

# History of Aviation



## Session 4

World War II 1937-1945

A quantum leap in Aviation  
Developments and Operations

# Coming Attraction for the OLLI Spring Term – US Space Exploration



**NASA's robot Curiosity  
landed on Mars. Early  
pictures show no signs of  
ESPN, beer, or porn. This  
makes it very clear that  
men are not from Mars.**

Visit A Man's Point Of View at [www.facebook.com/WomenAndDating](http://www.facebook.com/WomenAndDating)

# **Aircraft Historical Perspective**

- **Most of the aircraft that flew and fought in WWII were designed before the war.**
  - **The main exceptions were a few of the jet aircraft**
- **While the airframes were designed and relatively stable there were continual improvements in engines, fuels, propellers, electronics, instrumentation, navigation aids along with operations, weather forecasting and logistics.**



# When and Where did WW II Begin?

1. In the view of many historians :
2. Starts with Japanese Invasion of China, July 1937
3. From an American perspective there is Pearl Harbor, why is this earlier date important?
  - American Volunteer Group flying P-40s in 1941 in support of China
  - Pre-Pearl Harbor US embargo of oil and steel shipments to Japan put pressure on Japan and their “East Asia Co-Prosperity Sphere”
  - US factories started receiving orders for war materials

# A question to ponder

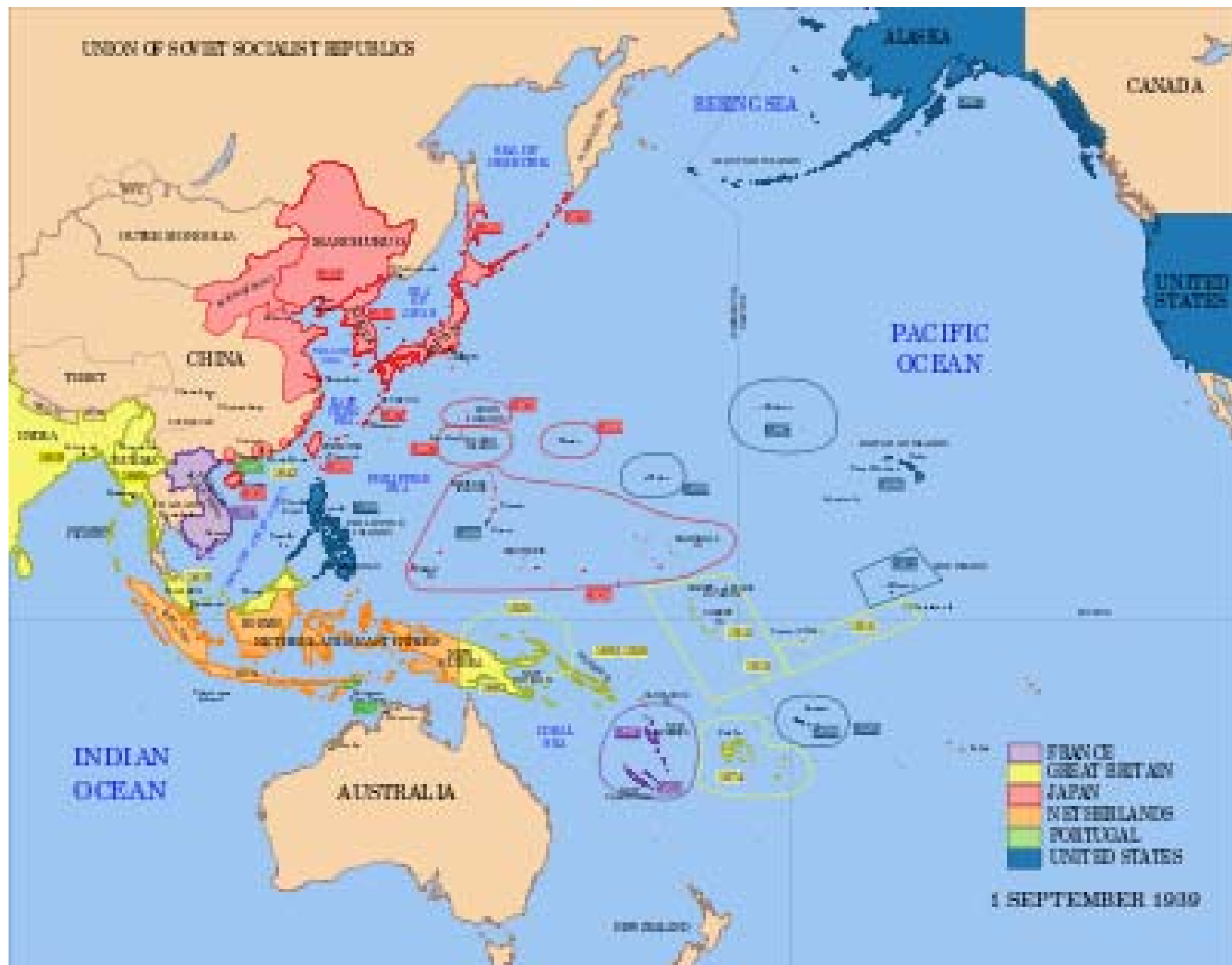
**Did aviation convince the Axis powers that this war was winnable?**

