

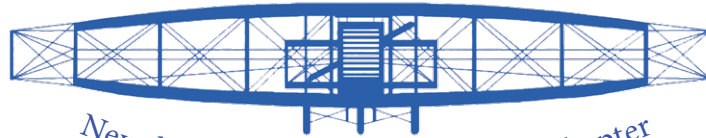
CONTACT INFO

President,
CAHS Toronto
65 Sussex Avenue
Toronto, Ontario
M5S 1J8

+1 416-923-3414

cahsnatmem67@
sympatico.ca

Flypast



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MARCH ZOOM MEETING REPORT Cold War Spyplanes, Part II - The Lockheed Blackbirds Martin Keenan

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Lockheed A-12 serial
60-6932 in flight.
Photo USAF.

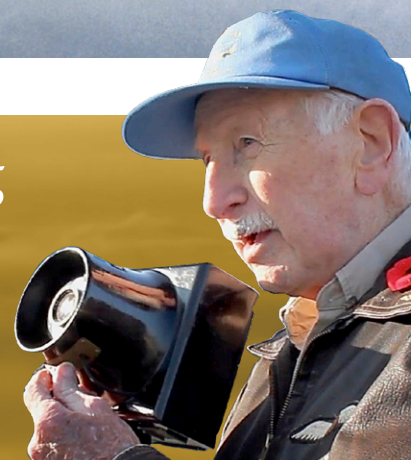
CAHS Toronto Chapter ZOOM Meeting

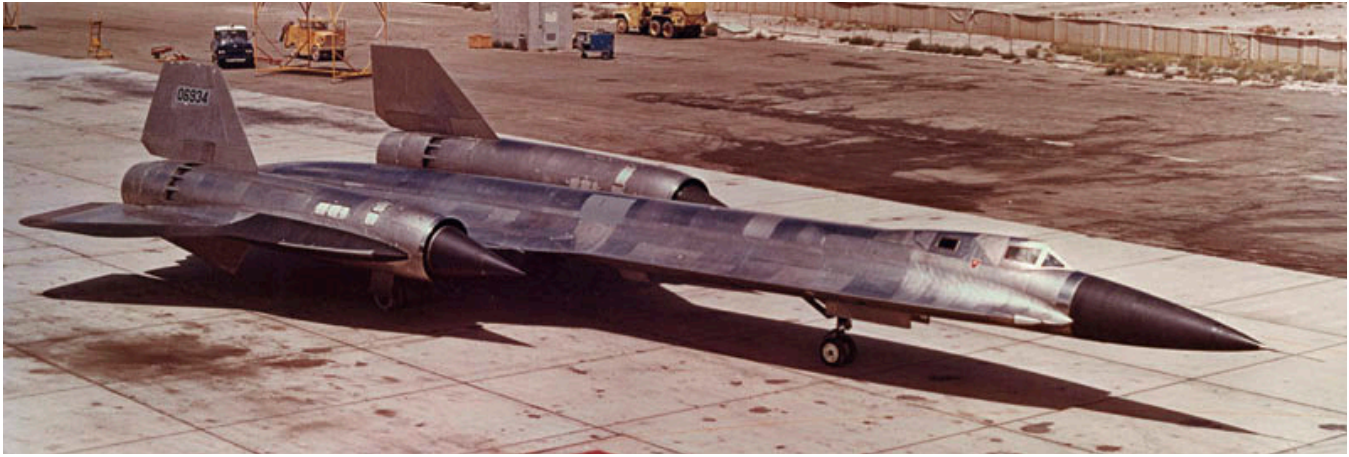
April 8, 2021 – 7:30 PM EDT

“Lou Wise: Canada’s Pilotographer”

Presented by John Bertram

Non-members can receive an invitation to join this meeting by sending their Name and Email address to cahstorsvp@gmail.com.





Lockheed YF-12A, 60-6934, in natural titanium at Groom Lake, Nevada. Photo CIA.

Cold War Spyplanes, Part II - The Lockheed Blackbirds

CAHS Toronto Chapter Meeting March 11, 2021
Presentation by Martin Keenan, Historian
Report by Gord McNulty

Martin Keenan has presented to the Toronto Chapter probably more often than anyone. The Burlington resident, a Chapter member since 2003, has made eight well-researched presentations. His latest talk, a sequel to his discussion about Cold War overflights of the Soviet Union and the Lockheed U-2 spy plane in March of 2020 (see *Flypast* Volume 54 Number 6), was a tour de force.

