



# BRIEFINGS

## HILLER AVIATION MUSEUM WHERE INSPIRATION TAKES FLIGHT

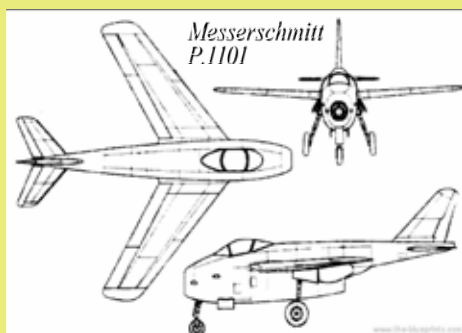
### BIRTH OF AN ICON THE 50TH ANNIVERSARY OF THE BOEING 747

By Jon Welte

**Immediately following World War II, aeronautical technologies developed for war were applied to civilian use. In the realm of commercial air transport, a series of developments over two decades converged in the creation of the remarkable Boeing 747 – an aircraft that first flew half a century ago this February.**

Well into the 1940s, even jet-powered airplanes had straight wings. In 1935, German engineer Adolf Busemann realized that rearward-swept wings would reduce drag at extreme speeds. World War II ended before aircraft such as the Messerschmitt P.1101 could take flight, but its elegant swept-wing shape foreshadowed many aircraft to follow.

Swept wings were useful for bombers as well. In 1945 a team of US engineers in Germany under Dr. Theodore von Karman discovered documents related to swept-wing aircraft. The discovery was quickly incorporated into a new medium bomber proposal under development at Boeing, a project that became the B-47 Stratojet.



Originally conceived as a straight-winged bomber, the B-47 evolved into the archetype for the modern jetliner. The German-style swept wing allowed for exceptional performance; six turbojet engines were placed in pods slung under the wings, to facilitate easy servicing or replacement and to dampen out instability. First flown in 1947, over 2,000 B-47s were built for the United States Air Force to serve in the Cold War.



Boeing B-47

While Boeing's B-47 line prospered, by 1950 commercial aviation was dominated by piston-engined airplanes built by Douglas and Lockheed. Boeing sought to use the B-47's technologies to re-establish itself in airliners. The result was the Model 367-80 prototype. Debuting in 1954, the -80 featured the swept wings and podded, underwing engines seen on the B-47. In 1955 Pan American World Airways ordered 20 of the larger production version, the Boeing 707. The 707 and aircraft like it transformed the face of air transportation, making long distance flights faster, smoother and safer than any air voyages had been before.

The success of the 707 emboldened Juan Trippe, Pan Am's president, to push Boeing for development of an even larger jetliner. Boeing had participated in an Air Force competition in 1963 to build a large military airlifter. While Boeing lost the competition to Lockheed's C-5, the effort created the



Flying Leprechaun!  
March 17



Easter Bunny  
by helicopter April 20



SPRING MODEL TRAIN SHOW  
MARCH 30 – APRIL 7



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# PRESIDENT'S PERSPECTIVE



Boeing Dash-80

foundation for the new aircraft. Designed under the leadership of Boeing engineer Joe Sutter, the new jetliner was intended to be capable of serving as a cargo carrier as well as an airliner. The wide main deck required two aisles when configured for carrying passengers, a first for a jet-powered airliner. And to facilitate the envisioned cargo mission, the flight deck would be placed on an upper level far above the passengers.

The 747's upper level was not originally intended for passenger seating. The positioning of the flight deck atop the fuselage created extra drag on the aircraft at high speeds. Elongating the area behind the cockpit into an extended "hump" substantially reduced this drag. The relationship between wing area, fuselage area and drag was first recognized by German scientists during World War II, but was not adapted to postwar aircraft design until American aerodynamicist Richard Whitcomb rediscovered and published the idea as the so-called "area rule" in 1952. Ironically, Whitcomb's inspiration was a lecture given by Adolf Busemann, father of the swept wing and a post-war immigrant to the United States.



JT9D Engine

The final key component of the 747 was its engine. Turbojet engines equipped the early 707's, but high fuel consumption made them unsuitable for a gigantic airplane intended to fly long distances. The Air Force competition that resulted in the Lockheed C-5 stimulated development of new high bypass turbofan engines. These engines direct large quantities of air around the engine core, mixing it with the hot exhaust blast. As much of the air entering the engine did not

need to pass through the core, efficiency was boosted substantially. Boeing selected Pratt & Whitney to build the JT9 to power its 747.

