The X-Planes

Flypast V. 49 No. 7

April Meeting

Topic: "The X-Planes"
Speakers: Mr. Hugh M. Neeson and Mr. Roy Lindberg, Niagara Aerospace Museum
Reporter: Greg Winson

Speaker: Mr. Hugh M. Neeson
Photo credit: Neil McGavock

Speaker: Mr. Roy Lindberg
Photo credit: Neil McGavock

CAHS Toronto Chapter members and guests were treated to a special presentation by our friends from the Niagara Aerospace Museum of Niagara Falls, New York. Making the journey north were Hugh M. Neeson and Roy Lindberg of the museum. Volunteer Bob Winson first introduced Mr. Hugh M. Neeson. Hugh is not a stranger to the CAHS Toronto Chapter. In May of 2012, Hugh, accompanied by Dr. Ilya Grinberg, spoke at the fourth annual Chapter Dinner about the return of the Bell P-39Q Airacobra to Buffalo from Russia. Hugh is the Development Director of the Niagara Aerospace Museum and a member of the Board of Trustees of the museum. He has been active with the museum since his retirement in 1999 from his industrial career. Hugh was employed by Bell Aircraft Corporation (Buffalo, NY) and its successors, Bell Aerospace – Textron and Lockheed – Martin from 1955 until his retirement. He held a variety of engineering and program management positions with the companies, including Vice – President of Electronic Systems. He has been a member and President of the Aero Club of Buffalo and the L.D. Bell Chapter of the Air Force Association. He also serves on the Board of the Buffalo Naval and Military Park. Hugh was educated at Canisius College (Buffalo), graduating with a B.S. in Physics and received an MBA at the State University of New York at Buffalo. Hugh resides with his wife, Marilyn, in Amherst, New York.

Mr. Roy Lindberg is a graduate Mechanical Engineer, BSME. He has worked as a volunteer for the Niagara Aerospace Museum for five years. He is a researcher and has written two documents for the museum; 1) In collaboration with Hugh Neeson, *Bell Aircraft / Aerospace Overview* and 2) *Lesser Known Aircraft and Manufacturing Companies of Western New York*.

Hugh opened the presentation with an update on the Bell P-39Q Airacobra "Miss Lend Lease" that was recovered from a lake beyond the arctic circle in Russia and returned to Western New York where it was built in late 1943. The P-39Q is now on display in the Niagara Aerospace Museum located in the old terminal building of the Niagara Falls International Airport. Restoration work is continuing on the aircraft. Hugh posed a question to the audience….how did the record setting X-1 airplane happen to come out of the Bell Aircraft Corporation of Buffalo, New York? How did two Bell aircraft, namely the X-1 and the XP-59A Airacomet end up in the centre hall of the Smithsonian Air and Space Museum in Washington, DC? The "X" designation was first used in earlier times and denotes "experimentation and/or research". The X is usually followed by something else…XE, XB, etc. Bell Aircraft's contribution to the aerospace industry was without peer. This was absolutely true for the first 25 years, 1934 to 1956. The original #1 X-1, 46 – 062 completed 78 glide and powered flights before being turned over to the Smithsonian on August 6, 1950. Hugh recalled the X-2 making the world's speed record of

approximately 2100 mph. The event made the front page of the New York Times. Unfortunately the record attempt ended in a crash and the test pilot died. Larry Bell, the founder and President of Bell and Bob Woods, his Chief Design Engineer, a very creative guy, developed a superb team. The Bell engineering group laid the groundwork for the long string of X-planes that followed. Since then, there have been some great X planes. The X-15 was probably considered the paramount purely X airplane. The XR-71 was not an X-plane but was a premiere plane. They both came out of North American Aviation in California as did the later Space Shuttle.