**This time there would be no European trench warfare?**

- If aviation advancements had not been as extensive as they were in the 1920's and more so in the 1930s; would Hitler have attacked the way he did and when he did?
- The WWI French/Belgium front was a four year stalemate that moved only 50 miles.
- The Blitzkrieg concept and the units it spawned, combined armor and air attack, caused the Germans to believe that they could overwhelm the French and possibly English allies and not repeat WWI stalemate
  - The Guernica air attacks in Spain was a crucial test
  - The attacks in the low countries and France proved their point
  - Blitzkrieg worked initially in the Soviet Union, but it was ultimately stopped and pushed back.
- **The Japanese started the war with more carriers than the US**



### Europe in 1942, maximum extension of European Axis Powers



Pacific National Status in September 1939

# The Air War in Europe (1939-1945)

## Four Major Turning Points

- [-] Germany combined a ferocious air attack with sweeping ground movements in their blitz across Europe that began on September 1, 1939.
- [+] English victory during the Battle of Britain (July-October 1940) preserved landing fields in England soon used by both RAF and American bombers to strike back at the Nazi Germany.
- [-] Starting in April 1942 though the spring of 1943, poor weather, **slowly building US aircraft production**, and the diversion of air forces to North Africa and the Pacific **hampered the European campaign**. Delayed introduction of **long range fighters also hampered operations**.
- [+] Combined American and British bombing in 1944 and 1945 **grew in intensity and scope** and continued till end of the war.



# The Battle of Britain



- **Date: 10 July – 31 October 1940**
- **Location: United Kingdom airspace**
- **Forces: Hundreds of German bombers and escorting fighter attacked Britain each day and were engaged by about 800 RAF fighters**
- **Result: Decisive British victory in that the Germans did not invade**
- **The Royal Air Force victory in the skies over England preserved vital landing fields that would be used by Allied bombers during the Combined Bomber Offensive that began in 1942 and continued to the end of the war.**
- **This was the first of many major WWII battles that was accomplished predominately by air power. Many later US Naval victories occurred via air power from ships that did not see each other.**

**This was a transitional event! How different world history might have been; if the British Isles had been invaded?**

# Hurricanes and Spitfires in Action



- Supermarine Spitfires and Hawker Hurricanes, the workhorse of the air battle, were flown by extraordinarily young pilots who fought with tenacity and courage.
- Both aircrafts are displayed at the Smithsonian.
- Both from the same MOD RFP, one a defensive tackle in a dust-up, the other a gymnast.