The 747's first flight took place at Everett, Washington, on February 9, 1969. An extended period of testing followed which uncovered a range of teething issues, particularly with the engine. For a time, 747 production substantially outpaced JT9 engine production and dozens of engine-less 747s accumulated on the ramp outside Boeing's factory. In time, however, problems with the JT9 were resolved. The combination of size and range provided by the 747 gave it capabilities never before available in air transport. Many of the world's premier airlines ordered it in quantity, as there was simply no substitute for it on many long range international routes.



Boeing 747-100

Over the past half century over 1500 747s have been built in several major versions. The latest iteration is the 747-8, which entered service in 2011. While outwardly similar to the 747 of 1969, the -8 has new engines, improved wingtips, a lengthened fuselage and a host of technological improvements. Despite this, the 747 has been increasingly supplanted by smaller and more efficient twinjet airplanes able to fly comparable distances with more modest passenger loads. While existing 747s will continue to fly passengers for years to come, future production is likely to consist primarily of freighters – finally validating Joe Sutter's guess from a half century before.

Since 1998 the Hiller Aviation Museum has exhibited the forward section and flight deck of a former British Airways Boeing 747-100. Sporting the livery of exhibit sponsor and Museum supporter Al Silver's Flying Tigers cargo airline, the exhibit provides thousands of visitors each year an unparalleled opportunity to explore the flight deck of this remarkable aircraft.

## Resources

*747: Creating the World's First Jumbo Jet*, Joe Sutter and Jay Spenser, 2006

*Boeing 747 – Design and Development Since 1969*, Guy Norris and Mark Wagner, 1997

*The Sporty Game*, John Newhouse, 1982



In the gallery's "Working World of Aviation" section, a new display called "Forces of Flight" is taking shape behind the scenes. In images, text and video we'll

answer the question, "How do airplanes fly?" Particular attention will be paid to that seemingly mysterious property of flight called "lift." Included will be an intriguing simulation in which the user can control an aircraft solely by the engine throttle to see the effect changing airspeed has in the ascent and descent of an airplane.

A spot in the gallery has already been designated for the museum's Fokker DR.1 Triplane, a full-size reproduction of which is under construction by our skilled volunteers in the restoration shop. The final stage has finally begun with the covering of the wings and fuselage with doped fabric. Look for the final result to debut in just a few more months.

A heartfelt "thank you" goes to all of the many contributors, visitors and museum Members for supporting us and making the museum part of your lives. There are great things coming and we look forward to seeing you this spring at the Hiller Aviation Museum.

*Jeffery Bass, President & CEO*



**FLIGHT SIM ZONE  
OPEN SAT & SUN  
11 AM – 2 PM**



# Hiller Aviation Museum



## AVIATION CAMP 2019

### Take Flight This Summer!

Created for children entering Grades JK-8, Aviation Camp uses hands-on experiments, authentic flight simulation and real aircraft to provide week-long adventures in flight.



#### Air & Space

*Entering Grades K-5*

Assemble and launch a high performance rocket!



#### Drone Engineers

*Entering Grades K-5*

Design, build and fly robotic aircraft!



#### X-Plane Pilot

*Entering Grades K-5*

Explore cutting edge aircraft!



#### Flight & Motion

*Entering Grades K-5*

Investigate the science of flight!

#### Advanced Camp

*Entering Grades 5-8*

Additional sessions are available for children ages 10-13. Visit [www.hiller.org](http://www.hiller.org) for complete information.



[www.hiller.org](http://www.hiller.org) ♦ (650) 654-0200

The Hiller Aviation Museum is a 501(c)(3) public nonprofit organization, ID #94-3226411



