



attached to a U shaped yoke that passed around the pilot, just under his arms. To bank the plane, he just leaned slightly in the direction he wanted to go, much like a motorcycle or skiing.

The engine was a unique, water cooled V8 built by Glenn Curtiss that drove a pusher propeller through a chain drive.

Apparently, there was almost no throttle control on the engine and much experimentation on the propeller design was needed to get the propeller drag just right to keep the engine running at optimum speed and still maintain forward thrust. The

**BACKGROUND**

2009 marks the anniversary of powered flight in Canada. On Feb 23, 1909, the Silver Dart took flight over Bras d'Or Lakes near Baddeck, Nova Scotia. The aircraft was built by the Aerial Experiment Association (AEA), pioneered by Alexander Graham Bell, and was piloted by J.A. Douglas Drury.

I thought it was only fitting that for the anniversary, I would build a scale model of the plane. It so happened that the Heritagecon model contest in Hamilton, ON, had a theme category of '100<sup>th</sup> Anniversary of Canadian Flight' and I made it my goal to complete the plane for that Feb 22, 2009 date. I got the plane constructed, but not all the rigging was done for the contest. I took it anyway and it was a very popular model.

The original Silver Dart was built of wood, bamboo, steel and about a mile of cable holding it altogether. The fabric on the wings was silk that had a silver colour to it, thus giving rise to the name. The undercarriage consisted of three motorcycle wheels, with the single front one being steerable.

The controls were quite unique:

Cable connected to the steering wheel went through pulleys to tiller bar which steered the front wheel. Attached to the tiller were two other cables that passed through pulleys on the lower wings back to the rear mounted rudder. Hence, when the steering wheel was turned, both the front wheel and rudder moved in opposite directions to steer the plane correctly.

Pitch control was done through the front mounted canard, controlled by moving the steering wheel shaft forward or



## Building the AEA Silver Dart in 1/24 scale

**by Evan Jones  
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back, changing the angle of attack.

Four triangular shaped ailerons were mounted, two on the outboard ends of each wing. These were controlled through cables

radiator consisted of a number of long, vertical copper tubes mounted just behind the pilot's seat.



**The Silver Dart. In 1/24 scale the wingspan is a little over 2 feet**

## RESEARCH

I began researching through the Internet to find photos and articles about the Silver Dart. I had seen the one replica hanging from the ceiling of the Canadian Aviation Museum in Ottawa, ON. I discovered that the original engine, which had been recovered years after the fateful Petawawa, ON, crash landing of the Silver Dart in 1910, was on display at the museum. I made a trip and was kindly granted access to photograph and measure the engine. The museum also had a number of photographs on hand and I purchased scanned copies of a few of them.

However, the more I delved into the plane, the more conflicting the reference material became. Each time the plane flew, something else was changed or improved from the previous flight. I ended up building a version as close as I could discover to the one that flew on the original flight. However, there were a number of details that I discovered after completing the model. For example, my model has no battery installed.

As far as I was able to find, there are now four full scale and one half scale replicas of the Silver Dart:

- ◆ An airworthy version at the Canadian Aviation Museum in Ottawa, ON, built by LAC Lionel McCaffrey
- ◆ A replica at Canada's Aviation Hall of Fame in Wetaskiwin, AB, built by Gordon MacRae of Baddeck, NS
- ◆ Another replica at Glenn H. Curtiss Museum in Hammondsport, NY, also built by Gordon MacRae
- ◆ An airworthy version that flew on Feb 22, 2009 at Baddeck, NS, in celebration of the original flight. This was built by the Aerial Experiment Association 2005 Inc. based in Welland, ON, and flew on Jan 22, 2009 in Baddeck, NS, and I believe is still somewhere in Nova Scotia



The pair of outboard mounted triangular ailerons

- ◆ A half scale replica at the Warplane Heritage Museum in Hamilton, ON

## THE KIT and CONSTRUCTION

The only known kit of the Silver Dart is from Trillium Balsa in Delhi, ON. The kit is a very basic, balsa wood based model. The best thing about the kit is the full, 1/24 scale plans that are enclosed. I didn't use any of the materials in the kit, but used basswood strips and pine dowels for the wooden pieces and some styrene and metal for various other parts. Below are descriptions of various components of the plane and how it differed from the Trillium kit.