# **Film Clips of Early BoB actions and the Blitz**

**December 7<sup>th</sup> 1941**  
**8 Bells**  
**Film Clip**

# Day of Infamy



- Active US entry into WWII began with a Japanese Naval Aviation attack, 400+ aircraft; four and a half years after Japan attacked China.
- The Japanese totally misjudged the US response.
- Battleship row was decimated, but the 4 US Pearl Harbor based carriers and their aircraft were at sea
- The fuel depot on the hill overlooking Pearl Harbor, with 6-12 months supply of fuel was ignored.



A Japanese photograph taken during the initial moments of the attack. (U.S. Navy)<sup>14</sup>

# **Post Pearl Harbor Film Clip**

# First Strike: The Doolittle Tokyo Raid, April 1942: The beginning of Joint Operations





# US Armed Forces Buildup

- In 1939, the US had about 174,000 men in the Army; 126,400 in the Navy; **26,000 in the Army Air Corps**; 19,700 in the Marine Corps; and 10,000 in the Coast Guard.
- At the height of its strength in 1945, the US had six million in the Army; 3,400,000 in the Navy; **2,400,000 in the Army Air Forces**; 484,000 in the Marine Corps; and 170,000 in the Coast Guard.
- In 1939, the US had about **2,500** airplanes and 760 warships. By 1945, it had about **80,000 Air Corps and Navy combat airplanes in service** and 2,500 warships. **300,000** aircraft were built: some were destroyed, some replaced and many provided to allies

# The Essex Class Aircraft Carriers



- In 1940 as part of a military build up and part of a continuing economic stimulus the keel for the first of 18 Essex Class Aircraft Carriers was laid.
- Construction continued throughout the war and all told the Navy had 90+ aircraft carriers of several types by 1945.

# On the Home Front

## “Arsenal of Democracy”

- The US goes to war and accelerates “lend-Lease” and US **defense production already in process**
- Approximately 300,000 aircraft were built in the U.S. before and during the war
- WW II was transitional; it opened Gender and Race doors in the work place – it took some time but the nation changed
- Demanded sacrifices on many levels
  - First and foremost, Service
  - Rationing, making do: victory gardens, coupon books
  - Changes in family life
  - Bond sales and taxes

## How many aircraft did we build?

Type of Airplane	Total	1940	1941	1942	1943	1944	1945
<b>Grand total</b>	<b>295,959</b>	3,611	18,466	46,907	84,853	96,270	45,852
<b>Combat airplanes</b>	<b>200,443</b>	1,771	8,395	24,669	53,183	74,564	37,861
Very heavy bombers	3,740	-	-	4	91	1,147	2,498
Heavy bombers	31,685	46	282	2,513	9,574	15,057	4,213
Medium bombers	21,461	52	762	4,040	7,256	6,732	2,619
Light bombers	39,986	453	2,617	5,954	11,848	12,376	6,738
Fighters	99,465	1,157	4,036	10,721	23,621	38,848	21,082
Reconnaissance	4,106	63	698	1,437	793	404	711
<b>Support airplanes</b>	<b>95,516</b>	1,840	10,071	22,238	31,670	21,706	7,991
Transports	23,900	164	525	1,887	6,913	9,925	4,486
Trainers	58,085	1,676	9,294	17,237	20,950	7,936	1,352
Communications	13,531	-	252	3,114	4,167	3,845	2,153

## Where did they go?

Type of airplane	Total	<a href="#">US Army Air Forces</a>	<a href="#">US Navy-Marines</a>	Other U.S.	<a href="#">British Empire</a>	<a href="#">Soviet Union</a>	Other nations
<b>Grand total</b>	<b>295,959</b>	158,880	73,711	3,714	38,811	14,717	6,126
<b>Combat airplanes</b>	<b>200,443</b>	99,487	56,695	8	27,152	13,929	3,172
Very heavy bombers	3,740	3,740	-	-	-	-	-
Heavy bombers	31,685	27,867	1,683	-	2,135	-	-
Medium bombers	21,461	11,835	4,693	8	3,247	1,010	638
Light bombers	39,986	7,779	20,703	-	8,003	3,021	480
Fighters	99,465	47,050	27,163	-	13,417	9,868	1,967
Reconnaissance	4,106	1,216	2,453	-	350	30	57
<b>Support airplanes</b>	<b>95,516</b>	59,939	17,016	3,706	11,659	788	2,954
Transports	23,900	15,769	2,702	267	3,789	703	670
Trainers	58,085	34,469	13,859	3	7,640	85	2,029
Communications	13,531	9,155	455	3,436	230	-	255