About 40 members and guests of the Chapter and National CAHS attended the Zoom presentation. Chapter 1st Vice President John Bertram introduced Martin, currently a product Specialist for Petro-Canada Lubricants in Mississauga. Martin's interest in aviation was sparked by a visit to the Canadian Warplane Heritage Air Show at Hamilton in 1975. His articles and photographs have been published in numerous periodicals and websites. He has a particular expertise in the record-setting jets and rocket-powered research aircraft of the Cold War.

Martin welcomed a special guest who joined us via Zoom from California. Chris Fyelling, 92, a retired engineer from the Lockheed "Skunk Works," worked on the Blackbirds A-12, YF-12, SR-71, and F-117A Nighthawk, as well

as the L-1011 TriStar. His particular specialty was the engineering of composite components.

Martin began by summarizing the Central Intelligence Agency's development of the U-2 to enable aerial photography of the interior of the USSR, as covered in *Flypast* Vol. 54 No. 6. A higher performance successor to the U-2 was already under way by the time CIA pilot Francis Powers was shot down on May 1, 1960. Clarence "Kelly" Johnson, head of Lockheed's Skunk Works, and the CIA felt "there should be one more round before satellites would make aircraft obsolete for covert reconnaissance."

A CIA team studying possible U-2 successors was concerned Johnson's designs would focus too much on aerodynamic performance and not enough on stealth. Johnson was bold, envisioning an aircraft to rule the skies for a decade or more. Subsequent studies, designated Archangel, aimed for a cruising speed of Mach 3, at an altitude of 90,000 feet. Such speed had been reached only once by the Bell X-2 in 1956. The X-2 crashed immediately afterward. Mach 3 wasn't attained by another aircraft until the North American X-15 in 1960.

Various designs, code named Archangel, began with Archangel I, using the same engine used in the final aircraft. Archangel II [Photo 4 – Page 3] and III had combinations of a ramjet engine for high-speed portions of the flight and turbojets for getting the ramjet up to speed and for landing. These high-performance aircraft designs



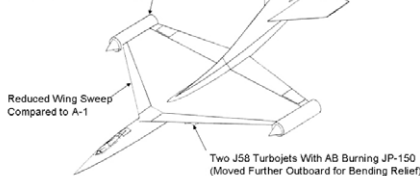
Lockheed U-2C in flight. Photo CIA.

Length: 129.17 ft
Span: 76.68 ft
Height: 27.92 ft

Zero Fuel Weight: 54,000 lbs
Fuel Weight: 81,000 lbs
Takeoff Gross: 135,000 lbs

Cruise Mach: 3.2
Cruise Alt: 94 - 105 kft
Radius: 2,000 NM

75" Dia Ramjets Burning HEP
(Lit @ Mach 0.95, 36,000 ft)



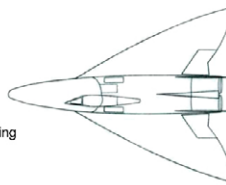
Archangel 2, Sep 1958.

were criticized for not focusing enough on stealth, specifically their radar cross-section or RCS. Convair proposed an even more exotic concept, the FISH, or "First Invisible Super Hustler." It would have used the proposed Convair B-58B, to carry the FISH to a launching altitude of above 35,000 feet, at Mach 2.2 twin ramjet engines would propel it to a maximum of Mach 4.2. The FISH involved multiple uncertainties and was doomed when the USAF cancelled the B-58B in 1959.

Cruise Mach Number: 4.2
Cruise Altitude: 90,000 ft
Range: 3,900 NM
Span: 37.0 ft
Length: 48.5 ft
Height: 9.8 ft

Propulsion:
• Two "Pop-out" Turbojets for Landing
• Two Ramjets for Cruise

Launched From B-58 at Mach 2.2
Above 35,000 Ft



Convair Fish, 1958-59.

the fuselage were smoothly integrated in the A-12, with chines along the side of the fuselage to reduce reflectivity. Other steps included canting the vertical stabilizers inwards, to reduce the radar reflection that would have been produced by a 90-degree angle.

The new design, 22 per cent heavier in weight, was known as the Archangel 12 or A-12.

In August 1959, the A-12 was chosen over the Kingfish. The super-secret project was named, of all things, "Project Oxcart." Tests showed the A-12 would be effective in reducing the RCS, though fine adjustments were needed.

