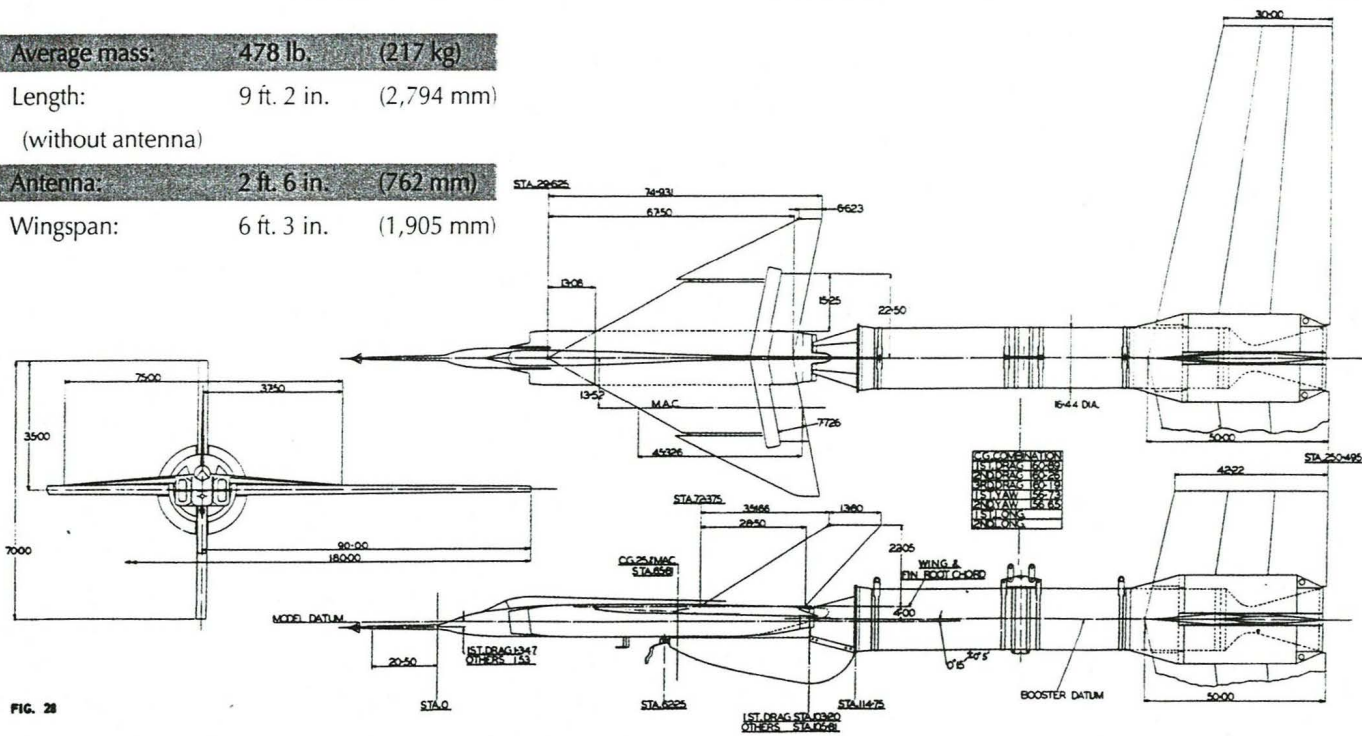


FIG. 28

fathoms. He says: "Sediment depth over bedrock is minimal, indicating that the models were not likely to be buried. The area is littered with individual flat rocks, approaching the size of the models."

The team found a number of possible targets, and in the process confirmed an unwelcome addition to the lake bottom. Two cameras showed that Quagga mussels were now covering all hard surfaces. Saunders says, "The models are covered with at least four to six inches of these mussels."

## THE SEA HUNTERS

In October 2003, Saunders and Garrington's team joined forces with the television series *The Sea Hunters*, produced by Eco-Nova Productions in Halifax, Nova Scotia.

Mike Fletcher, one of the divers with the program, was familiar with the free-flight test models. "Since childhood, I've had an obsession with learning everything about the Arrow," he says. "[The models] are the last tangible evidence of the existence of the Arrow. As a Sea Hunter, I've had some influence on what shows, and what stories, the series will present. When I asked my boss about doing a show on the search for the

Arrow models, he said to write up a single page about it... and we [planned] filming."

Last October, Fletcher and The Sea Hunters, in cooperation with the AHFC, dove to the underwater target, while Jim Delgado, the program's marine archaeologist, viewed the search on the surface via a remote underwater camera.

"The models are covered with at least four to six inches of mussels."

—Jim Garrington

Unfortunately, hopes were dashed when the target turned out to be a Nike Hercules missile. Nevertheless, Fletcher, Delgado and The Sea Hunters plan to continue searching for the Arrow models.