# CALENDAR OF EVENTS

## MARCH 2019

**SAT, MARCH 2 • 11 AM**

V1 Flying Bomb & V2 Missile Presentation

**SUN, MARCH 3 • 2 – 4 PM**

Flight Sim Rally

**SUN, MARCH 10 • 1 – 4 PM**

Drone Meet

**SUN, MARCH 17 • 10 AM – 12 PM**

Leaping Leprechaun

**SUN, MARCH 17 • 10 AM – 12 PM**

Kids' Carnival

**SUN, MARCH 24 • 10:30, 11:30 & 12:30 PM**

Starlab Sky Show

**SAT, MARCH 30 – SUN, APRIL 7**

Spring Model Train Show

**SUN, MARCH 31 • 2 – 4 PM**

Flight Sim Rally

## APRIL

**APRIL 1 – APRIL 5**

Aviation Camp

**MON, APRIL 1 – SUN, APRIL 7**

Spring Model Train Show

**SUN, APRIL 7 • 1:30 – 3:30 PM**

Drone Meet

**SUN, APRIL 14 • 7 AM**

Airport Runway Run

**SAT, APRIL 20 • 10 AM – 1 PM**

Easter Bunny by Helicopter

**SUN, APRIL 21**

Museum closed for Easter

**SAT, APRIL 27 • 10:30, 11:30 & 12:30 PM**

Starlab Sky Show

**SUN, APRIL 28 • 10 AM – 12 PM**

Kids' Carnival

## MAY

**SUN, MAY 5, 2 – 4 PM**

Flight Sim Rally

**SAT, MAY 11 • 10AM – 2PM**

Open Cockpit Day

**SAT, MAY 11 • 10AM – 5PM**

Scout Day

**SUN, MAY 12 • 1:30 – 4 PM**

Aero Design Challenge

**SUN, MAY 19 • 10 AM – 12 PM**

Kids' Carnival

**SAT, MAY 26 • 11AM**

Paper Planes with John Collins

**SUN, MAY 26 • 2 – 4 PM**

Fly For Fun Paper Planes

**GOURMET FOOD TRUCKS • WEDNESDAYS, 11AM-2PM,  
DRONE PLEX • SATURDAYS & SUNDAYS, 10:30AM-12PM & 1PM-3PM  
INVENTION LAB • SATURDAYS & SUNDAYS, 10:30AM-4PM  
FLIGHT SIM ZONE • SATURDAYS & SUNDAYS, 11AM-2PM,  
BOY AND GIRL SCOUT PROGRAMS  
OFFERED EACH MONTH – WWW.HILLER.ORG/SCOUT-PROGRAM**

## FLYING LEPRECHAUN

**SUN, MARCH 17, 10AM-12PM  
LEAPING LEPRECHAUN AT 11AM**

Come celebrate St. Patrick's Day at the Hiller Aviation Museum with face painting, bounce house, "Pot of Gold" treasure hunt and a Skydiving Leprechaun! Event included with museum admission.



## TRAINS AND PLANES DISPLAY

**SAT, MARCH 30 –  
SUN, APRIL 7  
DAILY, 11AM-3PM**

Join us for our annual Spring Model Train Show. This year there will be five separate model train layouts set up at the museum.



## OPEN COCKPIT DAY

**SAT, MAY 11, 10AM – 2PM**

Climb inside an L-39 fighter jet, A Grumman Albatross Seaplane, Cessna Cardinal, Boeing 737 and many more museum aircraft not usually open to the public. This is a unique opportunity



to get a pilot's-eye perspective of these amazing machines.

## FOOD TRUCK CR

**AT HILLER! EVERY WEDNESDAY**

The parking lot of the museum turns into a food court every Wednesday. Several food trucks participate in this gourmet event. The trucks rotate weekly,



**PEAXY** TOTAL DATA ACCESS FOR INDUSTRY

## Biggest Little AIR SHOW

Saturday  
June 1  
10am-1pm

Remote Control  
Air Show Featuring:  
Gas & Electric  
Powered Airplanes  
Helicopters  
Jets  
Drones

And one FULL Scale  
aerobatic performance  
by Vicky Benzing in  
her 1940 Stearman





## EASTER BUNNY ARRIVES BY HELICOPTER

**SAT, APRIL 20,  
10AM – 1PM**

Join the Easter Eggstravaganza on Saturday April 20 from 10AM-1PM, The Bunny arrives at 11AM. Get an Easter Egg straight from the Bunny and enjoy face painting, a bounce house. All included with museum admission.



## PERFECT PAPER PLANES

**FEATURING PAPER PLANE CHAMPION,  
JOHN COLLINS  
SUN, MAY 26, 11AM**

In Honor of National Paper Airplane Day join a unique exhibition of paperlight flight! Author and master paper airplane builder John Collins leads an interactive 45-minute session investigating the science of making things fly and the notebook-scale engineering required to fold and fly record-breaking paper gliders. Come prepared to try your hand building



## V1 FLYING BOMB & V2 MISSILE OF WWII

**PRESENTATION BY PHIL GIOIA  
SATURDAY MARCH 2, 11 AM**

An anonymous letter is received by British Naval Intelligence in 1939, warning of mysterious new secret weapons being developed by Nazi Germany.