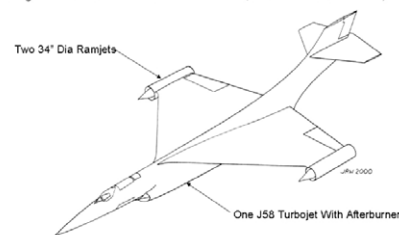
Lockheed and the CIA contracted on Feb. 11, 1960, for 12 A-12 aircraft. Less than three months later, "Oxcart" was shaken by the downing of Francis Powers' U-2 over Sverdlovsk (now Yekaterinburg) in Western Siberia on a flight from Peshawar, Pakistan. President

Eisenhower pledged to end overflights over the USSR. Oxcart was almost cancelled, but Eisenhower continued the program with lower priority for use as a reconnaissance aircraft in wartime. The A-12 quickly passed the B-70 in all phases of hardware development, but choosing the material to produce the Mach 3 A-12 was a concern. Aluminum alloys were ruled out. Stainless

Length: 93.75 ft
Span: 47.5 ft
Height: 22.85 ft

Zero Fuel Weight: 27,200 lbs
Fuel Weight: 43,700 lbs
Takeoff Gross: 70,900 lbs

Cruise Mach: 3.2
Cruise Alt: 91.5kft
Radius: 1,637 NM



Archangel A-7-3, Jan 1959.

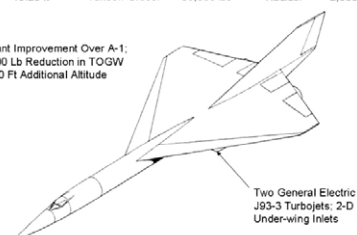
Lockheed evolved its designs with Archangels 4 through 11, trying to combine high performance with reduced RCS. Two similar designs, Archangels 10 and 11, again were optimized again for performance rather than stealth. The A-10 was powered by two GE J-93 turbojets, as used in North American's B-70 bomber and proposed F-108. The A-11 had two P&W J-58 turbojets. Meanwhile, Convair evolved its FISH design into the Kingfish, which could take off under its own power and also featured two J-58s. Lockheed tried to incorporate stealth into the A-11 design. A major issue with the U-2 had been reflections from the engine inlets and exhaust. The inlet issue was addressed in

Length: 109.5 ft
Span: 46.0 ft
Height: 19.25 ft

Zero Fuel Weight: 33,300 lbs
Fuel Weight: 52,700 lbs
Takeoff Gross: 86,000 lbs

Cruise Mach: 3.2
Cruise Alt: 90.5 kft
Radius: 2,000 NM

Significant Improvement Over A-1:
• 18,000 Lb Reduction in TOGW
• 2,500 Ft Additional Altitude



Archangel 10, Feb 1959.

steel honeycomb and titanium were the remaining options. Lockheed had not worked with stainless steel honeycomb and no one had ever built a production aircraft out of titanium. The USSR was the major supplier of the titanium.

Despite this, the weight advantages of titanium were compelling and the A-12 was built out of titanium. The purchase was arranged through dummy corporations and third parties. New techniques were devised for machining and drilling titanium, a very finicky material. In the end, 93 per cent of the A-12 structure was built out of titanium. High operating temperatures anticipated for the A-12 meant that conventional fuels and materials were inappropriate and couldn't be purchased off-the-shelf. Significant production delays and cost overruns occurred.

Major issues with the J-58 engine delayed the first flight originally set for May 1961. The first A-12s were fitted with smaller P&W J-75 engines for the initial flights. The A-12 couldn't be flown from Burbank, because of runway length and security issues. In February, 1962, the fuselage of the first A-12 was packed into a large box and

Length: 116.67 ft
Span: 56.67 ft
Height: 21.03 ft

Zero Fuel Weight: 36,800 lbs
Fuel Weight: 55,330 lbs
Takeoff Gross: 92,130 lbs

Cruise Mach: 3.2
Cruise Alt: 93.5 kft
Radius: 2,000 NM

Originally Designed to Carry
31,000 Lbs of HEP and 17,000
Lbs of JP-150

Key Operational Concept: Single
Base • Air Refueling (13,340 NM
Range With 2 Air Refuelings/8
Hour Total Mission Time)



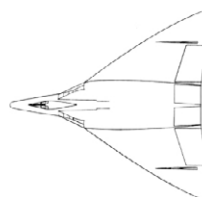
Archangel 11, Mar 1959.

the A-12 by using the conical inlet spike to shield the front of the engine, so it wasn't reflecting radar. The wing and

Cruise Mach: 3.2
Cruise Altitude: 85 - 94 kft
Total Range: 3,400 NM

Powerplants: Two J58 w/AB

Length: 73.6 ft
Span: 60.0 ft
Height: 18.3 ft



Convair Kingfish, Jul 1959.

moved by road to Groom Lake, Nevada.