Saunders continues to lead AMRP's lost model search, but he says the challenge is becoming greater. "Funding continues to be one of our biggest hurdles," he says. "There is lots of funding support for after retrieval... but we need money to retrieve it. And the

enthusiasm of our volunteers tends to dwindle the longer it takes."

## TURF WAR

The AHFC is not the only organization with a vested interest in locating and retrieving the Arrow models from the lake bottom. Arrow Recovery Canada Inc. (ARC) is a non-profit organization of volunteers with its own model search and recovery project underway, and they contest the AHFC's ownership claim on the models.

Scott McArthur a spokesman for ARC, says: "To the best of my knowledge, there was no money involved in the purchase of models and the federal government gave AHFC conditional rights only. The Ontario government claims all artifacts abandoned on the lake bed within the province of Ontario's waters, and this would also apply to the models. So, the AHFC ownership issue, which was designed to stop ARC, is moot as the models are owned by the Ontario government, not the federal government, and the AHFC has to have the proper licenses to search and recover, or they risk fine and jail.

"[ARC] has been operating under strict guidelines from the Ontario government. This



includes having proper survey and recovery licenses, as well as having a recovery and preservation plan submitted to the government prior to recovery. I hope these other teams are operating under the same guidelines. If AHFC believes they now own the models and ignore the provincial laws they may be headed for a confrontation with the provincial ministries over ownership."

But before all this litigation can happen, someone first must find an actual model. McArthur says: "[ARC's] search area is the actual location of the models. We have covered about half of our designated area, which I am sure is the area that AHFC is also now surveying. ARC has over 75 targets in its licensed area, so far. I believe we are within a couple of days' survey of finding the models. But we also are hampered by lack of money and available volunteer help."

#### MAVERICK ELEMENT

While the AMRP and ARC may be at odds over ownership, there is a third party both organizations aren't happy to have in on the act. Veteran shipwreck hunter Ed Burt, who owns and operates Ocean Scan Systems in Belleville, Ontario, is something of a maverick in the search for the Arrow models. And, most interestingly, he is the only person who can claim a measure of tangible success so far. In November 2003, Burt recovered and donated to the RCAF Museum the port wing section of the Nike missile that launched Arrow model number five. He says he found the remains of the rocket washed up on a beach near Point Petre.

Burt rejects AHFC's claim to have rights to the models through the federal government, and he has equal disdain for ARC's contention that the models are the property of the Ontario provincial government. Burt says if he locates any of the models he will claim them under international admiralty law, which essentially means "finders keepers."

Ed Burt isn't much concerned with competition from AMRP or ARC either: "They have made claims of finds, but those have turned out to be a Sparrow missile or a double-cylinder leather piston bilge pump from an old schooner."