## WINGS

The wings were built pretty well according to the Trillium Balsa plans, but basswood was used instead of balsa wood. The fabric for the wings was made of the finest weave synthetic material that I could find in the local fabric store. This was cut into strips that covered a section spanning three spars of each wing, overlapping with the next section just at the spar. Tamiya Clear Acrylic was brushed over the top layer of the material. This gave it a bit of stiffness and allowed additional paint to be applied. Since the silk on the Silver Dart reportedly had a silver sheen to it, a light dusting of Alclad Aluminum was airbrushed on the fabric between the spars.



Photoetched front wheel and mounting details

## UNDERCARRIAGE

A photo etch set of wheels from Replicas and Miniatures was used. These were meant for an old AMT Sizzler drag car and the size matched almost perfectly for the Silver Dart. The front steering mounting was scratchbuilt using various styrene rod and sheet. The rear substructure was made of copper and steel wire. A number of Scale Hardware hex head bolts were used at the various mounting points.

To simulate the bamboo used for the main frame, 1/16" diameter pine dowels were used. The dowel was first painted with a combination light stain and varnish from a local hardware store. After drying, the various pieces were cut to length using the plans as a guide. Each piece was cut a bit short to



Front wheel steering mechanism and pilot's "footrest"

accommodate the connecting brackets. These brackets were cut from soft aluminum sheet and drilled, where necessary, to

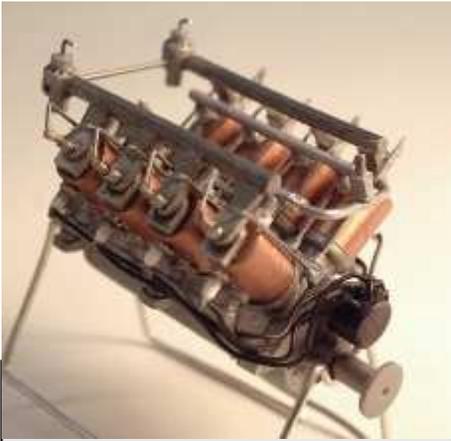


Pusher propeller made from laminated basswood

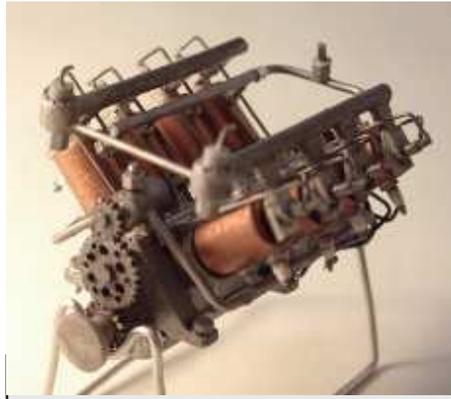


(Above and below) The engine block built up from styrene

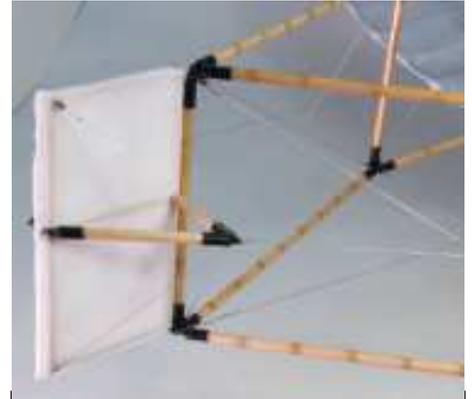




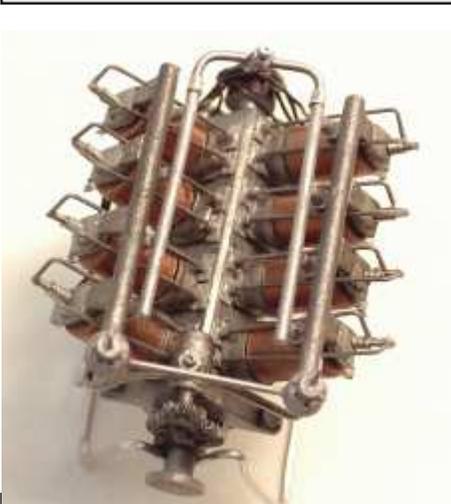
Rear of engine showing distributor and chain drive pulley for propeller