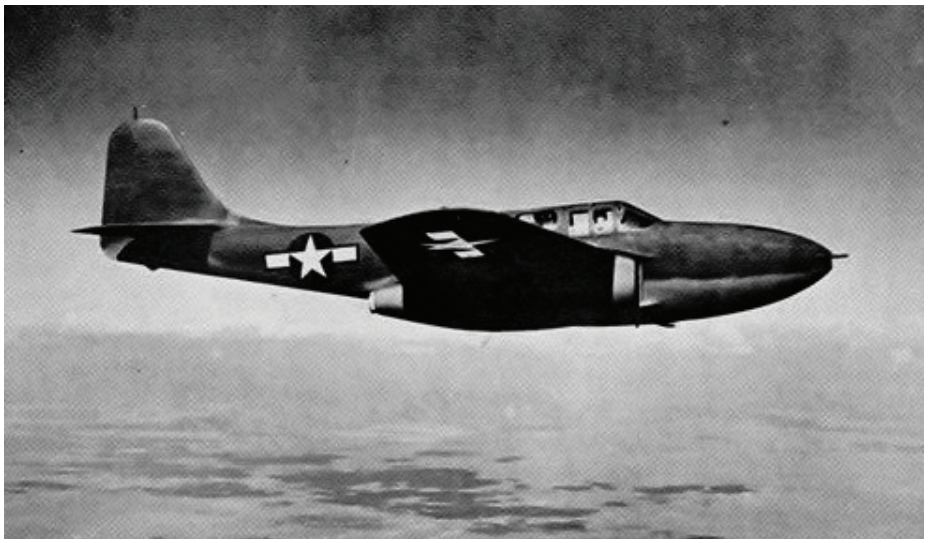
JN4 Jenny at the Glenn Curtiss Museum, Hammondsport NY
Photo credit: R. Winson

How did we gain an aviation industry in Western New York and part of Canada? It was due to Glenn Curtiss of Hammondsport, NY where he was running a bicycle shop and developing engines for motorcycles. In 1907 Curtiss set a world speed record of 136 mph on Ormond Beach, Florida, while riding the world's first V-8 powered motorcycle that he built in his shop. For this feat, Curtiss become known, "as the fastest man on earth". People tried to get Curtiss interested in building engines for the emerging new field of aviation. Curtiss was at first reluctant, but when the airplane became more prominent, he quickly formed the Curtiss Aeroplane Company. Curtiss caught the attention of Alexander Graham Bell, the famous inventor, who had just formed the Aerial Experiment Association which was financed by Bell's wife Mabel. Curtiss joined the group along with Canadians, F.W. "Casey" Baldwin, John A. McCurdy and US Army Lieutenant, Thomas Selfridge. The group proceeded to build and fly four experimental airplanes that increased in complexity and maneuverability with each model. Curtiss flew the second airplane, named the *White Wing*, as designed by Casey Baldwin with a Curtiss engine for over 1,000 feet in controlled fight. The amazing thing was that this was the first American aircraft to use ailerons for lateral control. The Wright brothers at this time still used "wing warping as a means of wing control". This innovation angered the Wrights and they subsequently began a long patent war with Curtiss. On July 4, 1908, Curtiss flew the third plane in the series, The June Bug, a distance of over one kilometer and captured the Scientific American Trophy. After the success of the final and fourth plane in the series, The Silver Dart, which ushered in aviation in Canada, the AEA disbanded and bequeathed its aircraft designs and patents to Curtiss.

A major event occurred in 1914 with the outbreak of the World War in Europe. The US government did not enter the war immediately, but did start building up its military aviation. The US found that it had a great shortage of training planes which were necessary to develop an air power force. Curtiss, the ever resourceful entrepreneur, hired a leading British aircraft designer, Benjamin D. Thomas, to design the very successful JN4 "Jenny" trainer. The Jenny trained virtually every allied pilot in WWI. Of the Jenny variants, over 6800 were built in the USA with an additional 1200 being built in Canada. Another major aircraft constructor in Western NY was the Consolidated Aircraft Corporation. It was started in Buffalo in 1924 by Major Reuben H. Fleet, a prominent WWI aviator and industrialist. Major Fleet was well aware of the capabilities in Buffalo. He brought his sales manager, Larry Bell to Buffalo and hired Bob Woods as an engineer. He formed and acquired a large number of aviation companies under the umbrella of Consolidated Aircraft. He also formed the Fleet Aircraft of Canada in Fort Erie