Lockheed's progress reflected ongoing development

of high-performance interceptors by the USAF, which had issued a requirement for a long-range Mach 3 interceptor in 1955. The XF-108 won the program, with a Mach 3 speed, operating altitude of 70,000 feet and an action radius of 1,000 miles. A new fire control system and missiles were featured. But priorities conflicted and the North American XF-108 Rapier was cancelled in 1959.



YF-12A, 60-0935 in flight. Photo USAF.

The USAF continued to develop an F-108 fire control and missile system while Lockheed built its A-12. An interceptor version of the A-12 was formalized in October 1960. Lockheed suggested a force of about 100 of what they called the AF-12 could defend all of North America against Soviet bombers. The AF-12 was a modified A-12, with a raised pilot cockpit for better visibility, a second seat for a weapons system officer, and also the chines cut back at the front fuselage to fit a powerful radar. The reduced size of the chines affected the stability of the aircraft, so fins were placed under the engine nacelles and the fuselage. The USAF ordered three AF-12s and arranged with the CIA to allow the seventh, eighth and ninth A-12s to be converted to AF-12s.

Armament for the AF-12 would be the Hughes GAR-9 missile, later re-designated the AIM-47 Falcon. The AIM-47 was originally intended to carry either high explosive or nuclear warheads, but only the high explosive version was developed. Three missiles in bays were proposed for the AF-12. They would have been ejected explosively, to ensure they cleared the aircraft before the solid-propellant rocket engine ignited. The 1962 tri-service designation system reclassified the AF-12 as the F-12. Three A-12 prototypes were classified as YF-12As.

The P&W J-58 engine featured tubes that ducted air from the compressor to the afterburner. At high speeds, the engine acted rather like a ramjet afterburner. The goal was to stealth the rear of the engine with plasma stealth. A fuel additive would obscure radar reflections from the back of the aircraft. Design of the engine inlets was complex, in order to reduce radar reflectivity and to slow the airflow through the engine from supersonic to subsonic speeds, the inlet spike had to be able to move horizontally. It would actually move back 26 inches as the aircraft increased in speed, to keep the shock wave in proper position. The inlets

generated almost two-thirds of the thrust. However, if they weren't in the right position, the engine would choke and lose thrust in alarming fashion, known as an unstart – most commonly during acceleration from Mach 2.5 to Mach 2.9. The A-12 propulsion system was developed by Ben Rich, who succeeded Johnson. The A-12 had an equipment bay known as the Q-bay, behind the pilot. It housed any cameras or intelligence-gathering equipment.

The A-12 with the J-75 engine was first flown briefly by Lockheed test pilot Lou Schalk on Apr. 25, 1960. He encountered instability, but set it down, unscathed, on a lakebed beyond the runway. The oscillations were traced to “improper hookup of some navigation controls.” The first official flight was made on April 30. Schalk made the first supersonic flight on May 4, 1962. By November 1962, Mach 2.2 at 60,000 feet had been achieved, with the J-75. The first flight with two J-58s was made in January 1963. By the end of January 1963, all of the A-12s had J-58s except for a two-seat trainer, the “Titanium Goose,” which always had J-75s.

Mach 3 was achieved briefly in July 1963. By January 1965, it was possible to fly for an hour and 45 minutes, mostly at Mach 3. An altitude of 90,000 feet was reached in August 1965. Three non-fatal A-12 crashes occurred during this period. Engine unstarts were problematic. Eventually, a system was developed to react to engine unstarts by immediately throttling back the other engine to prevent such a dramatic yaw and then automatically restarting the stalled engine. This reduced, but didn't eliminate, engine unstarts.

The CIA began cloak-and-dagger recruiting of A-12 pilots in 1961. It sought pilots with at least 2,000 flight hours --- including 1,000 hours in high performance jets. They had to be under six feet tall, and under 175 pounds, to fit in the cramped cockpit. Eventually 11 USAF pilots were chosen. Officially, they had left the air force and became civilian consultants.

In October 1962, U-2 overflights detected and monitored an attempt by the USSR to install ballistic missiles in Cuba. One U-2 was shot down over Cuba by a surface-to-air missile, killing Major Rudolf Anderson, underlining the vulnerability of the U-2. During the crisis, highly secret tests were conducted against Soviet radar installations that featured the latest radar. Tests indicated the A-12 would likely be detectable by these radars.