The British do nothing until 1942, when an accidental overflight of a German base at Peenemünde on the Baltic seacoast reveals heavy construction of a huge, unique military site with adjoining airfields.

Through late 1942 and into 1943 massive concrete structures and unusual radar installations also begin appearing in reconnaissance photos taken over Occupied France.

In late 1943 a young RAF woman Flight Officer identifies a mysteriously shaped object in an air photo of Peenemünde, and surmises it is a flying weapon of some kind. At the same time the Allies are also receiving human intelligence reports from resistance fighters on the Continent of some kind of giant rocket.

The Allies are preparing to launch the cross-Channel attack at Normandy in June 1944. A race begins to identify and destroy these new German weapons and their supporting facilities, before they can be brought into action against England.

This is the story of the secret development of the Nazi V-1 flying bomb and V-2 missile, and the Allied efforts to destroy them. As Wellington said of the victory narrowly won against Napoleon at Waterloo, 'It was a damn near-run thing.' Military historian Phil Gioia will tell this engaging story in detail, with photos of all the principals, weapons, sites, and technologies.

Presentation is included with museum admission.



## AZE CONTINUES!

**11AM TO 2PM — RAIN OR SHINE!**

so come for your favorite truck or try something new! Dine under our portecochere, or indoors when it's a little cold, or, grab and go!



## Volunteers Wanted

Volunteers Give the Gift of Time

Volunteer Opportunities include:

Spending time as a museum Docent

Working in the Restoration Shop

Volunteering in the Library or with office admin tasks

We are specifically in search of Docent volunteers for the Saturday or Sunday morning shift from 9:30 - 1:30



Contact Jen Roger - Volunteer Coordinator  
[jen@hiller.org](mailto:jen@hiller.org) 650-654-0200 Ext. 219



**REGISTER NOW**

**[WWW.HILLER.ORG/RUN](http://WWW.HILLER.ORG/RUN)**

**SUNDAY, APRIL 14<sup>TH</sup> 2019**



**WALK • JOG • STROLL**  
on the San Carlos Airport Runway!

*Certified 5K and 10K courses & 2K fun run*

**EVENT IS EXPECTED  
TO SELL-OUT AGAIN.  
REGISTER EARLY!**

**SPONSORSHIPS  
NOW AVAILABLE!**

**VOLUNTEERS  
NEEDED!**

**ADVANCED PACKET PICKUP – HIGHLY RECOMMENDED!**

Saturday, April 13 • 10 am – 2 pm  
Sports Basement  
202 Walnut St., Redwood City, CA 94063

**20% off** all in-store purchases\*  
during packet pickup hours for  
Airport Runway Run participants!

\*Some exclusions apply.

**Sports  
Basement**  
[www.sportsbasement.com](http://www.sportsbasement.com)



# EDUCATION PROGRAMS SPRING 2019

## AVIATION CAMP • SPECIAL SPRING SESSION

### PHYSICS FLYERS

**APR 1-5**

Join the fun at Aviation Camp! Explore the science of flight with model aircraft, flight simulation, drone missions and real aircraft in a special Spring Break session of Aviation Camp.



## FAMILY SUNDAY PROGRAMS • SPRING 2019

### DRONE MEET • AGES 8+

**MAR 10, APR 7 • 1:30 – 3:30 PM**

Compete in a mini-event in drone flying! Practice a specific maneuver on drone simulators, then fly against the best of the best inside the Drone Plex!



### AERO DESIGN CHALLENGE • AGES 10+

**MAY 12, JUN 23 • 1:30 – 4 PM**

Explore aeronautical engineering with the Hiller Aviation Museum's annual design event! Investigate helicopters and build and launch a unique design in an effort to create the longest-flying aircraft.



### KIDS' CARNIVAL • AGES 3+

**MAR 17, APR 28, MAY 19 • 10 AM – 12 PM**

Join the fun to paint a plane, complete an experiment, check out in an aircraft cockpit and more in a special experience for our youngest aviators.



### FLIGHT SIM RALLY • AGES 8+

**MAR 3, MAR 31, MAY 5 • 2 PM – 4 PM**

Fly with the best of the best in a 30-minute simulation challenge in the Flight Sim Zone! Learn to perform a specific flight maneuver in a unique simulated aircraft, then take the controls to complete the mission of the month!