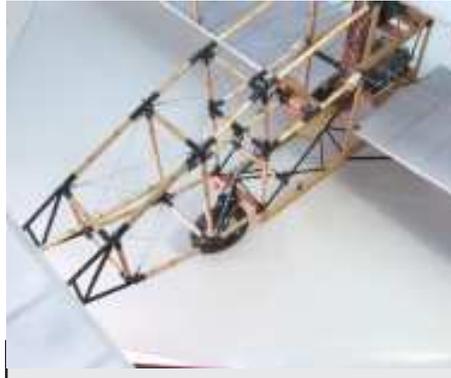
Front of engine with external gears for the camshaft



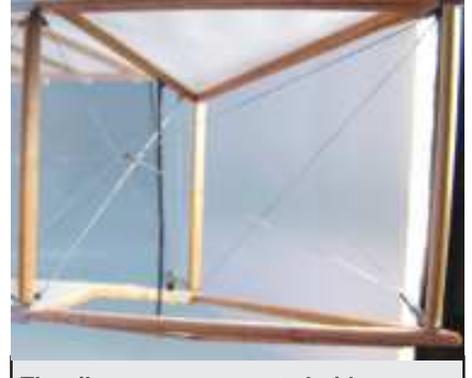
The rear of the plane with cable controlled rudder



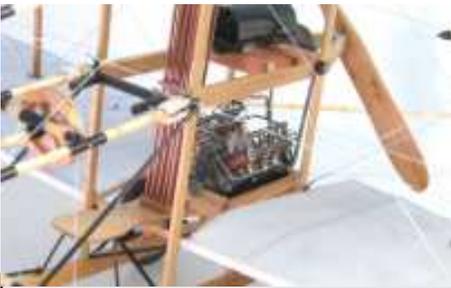
Top of engine with push rods, coolant lines and fuel system



A view of a very breezy open cockpit



The ailerons are connected with a vertical rod and controlled by cables



Vertical tube radiator mounted behind pilot's seat



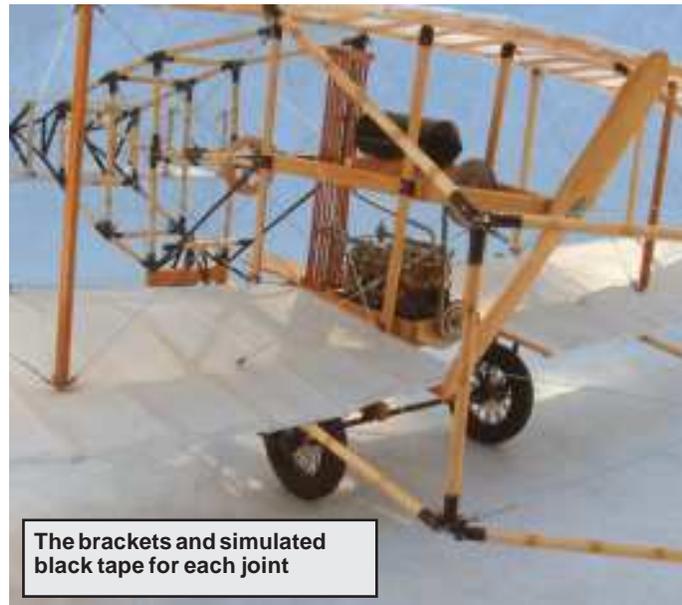
Combined gas and oil tank mounted above engine

accommodate the rigging. Each joint on the real plane was reinforced by wrapping with black adhesive tape. This was simulated by cutting 1 mm wide Tamiya masking tape, wrapping around the end of the dowel and then 'painting' with a black felt pen. A slot was cut using a razor saw just before assembling with the aluminum brackets. The cross pieces and a few other joints used craft wire stuck in the end of the dowel to serve as reinforcement and mounting mechanism.