The CIA and the USAF nonetheless began to consider overflights, with particular interest in monitoring China's nuclear program. Johnson developed a drone aircraft, using the innovations developed for the A-12. The Q-12, a Mach 3.5 drone, used a version of the ramjet used in the Bomarc. The Q-12 version of the engine would be redesigned, upgraded, and carry a camera and navigate with an inertial guidance system. It would be capable of flying a 3,000-mile preprogrammed sequence, after which the camera would be released, descend under a parachute and the



Lockheed D-21 Drone. Photo National Museum of the USAF.

Q-12 would self-destruct.

The ramjet engine on the Q-12 needed a high-speed launcher, so the A-12 was modified to carry a drone on its back. The Q-bay was replaced with a second seat for a launch control officer. The project was formalized in late 1963, with the drone designated D-21 and the carrier aircraft M-21. Two A-12s were modified on the production line, with a hard point on the upper fuselage to mount the D-21.

Information about the A-12 began to leak, with speculation that Lockheed was producing a super U-2. Commercial pilots sighted A-12 test flights. The program was becoming very expensive and the secret expenses were getting hard to hide. It was publicly announced that Lockheed was working on a high-speed interceptor, as the YF-12 was now flying. They misleadingly described it as an A-11 at Johnson's suggestion, to conceal development of the A-12. On Feb. 24, 1964, President Lyndon Johnson announced the new A-11 with a performance "far exceeding any other aircraft in the world." The media weren't fooled by the description of the A-11 as an interceptor and immediately speculated it was some type of U-2 successor.

Testing of the three YF-12s was relatively smooth. In the first attempt to release a missile from a YF-12 in April 1964, the missile left the aircraft. But it assumed the wrong attitude and had it been live it would have flown right into the YF-12. A live missile launch was made in March 1965, successfully hitting a drone 38 miles away. Twelve live missile firings were made, including one where a YF-12 flying at 75,000 feet and Mach 3.2 hit a drone B-47 53 miles away.

The performance of the YF-12 was then shown officially. On May 1, 1965, the first and third YF-12s set records for sustained altitude at 80,258 feet and several world records over various course lengths and payloads. Air Defense Command believed 96 operational F-12B aircraft could replace the entire interceptor fleet, with 48 aircraft on each coast. But the expensive program was further hindered by the rising costs of the Vietnam war. The F-12 program ended on January 1968. The two surviving aircraft were put in storage.

As for the A-12, the original idea of USSR overflights

had become a political non-starter and the USSR had threatened to shoot down any Cuba overflights. Operation Skylark had proposed using A-12s to monitor Cuba. In the end, however, U-2s continued making overflights in Cuba and A-12s were never required. Emphasis shifted to collecting intelligence about China, and development began on facilities to accommodate the A-12 in Okinawa by the end of 1965 in the "Black Shield" program.

The A-12 was deemed operational in November 1965. By then, Vietnam was considered a possible Black Shield target. In January 1966, the A-12 was readied for deployment in Okinawa. Five proposed missions were rejected for diplomatic and security reasons. The logjam was broken by concern about possible surface-to-surface missile deployment in North Vietnam. The A-12's camera was superior to the U-2 or to drones, and far less vulnerable. By May 31, 1967, the aircraft were ready to fly their first mission and they subsequently flew 29 missions over North Vietnam, Cambodia, Laos and North Korea. Normally the aircraft were painted all black, except for fake tail numbers changed after every mission. By the end of 1967, they had mapped all of North Vietnam and didn't find any surface-to-surface missiles there. The missions also provided intelligence for American bombing operations.

It's not clear if the plasma stealth additive was ever deployed. There were concerns whether KC-135 tankers that would refuel the A-12s would be able to safely operate on the treated fuel if they needed to use it in an emergency. On three occasions during Black Shield, North Vietnamese missiles fired on A-12s and once, a missile exploded close enough that debris was found on the lower right wing.

On Jan. 23, 1968 North Korea seized the intelligence ship USS Pueblo. An A-12 located the vessel in a North Korean port and determined the North Korean military wasn't mobilizing. Two subsequent A-12 flights took place over North Korea. The last, on May 6, 1968, was the final operational A-12 flight. Black Shield was closed. The A-12s were returned to the U.S. and mothballed.

The CIA and USAF had never agreed on the CIA's aerial reconnaissance, as the air force felt it should be responsible. They wanted their own reconnaissance 'black birds,' which led to the best-known of the Blackbirds, the SR-71. The A-12 had better high-altitude performance and a better camera, while the SR-71 offered a second crew member to operate the intelligence equipment and could carry more sensors on a single mission. Budgetary pressures ended the CIA's A-12 fleet.