# On the Home Front



# **The impact of fuel on the war - 1**

- **The axis powers were always on the edge of running out of gas. They had no available national sources.**
- **Prior to the war, Japan obtained its fuel mainly from the US and from the British fields in Burma and Borneo (40%) and the Dutch (Shell) in the East Indies.**
- **The US embargo in July 1941 had a profound impact on their War in China. Some claim that Pearl Harbor was to teach the US a lesson.**

# **The impact of fuel on the war - 2**

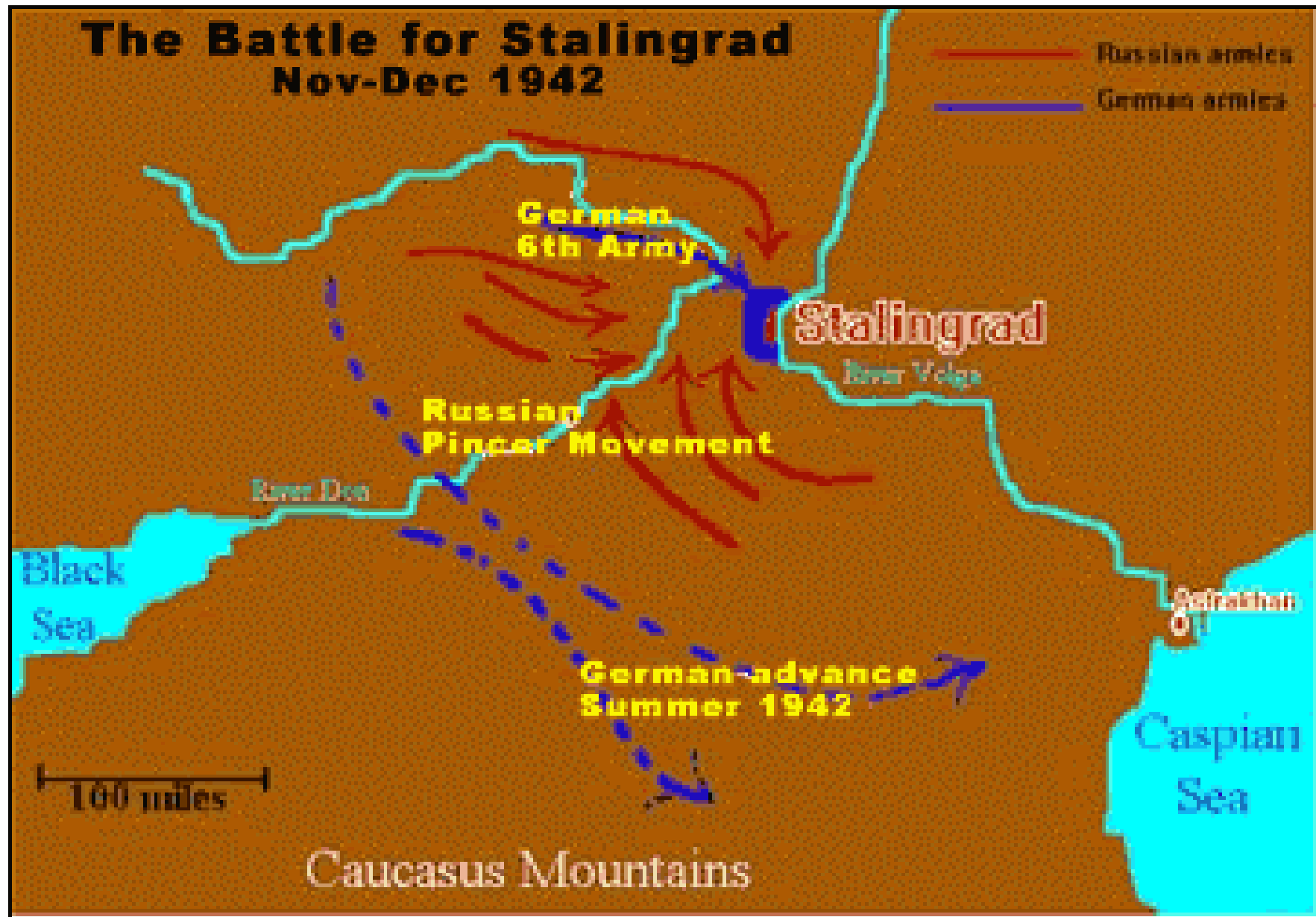
- **Germany was dependant on Rumanian and US oil prior to the war, after the invasion of Poland the Germans went to the SE Polish oil fields but were thwarted by the quick Russian invasion.**
- **A major impetus of the June 1941 German invasion of Russia was to seize the Caspian Sea oil fields, Ukrainian food, iron ore and coal.**
- **Until driven back by the Russians in 1944 the Germans exploited the Polish fields and Lithuania oils sands.**