To simulate the joints in the bamboo, it was first marked with a mechanical pencil. Tamiya rust weathering was then lightly applied to highlight the joint. The front two sections of the frame, to which front canard pivots, were made of styrene rod. This replicated the steel pieces on the real aircraft.

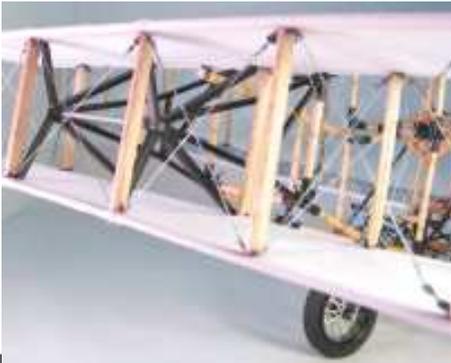
#### ENGINE & PROP

The engine was scratchbuilt by building up various shapes of styrene.



The brackets and simulated black tape for each joint

The lower crankcase came from a large diameter plastic clothes hanger, cut lengthwise. The top half of the crankcase was from a section of square tubing. The cylinders were turned on a lathe from thick diameter styrene reclaimed from some leftover sprue. The gears – the front drove the camshaft and water pump, and the rear, through a chain drive turned the propeller – were punched out of sheet styrene. The teeth were made using a Mission Model chisel edge, turned sideways and then cleaned up with a file. Spark plugs were



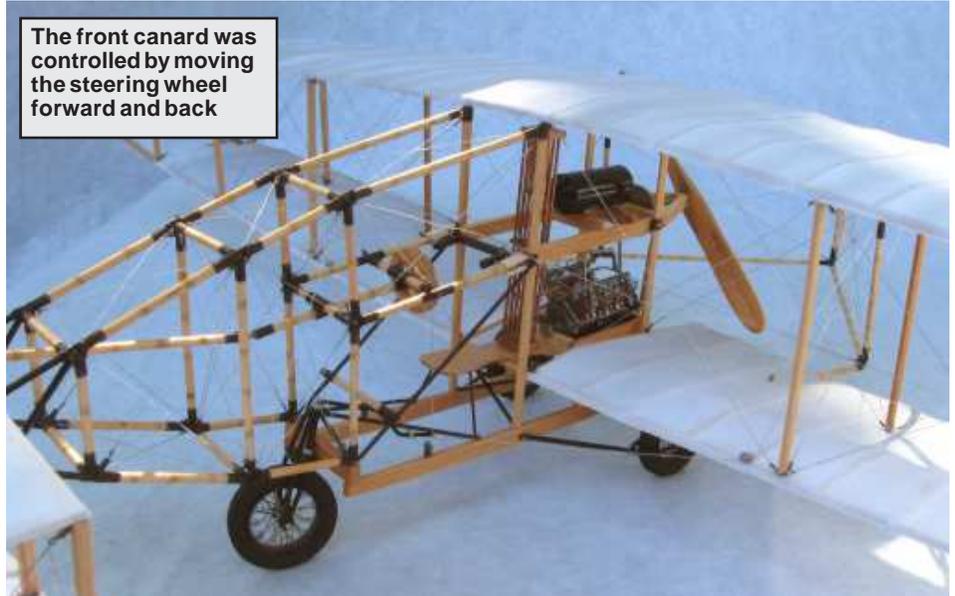
The front canard was mounted to a steel subframe so that it rotated up and down



Details of a lathe turned pulley for the rudder cable, some of the more than 140 scratchbuilt brackets

turned from hex rod and mounted on the outboard cylinder walls.