The first flight of a M-21 aircraft carrying a D-21 drone took place in December 1964. It was challenging to get the combined aircraft through the sound barrier. A descent from 40,000 feet at Mach 0.9 was developed. Flight and engine tests and high-speed evaluations continued through 1965 and into 1966. On March 5, 1966, the D-21 was successfully launched from an M-21. Three successful launch-

es were made, with the M-21 pushing over in a descent to assist the D-21 in getting clear of the launch aircraft. Unfortunately, on the fourth launch in July 1966, done from level flight, the D-21 engine unstarted and the drone fell back on the M-21. Both crew members safely ejected from the M-21, but the launch control officer drowned after parachuting into the sea. That ended the M-21 program.

A safer alternative involved launching from a B-52. The modified D-21 was known as a D-21B. Two B-52H models were modified as launch aircraft. As the B-52 was subsonic, a rocket booster was put on the D-21 to boost the D-21 to a speed where its ramjet would start. The D-21's engine would start at 74,000 feet and the booster jettisoned at 80,000 feet. At this point, the D-21 would start taking photos and ultimately reach 95,000 feet. The engine would be commanded to shut down and the D-21 would descend. The camera would be ejected at 65,000 feet and descend under a parachute to be recovered mid-air by a C-130 while the D-21 would be destroyed by an explosive charge. If the C-130 couldn't catch the camera, the navy would recover the camera from the sea.

Twelve development flights were made in 1967 through 1969. The D-21 was finally declared operational in July 1969. The first operational flight in November 1969 targeted a Chinese nuclear test range, but the navigational system evidently failed and the D-21 was lost over the USSR. Another mission was flown over China in December 1970, but parachute issues caused the camera to be lost at sea. A third mission again had parachute issues. A fourth attempt was made in March 1971, but the D-21 crashed in China.

After these losses, with improved satellite photo reconnaissance and better relations with China, operations over China were cancelled in July 1971. The remaining D-21 drones were stored at Davis-Monthan AFB in 1977, where their existence became widely known. Eleven are now displayed at various U.S. locations. The wreck of the first



D-21B drone attached to B-52H launch aircraft. Photo National Museum of the USAF.

operational D-21B was recovered by the USSR. The CIA eventually recovered a metal panel and gave it to Ben Rich, by then head of the Skunk Works. The Chinese recovered one D-21 that crashed. It's displayed at an aviation museum near Beijing.

With the end of Black Shield, the remaining A-12s and surviving M-21 were stored at Palmdale, CA. In the late 1980s, the A-12s were sent to museums. The M-21, with its matching D-21, is displayed at the Museum of Flight in Seattle. The eight surviving A-12s are displayed throughout the U.S. As for the YF-12, the missile and radar system evolved into the ones used in the F-14 Tomcat. In 1969, two surviving YF-12s were loaned to NASA for joint NASA-USAF research. One was lost in a crash in 1971. The second flew with NASA until 1979. The last surviving YF-12 was sent to the National USAF Museum at Dayton in 1979.

Martin felt the SR-71 deserves a presentation of its own, which he plans for next year. Stay tuned! Martin

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UPCOMING CAHS ZOOM MEETINGS

April 8, May 13. Chapter members will receive Zoom meeting access passwords by email. Non-members must contact cahstorsvp@gmail.com to be added to the meeting notification list.

DONATIONS

Tax receipts for the year 2021 will be issued by CAHS National for donations of \$25.00 or greater. No 2021 tax receipts will be issued for donations received after December 31, 2021.

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Members receive seven issues of the *Flypast* newsletter a year:

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Flypast is the newsletter of the Toronto Chapter, Canadian Aviation Historical Society (CAHS), and is available with membership. Membership fees are payable in November. **EDITOR:** Ken Swartz, 190A Lowther Avenue, Toronto, M5R 1E8, +1 416-836-7094 — newsletter@cahstoronto.ca



Lockheed A-12 at Groom Lake, Nevada with F-101B Voodoo chase plane. The secret base 140 km (87 mi) northwest of Las Vegas was expanded in 1960 to accommodate an A-12 flight test facility. Photo CIA.

answered lots of questions. Chris Fyelling noted how secure the Skunk Works was. By comparison, he suggested “in today’s world there is no more security, because everything is on computers now and those are wide open to everybody.” Martin was thanked by Director Eric Roscoe for an in-depth presentation that drew rave reviews.



Mothballed A-12s in secure storage at Palmdale, Calif. after their retirement. Photo CIA.



M-21 carrier aircraft with D-21 drone. Photo CIA.



M-21 carrier aircraft 60-6940 with D-21 drone at the Museum of Flight, Boeing Field, Seattle. Photo Chris Light via Wikipedia.