in 1930. A major aircraft development was the famous PBY "Catalina" flying boat conceived in Buffalo. But Fleet then moved Consolidated to San Diego in 1935, since a frozen Lake Erie in the winter was no place to test seaplanes! With the departure of Consolidated Larry Bell forms Bell Aircraft in 1935 and hires Bob Woods. With WWII underway, the aircraft companies of Western NY led by Bell and Curtiss-Wright constructed an amazing number of aircraft. In all 30,000 aircraft were built in Western New York in a five year period. An amazing figure to this day!

The Jet Age



Oct 2, 1942 First official flight of the Bell XP-59A, America's first jet
Photo Courtesy Niagara Aerospace Museum

In 1941, US General "Hap" Arnold went to Great Britain to meet with British authorities. Intelligence sources said that the Germans were building a jet plane. Frank Whittle, who had just developed a turbojet engine wanted the British government to also build a jet aircraft. Britain gave the United States the plans for the Whittle jet and the contract to build an American version of the engine was given to General Electric (GE). GE was chosen since they had experience in building turbines. "In those days you could make things happen". GE started to build the engine in May, 1941. General Eccles (one of Hap Arnold's aides) called Larry Bell in the middle of the night, "Hap wants you and two of your best engineers that can keep their mouths shut to come to Washington tomorrow". Larry Bell always went by train since he hated to fly! At the September 4, 1941 meeting Hap Arnold tells Bell to build planes to use the engines being built by GE - you'll have a contract next Friday. No competition. The government wanted the development done in complete secrecy. The big Bell plant in Wheatfield was too open – instead Bell took over a former Ford assembly plant on Main Street in Buffalo. Bell occupied the second floor. Within 13 months the prototype XP-59A Airacomet flew for the first time. The airplane was camouflaged with a plywood prop and the air intakes were covered up when it was being moved on the ground. Other pilots did see the airplanes flying and observers spotted planes flying without propellers. Test pilots responded by wearing a guerilla mask bought at a hobby shop and waving to onlookers. The engine that GE built and designated as J31 produced about 2000 pounds of thrust and two were required for the XP59A. The top speed of the XP59A was approximately 400 mph and the Air Force was not impressed that the jet aircraft was only marginally faster that the leading piston-powered fighter aircraft of the time. One jet was sent to the RAF in exchange for a Gloster Meteor fighter jet. The P59 was only used by the Air Force and Navy as a training aircraft and it never saw combat. The main benefit of the P59 was that it gave the Air Force experience with jet aircraft in preparation of receiving more advanced types. One P59 was designated to go to the Smithsonian in 1945. The US government requested Bell to build a jet escort fighter with more speed and range. Bell built two prototypes designated XP83 and based on the P59 which did met the specifications but were considered underpowered. The project was later scrapped as more advanced designs appeared.

Bell X-1B Front view Showing the duplication of the shape of a 50 cal. bullet
Photo Courtesy Bell

Post WWII

Toward the end of WWII, fighter planes were getting faster and were achieving near sonic speeds in dives. The effects of compressibility started to occur causing control reversals, instability and structural failures resulting in the loss of aircraft. The US Government conducted compressibility studies throughout 1944 using the resources of the NACA (National Advisory Committee for Aeronautics), the Air Force and the Navy. Wind tunnels of that period were of little research use at speeds between Mach .9 and 1.2. By the summer of 1944, Ezra Kotcher, an engineer working at Wright Field was authorized to find a contractor to begin development of Project MX-524, a rocket-propelled transonic research aircraft. Kotcher had great difficulty in finding a contractor willing to build only three research aircraft since every aviation company was booked solid with warplane orders. Finally in November of 1944, Bell Aircraft Corporation, design engineer, Robert Woods, stopped in to visit Kotcher at his Wright Field office. The ensuing conversation got around to the MX-524 project and by the end of the meeting Woods had committed Bell to building the transonic research aircraft. Woods had a keen personal interest in the science of transonic research and associated data, so he quickly assembled an engineering team to build the world's first manned supersonic aircraft. Turbojet propulsion was at first considered but was dropped, since the jet engines of the day were not capable of the speeds necessary "to break the sound barrier". So the aircraft, the XS-1 ("s" was for sonic, later dropped) was designed with four rocket barrel engines each capable of developing 1500 pounds of thrust for a total thrust of 6000 pounds. The US Navy was proceeding with tests of rocket assist from aircraft carriers at this time. The X-1s fuselage was designed after the shape of a 50 caliber bullet, since it was known that this shape was aerodynamically stable at supersonic speeds. The wings were thin, but straightforward in design. The whole structure was built strongly enough to absorb 18Gs of force.