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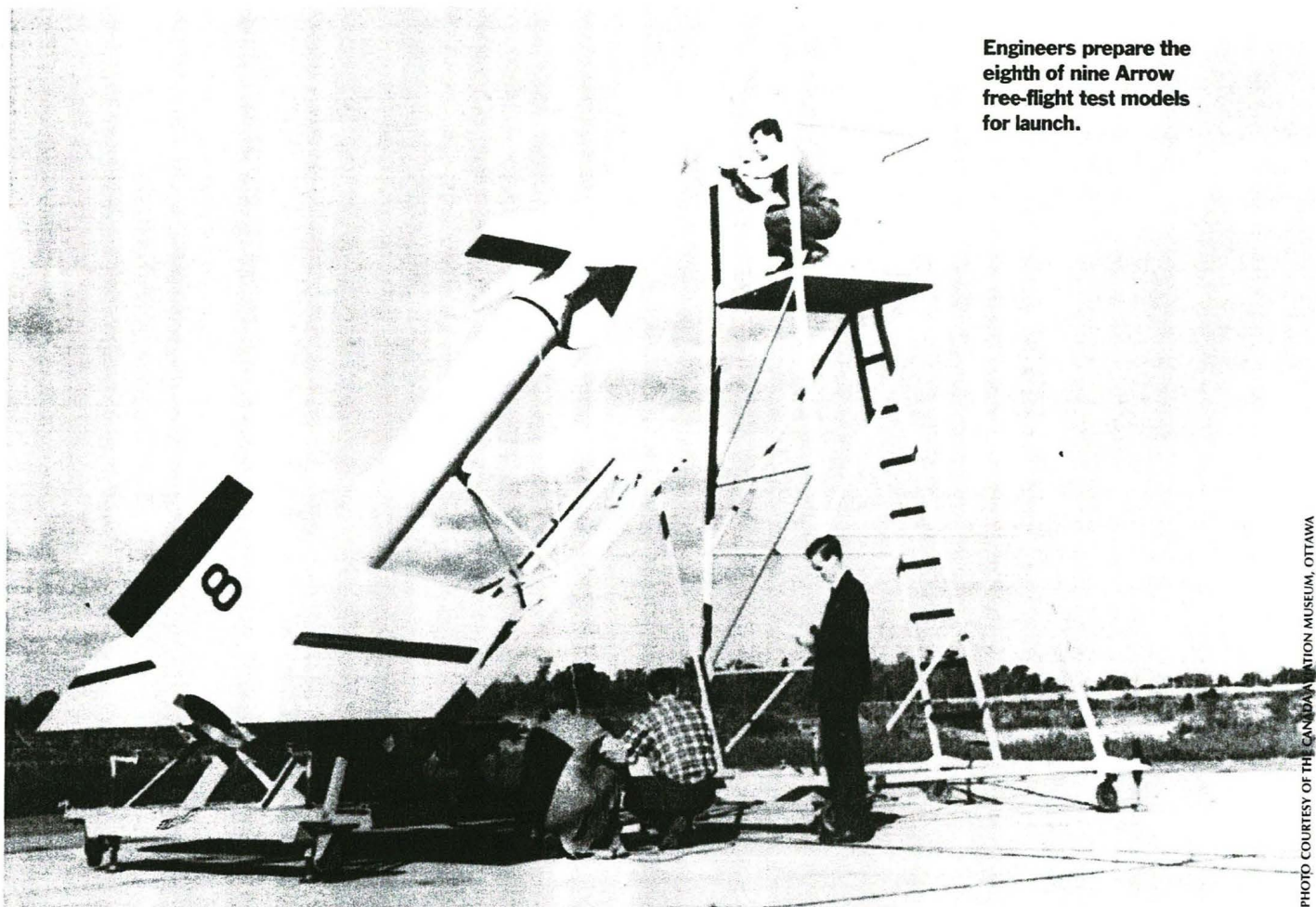
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Engineers prepare the eighth of nine Arrow free-flight test models for launch.

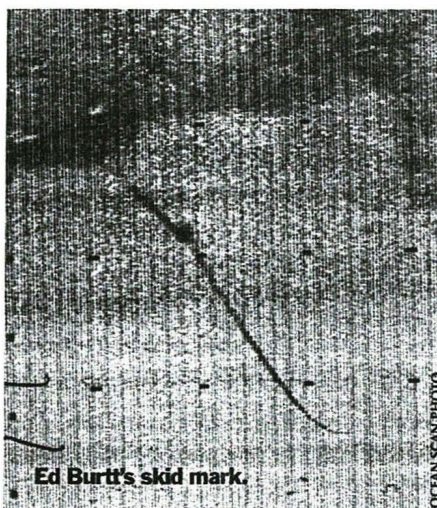
PHOTO COURTESY OF THE CANADIAN AVIATION MUSEUM, OTTAWA

What's more, Burt believes he was the first to discover evidence of the test models in the 1960s. While looking for a shipwreck in Lake Ontario, he came across a number of apparent "skid marks" on the lake bottom. He didn't give them much attention at the time because there was no debris to be found at the end of the marks. Then, in 1985, Ocean Scan Systems did a side scan survey for Ontario Hydro in Lake Ontario and discovered more skid marks near Point Petre.

When the company was later asked to participate in the search and recovery of the Arrow test models, Burt remembered the skid marks and deduced they may have come from Arrow models impacting the bottom of the lake at high speed. \*

Burt says the actual area where the models splashed down is very small in size, but the challenge, he says, lies in the fact that the search area contains over 600 air-to-air missiles, such as the Velvet Glove, the Sparrow and Falcon missiles, which were also fired

from the Point Petre range. No matter. Burt is convinced the skid marks provide convincing clues to the location of the models. On the basis of where he located the wing section of the Nike booster rocket last fall, Burt says he has located the exact position of one of the models: "There is a 100 per cent chance of a recovery sometime this year,



Ed Burt's skid mark.

probably this summer." But before that can happen, he says, "there are a lot of conservation preparations and documentation to organize, and we have to find a home for it, preferably with the RCAF Museum in Trenton, Ontario. There's a lot more to recovery than just pulling it up on the beach, you know. We haven't made any effort to raise the model as yet, but have plans to apply for permits to be able to do this along with a film documentary group. We also have to find a home or museum that is interested in taking the artifact and doing conservation on it as soon as it is out of the water."

#### PRESERVING THE PAST

Regardless of who brings up an artifact, the survey work still requires an archaeological permit from the Province of Ontario, which is issued annually and remains valid for a one-year period. As the wreckage of these Arrow free-flight test models are considered heritage wrecks, any recovery activities must be

\* There is some doubt surrounding the origin of Ed Burt's "skid marks." Since the models impacted the surface of the lake at over 756 knots, odds are the models broke apart on impact at the surface, then sank vertically to the bottom. What is more likely is that Burt discovered ice scours, which are common in the Great Lakes.



carried out using accepted archaeological and conservation practices.