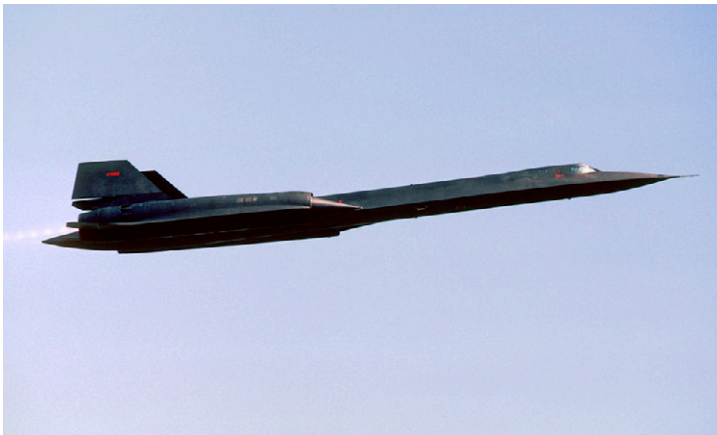


Lockheed M-21, 60-6940 with D-21 drone, Museum of Flight, Boeing Field, Seattle, Aug 27, 2008. Photo Ken Swartz.

Lockheed A-12 & SR-71 Photo Collection



SR-71, 61-7961, Toronto International Airport, Aug 28 1976. Photo Gary Vincent.



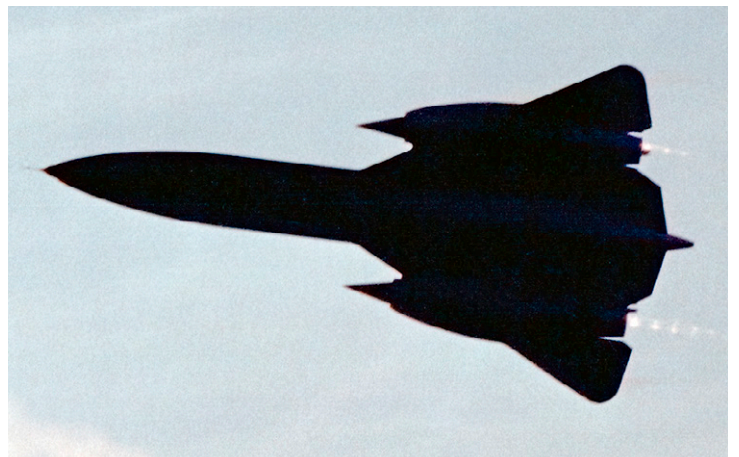
SR-71A, 64-17980 from Detachment # 4, 9th Reconnaissance Wing, USAF Mildenhall. Seen Chièvres, Belgium, Jun 29, 1986. Photo Pierre Gillard.



SR-71A, 64-17980 from Detachment # 4, 9th Reconnaissance Wing, USAF Mildenhall. Seen Chièvres, Belgium, Jun 29, 1986. Photo Pierre Gillard.



SR-71, 64-17967, Mildenhall, UK, May 27, 1989. Photo Neil Aird.



SR-71, 64-17967, Mildenhall, UK, May 27, 1989. Photo Neil Aird.

Lockheed A-12 & SR-71 Photo Collection



SR-71, 64-17967, Mildenhall, UK, May 27, 1989. Photo Neil Aird.



SR-71, 17973, Palmdale, CA, Aug 11, 1990. Now part of the Blackbird Airpark collection. Photo Eric Roscoe.



SR-71, 17973, Palmdale, CA, Aug 11, 1990. Now part of the Blackbird Airpark collection. Photo Eric Roscoe.