The first X-1 Tail Number 46-062 rolled off the assembly lines at Bell's Wheatfield, NY plant on December 27, 1945. It was then flown to Pinecastle Field in Florida by a B-29 carrier aircraft. A series of glide and stability tests were carried out by Bell's premier test pilot, Jack Wollams, who unfortunately died later in the crash of a P-39. The X-1 testing was then moved to Muroc Air Force Base in California for the duration of the program. The decision to move to California was based on the remoteness of the site and the expansive landing areas provided by its dry lake beds. Another Bell test pilot, Chalmers "Slick" Goodlin was assigned to continue the test program. Goodlin conducted three glide tests on the second X-plane, Tail Number 46-063 until on December 9, 1946, he flew the first powered flight. Goodlin flew 20 powered flights and got close to the sound barrier (rumored to have broken it), but Bell never got in an argument….nothing official. The US Army formed a flight test group and wanted the best pilots and included Major Chuck Yeager in the pool of candidates. Rumours said that Goodlin wanted a life insurance policy of $150,000, but Bell told him that the air force with Chuck Yeager would take over the test flying. Goodlin went onto an illustrious career including helping Isreal form their forces. The X-1 was lowered into a pit, then the B-29 would taxi overhead and then the hook-up was started. Chuck Yeager started his test flights with a glide flight on August 7, 1947 in X-1 Tail Number 46-062 and continued through to his historic flight of Oct. 14, 1947 when he became the first person to exceed the speed of sound at a speed of Mach 1.06 or approximately 700 mph. Chuck Yeager flew the X-1s for 34 flights including one on January 5, 1949 that started on the ground under full

rocket power, lifted off after a run of 1200 feet and proceeded to climb at a steep angle until reaching 23,000 feet at a speed of Mach 1.1. This was all precipitated by Douglas Aircraft and the Navy who were building the Skyrocket D-558-2 running ads saying "the X-1 was not a true supersonic plane because it had to be drop-launched".

Oct 14, 1947 Bell X-1 becomes the first aircraft to break the sound barrier
Photo Courtesy Niagara Aerospace Museum

Joe Cannon, an American pilot who flew for the RCAF in WWII had a one glide flight in X-1 46-064, on July 20, 1951, which turned out to be the last and only "free flight". On the next flight of Number 46-064 on November 9, 1951 there was an onboard explosion and Joe Cannon was badly burned and the X-1 was a total loss. A major technological advance for the X-1, among many, was the use of an all-moving stabilizer in a transonic airplane. Originally they were ground-adjustable, but later Bell installed a positioning system so that the pilot could change the position of the stabilizer in flight. The third flight after the system was installed, the X-1 broke the sound barrier. It was not initially announced that the sound barrier had been broken. Everyone was sworn to secrecy about the stabilizer until Russian pilots flying for North Korea shot down some F-86s and then the secret was out. In an Atlanta plant, Bell built 636 B-29s, which had a higher priority than the a-bomb.