The pushrods and rocker arms were all exposed on the real engine and were simulated using craft wire bent to shape. Two different gauges of craft wire were wrapped around steel guitar string wire to replicate the valve springs. Various diameter styrene rod made up the intake pipes and two carburetors. The coolant piping was made of



The front canard was controlled by moving the steering wheel forward and back

styrene rod and small diameter soldering wire.

The radiator was made of styrene rod, with 2mm thick styrene sheet for the top and bottom reservoirs. To support the tubes, some styrene strip was added in a roughly u shaped reinforcement at two spots.

The chain drive for the propeller was made by cutting a thin strip of 0.5 mm (0.020") ribbed styrene sheet. This was then carefully bent around the two gears - although not carefully enough as it was broken in one place. The propeller was made by layering 1/32" sheet basswood, carving and sanding to shape and then varnishing.

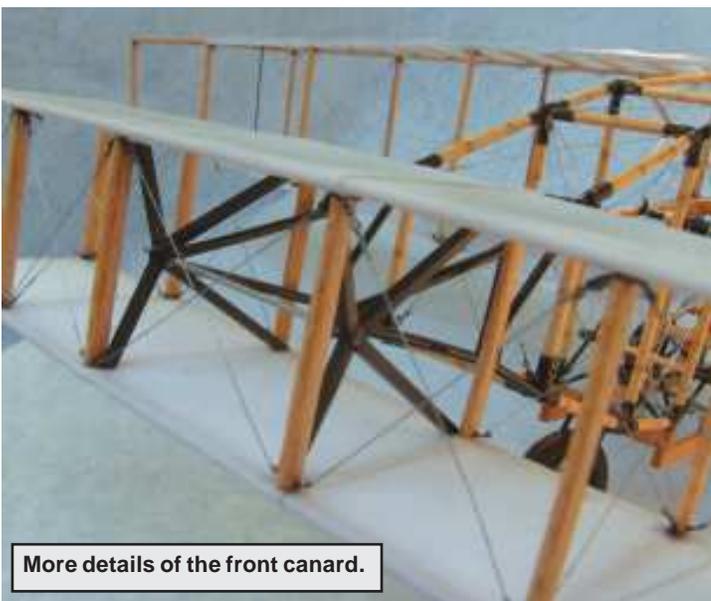
Since the engine case was a rough casting, it was brush painted with Mr. Surfacer 500 and was stippled with a stiff old brush as it was almost drying. Alclad aluminum was then sprayed on the rough surface. The cylinders were sprayed with Alclad copper. The propeller chain drive was Alclad steel and the

whole engine and drive chain received a light black wash.

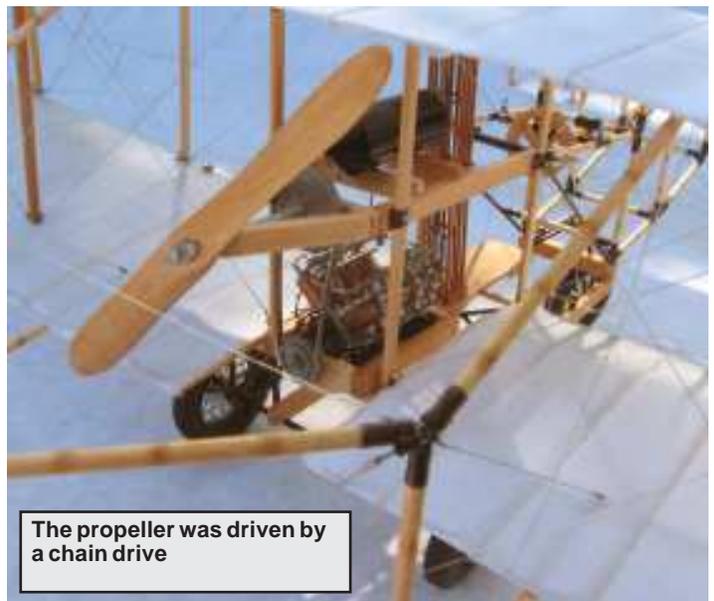
**ASSEMBLY and RIGGING**

Since the model was done on a fairly large scale, it was clear that the cable joints would be quite visible. The cables on the full size Silver Dart were solidly mounted at one end, whereas the other end went through an eyebolt. This eyebolt passed through a roughly U shaped bracket and had a nut threaded onto it. This allowed the tension in the cable to be adjusted. Both types of brackets for the model were made from pop can aluminum strips and holes were drilled to accept both a mounting pin and a craft wire eyebolt. At least three #80 drill bits were sacrificed in the construction of the roughly 140 brackets.