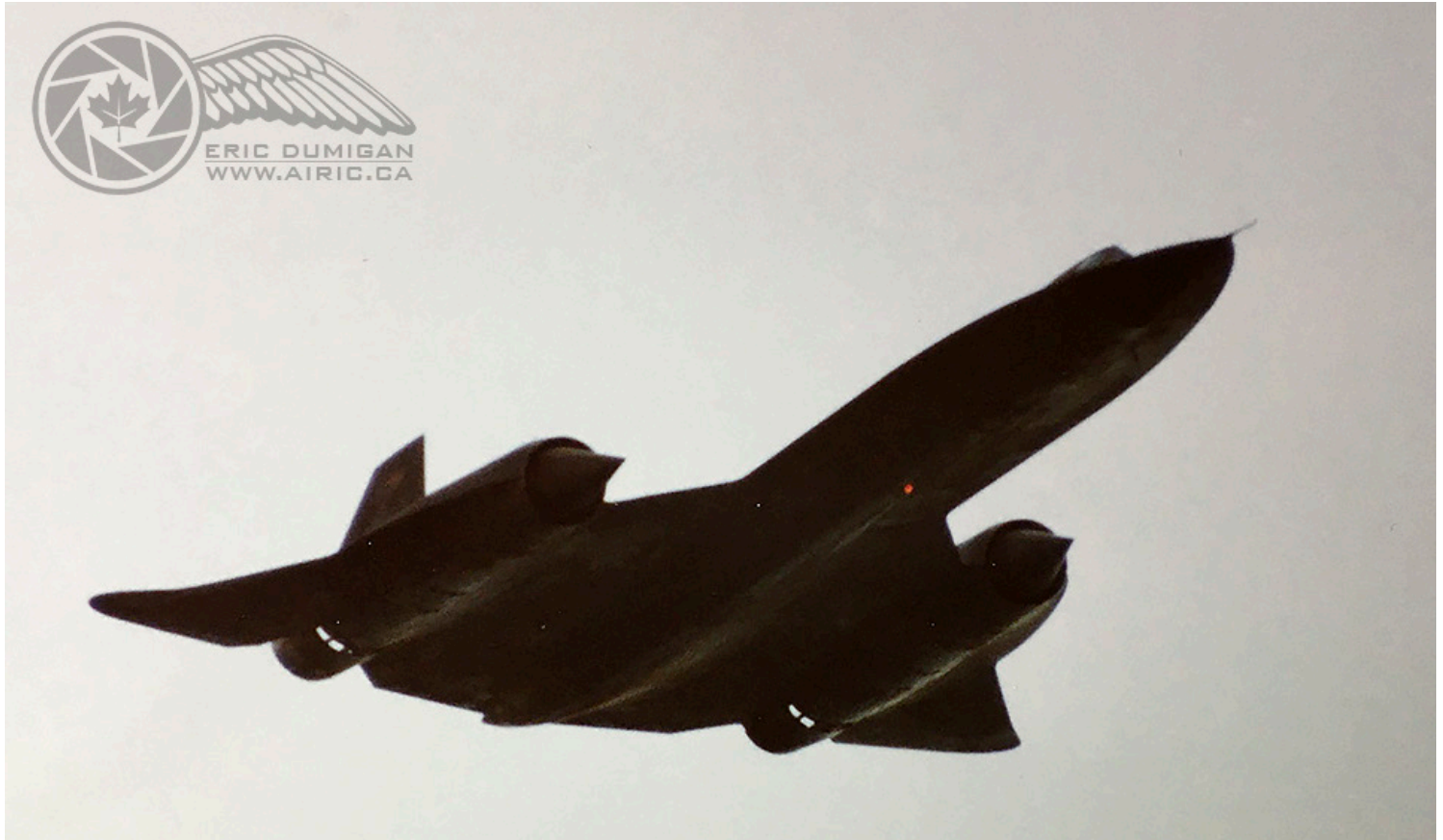


Blackbird Airpark at Palmdale contains SR-71A 61-7973, A-12 60-6924, U-2D 56-6721 and a D-21 drone, Mar 3, 2019. Photo Ken Swartz.

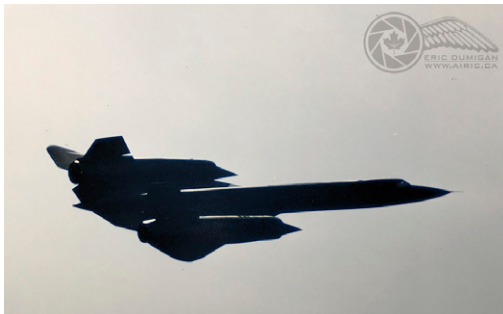


SR-71, 61-7974 over Toronto Island. Canadian International Air Show, 1981. Photo Eric Dumigan.

Lockheed A-12 & SR-71 Photo Collection



SR-71, 61-17974 at the Canadian International Air Show, Toronto, 1981. Photo Eric Dumigan.



SR-71, 61-7974 at the CIAS, Toronto, 1981. Photo Eric Dumigan.



SR-71, 61-7971, Evergreen Aviation Museum, McMinnville OR, Aug 9, 2016. Photo Ken Swartz.



SR-71A, 61-7958, Museum of Aviation, Robins AFB, GA, Mar 3, 2019. Photo Ken Swartz.



A-12, 60-6933, San Diego Air & Space Museum, Balboa Park. Photo John Bertram.