Bell went on to build many other X planes in a continuation of the original program. On April 2, 1948 Bell was awarded an Air Force contract to build the second generation of X-planes. The new generation X-plane under the terms of Project MX-984 were designed to investigate aeronautical properties above Mach 2 and above 90,000 feet, including aerodynamic heating, pilot actuated reaction controls and supersonic armament problems. The new aircraft were larger with increased capacity fuel tanks, canopy access (the older X-1s required the pilot to descend on a ladder from the mothership into the below zero slipstream and then slide into the right side hatch opening feet first while wearing a seat pack parachute!!), improved cockpit, a low pressure turbopump fuel system and improved maintenance access. Four aircraft were requested, but only three were built, X-1A, X-1B, and X-1D. As testing progressed in the mid 1950s, two accidents occurred that destroyed the X-1A and X-1D. However, in the time period before its destruction, Chuck Yeager on December 12, 1953 was able to take the X-1A to an altitude of 70,000 feet and a speed of Mach 2.4. However, disaster was looming and the X-1A rolled and tumbled out of control and Yeager descended 36,000 feet before he could regain control and recover from an inverted subsonic spin. This was a true testament to his superb airmanship. This sequence was simulated in the movie "Apollo 13" as flown by the late Art Scholl.

The Bell X-1B at the US Air Force Museum Dayton, Ohio
Photo Courtesy Ken I. Swartz

The X-1B did survive and is permanently displayed at the Air Force Museum at Dayton, Ohio. The last three fights of X-1B were flown with extended wingtips and the installation of a reaction control system powered by hydrogen-peroxide. This system would later be incorporated into space vehicles. A little known NACA pilot by the name of Neil Armstrong would fly the last four flights of the X-1B and have the honour of making the last landing ever in a second generation X-1 aircraft. A lesser known X-plane was the X-1E which was born out desperation following the previous X-plane losses. The #2 original X-1 46-063 was rebuilt with new extremely thin wings, redesigned canopy, cleaned up fuselage and it flew for 54 more successful missions. It is now the "Gate Guardian" at the Neil A. Armstrong Flight Research Centre in California.

Bell X-2 Model
Photo credit: Neil McGavock

On December 14, 1945, Bell Aircraft and the Air Force signed a contract calling for the development, construction and initial flight testing of two XS-2 swept wing supersonic research aircraft. The concept of a Mach 2 swept wing aircraft had always been active, but it was just not practical to fit swept wings to the X-1 series. This new aircraft would be designed to explore flight at speeds to Mach 3.5 and altitudes unattainable with the first and second generation of research aircraft. Aerodynamic heating at high Mach speeds was a prime interest area along with its effect on airframe structures. Research on swept wing design had been done since the early 1930s in Germany and it continued during WWII, both in Germany and the USA. Bell engineer, Paul Emmons was assigned the task of creating the basic aerodynamic layout of the X-2, including where the 40 degree swept wings would be placed on the fuselage. The aircraft was largely constructed with K-monel and stainless steel for strength and heat resistance as opposed to the X-1s which were built up with conventional aluminum. On May 12, 1953 X-2 Tail Number 46-675 was on a captive test flight from Niagara attached to the EB-50A carrier aircraft. The flight was to test and qualify the liquid oxygen top-off and jettisoning system. A mysterious explosion rocked the X-2 approximately 35 miles northeast of Rochester and the X-2 fell into Lake Ontario with the loss of Bell test pilot Jean Ziegler and EB-50A observer, Frank Wolko. The EB-50A also suffered major structural damage, but landed successfully back at its base.