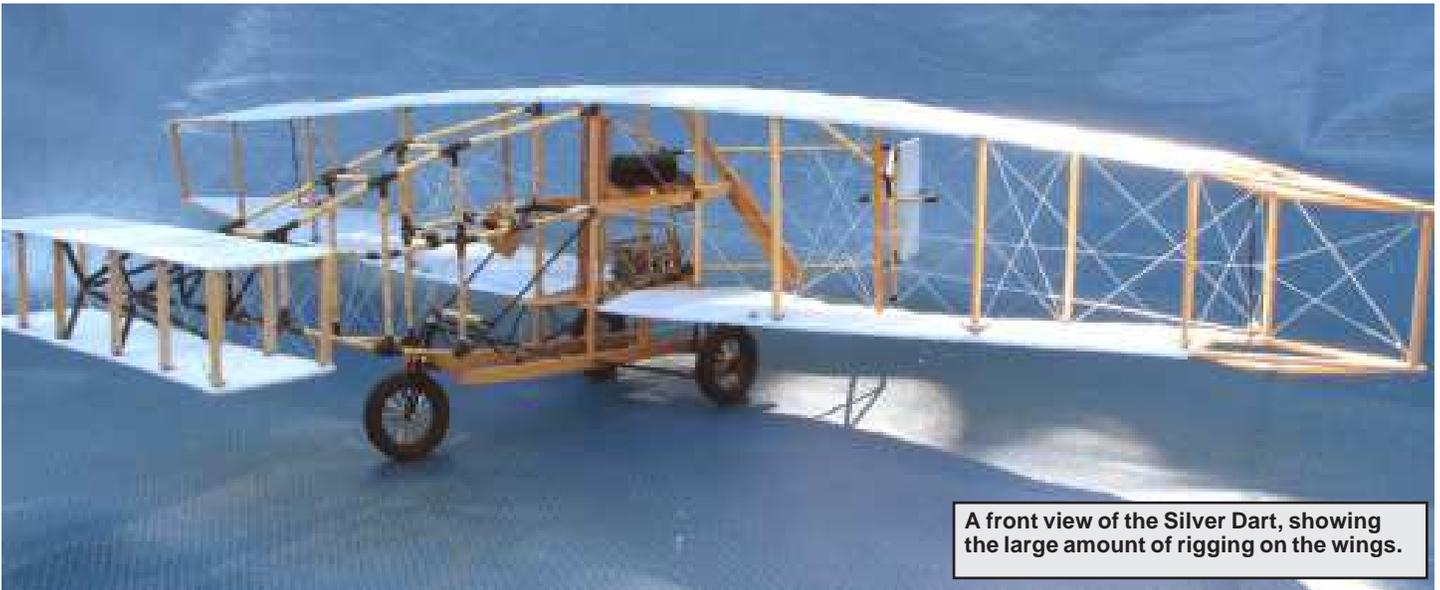
A number of different options were explored for the tensioning cable, from actual braided stainless steel beading wire, to various gauges of monofilament fishing line, to invisible thread. The final choice was a



More details of the front canard.



The propeller was driven by a chain drive



**A front view of the Silver Dart, showing the large amount of rigging on the wings.**

metallic thread from a fabric store. This thread did not fray as it was made of synthetic material and had a segmented structure to it so it looked a bit like wound cable. To get the steel look to the thread, it was run through a Tamiya silver painting marker.

The rigging assembly was the following sequence:

The thread was passed through the hole in the fixed end and tied in a knot

The other end was passed through the 'eye bolt', wrapped around a couple of times and then fixed with CA glue.