As part of this project, the Canadian Conservation Institute (CCI) has completed a conservation plan for recovery operations which includes underwater activities, surface assessment, cleaning and transport.

After many years submerged in water, recovered models are likely to require extensive restoration. This work will be carried out under the guidance of conservation or aircraft preservation professionals, with most hands-on work being done by volunteers.

Any models recovered will be stabilized and studied, and then turned over to the Canada Aviation Museum in Ottawa, the RCAF Memorial Museum in Trenton, the Canadian Warplane Heritage Museum in Hamilton, and the A.V. Roe Heritage Museum in Calgary.

## ROCKET ENVY

So, will 2004 be the year of discovery? Each of the groups involved in the quest for the Arrow free-flight test models seems convinced they have narrowed down the exact search area. The only thing which remains to be seen, then, is who will be first to locate, retrieve and confirm the identity of the remains of one of the nine models.

The AHFC continues searching the lake bed around Point Petre with their target area based on different interpretations of flight path trajectory data and anecdotal information from ground observers present when the launches were carried out.

As the AHFC struggles to secure sponsors for the recovery, this summer will likely be a

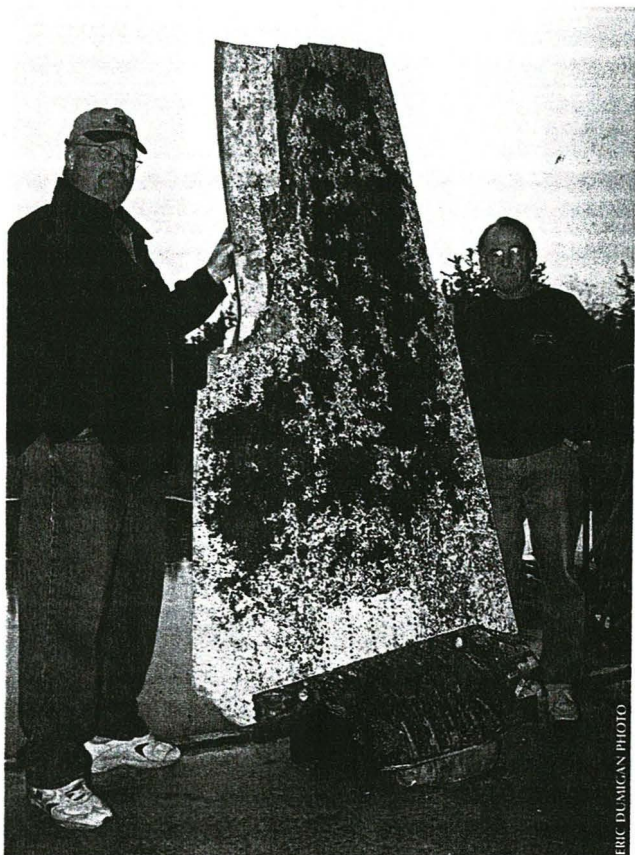
make-or-break year for their project. Fortunately, the Canadian navy has offered to assist them in the search for the lost models in July. Saunders and Garington, with the AMRP team, will coordinate and control the search, while the navy will provide two vessels, equipment, services, and divers. The target area they are searching is three kilometres long and two kilometres wide, littered with over 600 rockets and missiles. However, Saunders acknowledges that if the search comes up empty this year, it may mean the end of the AMRP, and AHFC's active role in searching for the models.

Similarly, ARC struggles to raise sponsorship funds, and has its own challenges to overcome, yet there is a mood of genuine optimism that the organization will locate and retrieve one of the models this year.

As for Ed Burtt, well, he has the grin of a Cheshire cat.

## CONNECTING WITH THE LEGACY

In an ironic twist, the story behind the search for the free-flight test models mirrors the intrigue behind the Arrow saga itself. Both have been shrouded in secrecy, involved turf wars and government bureaucracy, and both



Diver Ed Burtt (right) and Larry Scott pose with the left wing section of the Nike booster rocket which launched Arrow model number 5. The artifact has been donated to the RCAF Museum in Trenton, Ontario.

are imbued with passionate and colourful characters. Further, the mysterious elusive-ness of actual artifacts is common to each.

Few large artifacts remain from the ill-fated Arrow project. When, and if, one of these parties locates and retrieves a free-flight test model from the bottom of Lake Ontario, it will, undoubtedly, provide the nation with a significant and tangible link to the Arrow program, and a reminder that Canada was once a world leader in advanced aviation technology and development. ✈



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