### STARLAB SKY SHOW • AGES 5+ (3+ AT 10:30 SHOW)

**MAR 24, APR 27 • 10:30, 11:30, 12:30**

Enter the Starlab Planetarium and take a trip through the glittering stars, planets and constellations of spring. Identify star patterns visible from your own backyard this season during a special 30-minute presentation.



### FLY FOR FUN PAPER PLANES • AGES 5+

**MAY 26 • 2 - 4 PM**

Celebrate National Paper Airplane Day with a Fly for Fun session! Build and fly a high performance paper glider and go long with amazing distance launches!



*All Sunday Family Events are included with Museum admission. Space is limited for some events and no-cost tickets or reservations may be required. Check [www.hiller.org](http://www.hiller.org) for capacity information, or request tickets at the Admissions counter on the day of each program.*

## AVIATION CAMP • SUMMER 2019

Registration is now open for this summer's Aviation Camp program! See the flyer or visit [www.hiller.org](http://www.hiller.org) for more information. Online registration now available. Make your plans now to join us this summer for an amazing experience in flight!



# HILLER AVIATION MUSEUM

601 Skyway Road, San Carlos, California 94070 [www.hiller.org](http://www.hiller.org)

Non-Profit  
Organization  
US POSTAGE PAID  
San Carlos, CA  
PERMIT No. 96

## Join Now!

### Senior (age 65+) \$50

Unlimited admission for you + 2 guest passes.

### Individual \$65

Unlimited admission for you + 2 guest passes.

### Family \$90

Unlimited admission for 2 named adults and up to 4 children (17 & under) + discounts on Aviation Camp.

### Pioneer \$125

Family Membership benefits + an additional card for a named member (ideal for caregivers) and 2 guest passes.

### Pilot \$275

Family Membership benefits with a total of 3 guest passes + 8 FMX Flight Simulator passes and 50% off additional FMX tickets.

### Barnstormer \$550 • Adventurer \$1,000

Pilot Membership benefits with a total of 4 guest passes + 10% off Museum Rental and Birthday Parties.

### Explorer \$2,500 • Navigator \$5,000

Pilot Membership benefits with a total of 8 guest passes + 15% off Museum Rental and Birthday Parties.

### Aviator \$10,000

Pilot Membership benefits with a total of 12 guest passes + 25% off Museum Rental and Birthday Parties and a Hiller Aviation Museum jacket.

## Annual Membership Application

Or join online at [www.hiller.org/member](http://www.hiller.org/member)

### I want to be a member of Hiller Aviation Museum in the following category:

- |  |   |
|--|---|
| <input type="checkbox"/> Senior (65+) \$50 | <input type="checkbox"/> Barnstormer \$550  |
| <input type="checkbox"/> Individual \$65   | <input type="checkbox"/> Adventurer \$1,000 |
| <input type="checkbox"/> Family \$90       | <input type="checkbox"/> Explorer \$2,500   |
| <input type="checkbox"/> Pioneer \$125     | <input type="checkbox"/> Navigator \$5,000  |
| <input type="checkbox"/> Pilot \$275       | <input type="checkbox"/> Aviator \$10,000   |

New Member     Annual Renewal

Primary Adult Member: \_\_\_\_\_

Second Adult Member: \_\_\_\_\_  
*(Family Memberships and up)*

Third Adult Member: \_\_\_\_\_  
*(Pioneer Memberships only)*

Address: \_\_\_\_\_ City: \_\_\_\_\_

State: \_\_\_\_\_ Zip: \_\_\_\_\_ Daytime Phone: \_\_\_\_\_

Email: \_\_\_\_\_

This is a gift membership from: \_\_\_\_\_

Payment Amount: \_\_\_\_\_  VISA     MC     AMEX

Card #: \_\_\_\_\_ Exp. Date: \_\_\_\_\_

CSC: \_\_\_\_\_ Print Name on Card: \_\_\_\_\_

Signature \_\_\_\_\_

## SUPPORT THE MUSEUM!

### DONATE YOUR CAR, TRUCK, RV, OR BOAT



### CALL TOLL FREE 1-888-500-1555

Or call Development Office at  
650-654-0200 x203  
Tax Deductible Gift

### AN AVIATOR'S PARADISE! VISIT OUR GIFT SHOP

Shop on line: [www.hiller.org](http://www.hiller.org)  
Gift Certificates available!

### Thank you for your support.

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