In order for the thread to dry taut, the free end was tightened by clamping with a small clothes pin or metal clamp and hung in a vertical position (not always easy), while the CA glue dried.

**NEXT TIME AROUND....**

I estimated that the construction took about 150 hours. If I was to make another Silver Dart, I would seriously consider spending the time and expense and contract with a company to make all the cable brackets and frame joint brackets using photo etched pieces. This would save a great deal of time in doing the rigging. It would also be possible to make photo etch rocker arms, gears and maybe even a drive chain.

I might also add more detail to the fabric on the wings. There were a number of sewn joints on the wings that would add to the detail of the wings and break up the plainness of the surfaces.

**REFERENCES**

There are a number of Internet web pages that have information and photos of the Silver Dart. Here are a few of them:

[www.flightofthesilverdart.ca/](http://www.flightofthesilverdart.ca/) - the website of the Silver Dart Centennial Association,

based in Baddeck, NS with historical information and a list of the events in 2009  
[www.silverdartreplica.com](http://www.silverdartreplica.com) – the website of Aerial Experiment Association 2005, the builders of the full scale replica that flew in Feb 2009 in Baddeck, NS.

[www.pc.gc.ca/lhn-nhs/ns/grahambell/index\\_e.asp](http://www.pc.gc.ca/lhn-nhs/ns/grahambell/index_e.asp) - the website of the Alexander Graham Bell Museum in Baddeck, NS  
[archives.cbc.ca/science\\_technology/aeronautics/clips/2424/](http://archives.cbc.ca/science_technology/aeronautics/clips/2424/) - a 1949 CBC radio broadcast interview with J.A.D McCurdy

[www.cbc.ca/canada/story/2009/02/22/silver-dart.html](http://www.cbc.ca/canada/story/2009/02/22/silver-dart.html) - CBC article on the 2009 flight of the Silver Dart replica

[www.aviation.technomuses.ca/collections/artifacts/aircraft/AEA\\_Silver\\_Dart/](http://www.aviation.technomuses.ca/collections/artifacts/aircraft/AEA_Silver_Dart/) - Canadian Aviation Museum web pages about the Silver Dart

[www.thesilverdart.com/](http://www.thesilverdart.com/) - a website with some videos about the recent replica flight, the Trillium Balsa kit and other Silver Dart information

[www.trilliumbalsa.com/](http://www.trilliumbalsa.com/) - Trillium Balsa website, makers of the balsa wood kit.

There were also two great articles published in the Winter 2009 edition of Airforce magazine (Vol. 32, No. 4)

An article about the history of the AEA and the Silver Dart

An article about the building of the 1959 replica built by members of the Canadian Air Force

The best references are the full scale and half scale replicas located at various museums listed in the introduction. Be aware that different replicas have interpreted the Silver Dart design slightly differently and that some have departed from the original design to add features necessary for airworthiness.

Some great photos are available for purchase from the Canadian Aviation Museum in Ottawa, ON; just ask for their curatorial department.

**Acknowledgements**

I want to thank all the folks at the Canadian Aviation Museum for their assistance in giving me access to the original Silver Dart engine. I also want to thank Donnie Macaulay of the Alexander Graham Bell Museum in Nova Scotia, who provided me with a contact in Baddeck, Nova Scotia. That contact, Gordon MacRae was invaluable in helping out with many of the technical details of the Silver Dart. He had built two static full scale replicas I mentioned at the beginning of this article.

**About the author**



Evan Jones is a mechanical engineer working in the building energy performance industry. He was born, raised and still lives in Guelph ON and

is a member of the Guelph Plastic Modellers Group. His primary model interests are motorcycles, cars and sci-fi, with the occasional forays into other subjects. He initiated and still helps organize an annual Model Motorcycle Display and Contest during the Motorcycle Supershow event each January at the International Centre in Toronto.

His website is [www.eajonesgue.com/scalemodels](http://www.eajonesgue.com/scalemodels).