The Bell X-5 at the Air Force Museum Dayton Ohio
Photo Courtesy Ken I. Swartz

Following the tragic loss of 46-675 and two personnel, Wright Field informed Bell that the contractor flight tests would have to be accelerated as the X-15 program was coming in late 1957 or early 1958. On August 15, 1954 the second X-2, 46-674 commenced its flight test program in California with its first glide flight. Landing problems persisted until Bell redesigned the main landing skid oleo strut. With Air Force pilot Iven Kincheloe at the controls on September 7, 1956 the X-2 set a world altitude record of 126,200 feet. This record would stand until the arrival of the North American X-15 four years later. The final flight of 46-674 took place on September 27, 1956 with Air Force Capt. Milburn Apt at the controls. Bell had warned the Air Force that the interactions of the controls on a swept winged aircraft were not fully understood, "take it up, and for God's sake don't turn". However, the Air Force put no restrictions on Apt and in fact encouraged him "to go at it". The reason for this was that the Air Force had to give up the aircraft to NACA shortly and were determined to make the most of the remaining time. Apt reached 72,000 feet after launch and then he nosed the aircraft down to 66,000 feet at which time a speed of Mach 3.196 or 2,094 mph was attained for an unofficial world record. However, he was nervous that he was too far away from base and he radioed that he was returning to base. For unexplained reasons the aircraft entered a steep left bank with a nose down attitude. Apt corrected to the right but the roll to the left continued and the X-2 went into a violent aerodynamic phenomenon known as "inertia coupling". Apt got banged around the cockpit indicating that he may not have been fully strapped in. The X-2 was equipped with a jettisonable escape capsule and Apt fired the explosion charges and the capsule separated from the aircraft. He remained in the capsule as it descended under a parachute, making no attempt to parachute free. It struck the ground and he did not survive the impact. The loss of the final X-2 effectively closed the program, but the X-2 did pave the way for future high performance aircraft and the development of crew escape capsules.

On July 26, 1949, Bell signed a contract for the construction of two variable sweep wing aircraft to be known as the X-5. The aircraft would be designed after the layout of the wartime captured German Messerschmitt P.1101. The X-5 would be constructed with positive full time controlled variable sweep wings with a range of 20 degrees to 60 degrees sweepback. An Allison turbojet of 4,900 pounds thrust was installed as the powerplant. An extensive flight test program was carried out by NACA and no great surprises were found. The #2 X-5 was, however, lost in a flight test accident. The Air Force eventually lost interest in the X-5 project and the X-5 program was terminated in 1955. The surviving #1 X-5 is now on display in the Air Force Museum at Dayton, Ohio. Another significant project for Bell Textron was the X-22, a ducted fan V/STOL research aircraft, development of which began in 1962. The X-22 flew for many years and performed well in all landing and take-off modes. Research from this aircraft was applied to the military V-22 Osprey VTOL aircraft. Bell Canada has just celebrated its 25th anniversary and now makes all commercial helicopters for Bell Textron. At the conclusion of the meeting, Chapter volunteer, Bob Winson, presented the speakers with personal gifts in appreciation for an excellent presentation. A donation to the Niagara Aerospace Museum was also presented on behalf of the Chapter members.

The X-22 VSTOL Research Aircraft
Photo credit: Bell Textron

***

Reference: Jay Miller, The X-Planes X-1 to X-29

Other X-Planes Developed By Bell Aircraft

The Bell XV-3 at the US Air Force Museum Dayton Ohio
Photo Courtesy Ken I. Swartz

The Bell X-14A VSTOL Research Aircraft
Photo Courtesy Niagara Aerospace Museum

Replica of the Bell X-1 at the Calspan Corp. Flight Centre Niagara Falls NY Airport
Photo Courtesy: Kenneth I. Swartz

CAHS Toronto Chapter Executive 2014-2015

President & Membership Secretary: **Sheldon Benner**

1st Vice-President: **Dr. George Topple**

2nd Vice-President, Secretary, & Archivist, Historian: **Neil McGavock**

Treasurer: **Brigadier – General Paul A. Hayes** OMM, CD (Ret'd)

Directors: **John Bertram**

Flypast Reporter: **Gord McNulty**

Flypast Graphics, Editing & Email Services: **Lisa Ruck**

Flypast Printing & Mail Distribution:
Minuteman Press – minutemanpress@on.aibn.com

Volunteers: **Bob Winson** – Website Support
Ken Churm – Liaison
Scott Maclagan

Contacts

President: cahsnatmem67@sympatico.ca
Tel: (416) 923-3414

Websites: www.cahs.ca/chapters/toronto
www.torontoaviationhistory.com

Mailing Address: Canadian Aviation Historical Society,
Toronto Chapter
65 Sussex Avenue
Toronto, Ontario
M5S 1J8