# **The impact of fuel on the war - 3**

- **The Germans were compelled to go to synthetic oil derived from coal regardless of its inefficiencies.**
- **Italy had exhausted its limited oil fields by 1941 and was dependent on Rumanian and synthetic oil.**
- **The US had unlimited fuel for all allied needs and had developed higher octane fuels which enhanced aircraft performance.**
- **Russia supplied its fuel need from secured fields.**

# The Battle for Stalingrad Nov-Dec 1942



# **Women Pilots**

**"This is not a time when women should be patient. We are in a war and we need to fight it with all our ability and every weapon possible. WOMEN PILOTS, in this particular case, are a weapon waiting to be used."**

**Eleanor Roosevelt, 1942**

# Women Airforce Service Pilots (WASP)

- Facing the need for male combat pilots, the situation by mid-1943 favored the use of experienced women pilots to fly Army Air Forces aircraft within the United States.
- Two women's aviator units were formed to solve this need and **more than 1,000 women** participated in these programs as civilians attached to the AAF.
- These were merged into a single group, the WASP program in August 1943 and broke ground for USAF female pilots who would eventually follow in their footsteps.

# B-17 Crew Who Happened to be Women



# Ultimate Allied advantages

- US aircraft production plants were safe, as were our ship yards
- While neutral, the US embarked on aircraft design and production well prior to December 1941
- US population size was fourth only to China, India and Russia and we could safely mobilize our population for war production
- US had most raw materials needed and developed substitutes as needed for those we didn't have, example: synthetic rubber
- We were able to feed ourselves and a good portion of the rest of the free world with limited agricultural labor
  - Many 100,000s of POWs worked in the fields
- US had an **unlimited sea of fuel**

# **WW II Aircraft in the Smithsonian Collection**

# Smithsonian World War II Aircrafts-1

## American

- Boeing B-29 Superfortress *Enola Gay*
- Republic P-47D Thunderbolt
- Lockheed P-38 Lightning
- Stinson L-5 Sentinel (Brodie System)
- Vought F4U-1D Corsair
- Curtiss P-40 Kittyhawk
- Grumman F6F Hellcat
- Naval Aircraft Factory N3N-3 Yellow Peril
- North American P-51C Mustang (Excalibur)
- P-51D Mustang





# Smithsonian World War II Aircrafts-2

- **American, con't**
- Vought-Sikorsky OS2U-3 Kingfisher
- B-26B Marauder “Flak Bait” Nose section
- Grumman F4F (FM-1) (Sea/Air)
- Douglas SBD-6 Dauntless (Sea/Air)
- Lockheed XP-80 Lulu Belle (Jet Aviation)
- McDonnell FH-1 Phantom I (Jet Aviation)
- Northrop P-61, Black Widow
- Sikorsky RX-4 helicopter
- **BRITISH**
- Hawker Hurricane Mk IIc
- Westland Lysander
- Supermarine Spitfire Mk. VII



# Smithsonian World War II Aircrafts-3

## JAPANESE

- Aichi M6A1 Seiran (Clear Sky Storm)
- Kawasaki Ki-45 Kai Hei (NICK)
- Kugisho Okha 22 (Cherry Blossom)
- Kawanishi N1K2 (GEORGE)
- Japanese Zero (Mitsubishi A6M5)



## GERMAN

- Messerschmitt Bf. 109G-6
- Messerschmitt Me 163, Komet
- Arado Ar 234B-2 Blitz
- Focke Wulf Fw 190
- Heinkel 219
- Messerschmitt Me 262 *Schwalbe* (Jet Aviation)
- Dornier D335 Pfeil



# Smithsonian World War II Aircrafts-4

## Italian

- Macchi c.202 Folgore



## Russian

- Active In the war in great numbers, none on display





# The Air War in Europe





# US WW II Air War

- **European Theater rollout: 8<sup>th</sup> and 15<sup>th</sup> Air Forces**
  - Massive strategic bombing from England and later North Africa and then Southern Italy
  - Tactical air warfare and ground support in North Africa and advancing into southern Italy
  - Tactical air warfare and ground support first from England and then advancing east with the ground forces after the Normandy invasion
  - Extensive anti-submarine search and destroy and convoy protection

# Key Factors in Air War in Europe

- The buildup of American bombers in England and Italy gathered momentum by mid-1943.
- Boeing B-17 Flying Fortresses and Consolidated B-24 Liberators carried out most of the U.S. high-altitude, precision daylight bombing campaign in Europe.
- Pointblank, the code name for the Eighth Air Force's part in the Combined Bomber Offensive with the Royal Air Force, began on June 10, 1943.





# **Eighth Air Force Chronology -1**

- **First units land in England in Feb 1942.**
- **First missions using borrowed British Lockheed A-20s attack airfields in Holland.**
- **B-17s and lesser numbers of B-24 arrive and build up attacks on targets in Holland and France.**
- **Beginning in 1943 deep large scale raids are made against German/Czech industries, refineries, cities and rail networks using daylight precision bombing.**
- **In Spring 1944 attacks concentrate on German military targets in France to support the Normandy Invasion.**





## **Eighth Air Force Chronology -2**

- **Post invasion heavy bombing continues to hammer German military industries, synthetic rubber factories, synthetic fuel refineries and rail networks supporting the front.**
  - **Many combined operation with 15<sup>th</sup> AF flying from Italy**
- **In Jan 1945 the Luftwaffe launches 600 aircraft in last ditch attack on US and British airfields in France, Belgium and southern Holland – it fails and the allies have virtual air superiority for the rest of the war.**
  - **Except for the ME 262 jet interceptor**
- **Over 135,000 US airmen served in the 8<sup>th</sup> AF.**
  - **Over 5,100 aircraft were lost with unfortunately more than 47,000 casualties, including more than 26,000 dead**
- **Over 440,000 bomber sorties dropped 697,000 tons of bombs**
  - **Over 11,200 aerial victories were attained**

# B-17 Shoo-Shoo-Baby



Nose Art

# Memphis Belle



# **15<sup>th</sup> Air Force Chronology - 1**

- **The 15<sup>th</sup> was activated in July 1943. It was hoped that the 15th AF stationed in the Mediterranean would be able to operate when the 8th AF in England was socked in by bad English weather.**
- **Once bases around Foggia, Italy became available, the 15th was able to reach targets in southern France, Germany, Poland, Czechoslovakia, and the Balkans, some of which were beyond reach from England.**
- **In February 1944, first attacks began on aircraft factories in Germany, Austria and Czechoslovakia**
- **In April 1944 the 15<sup>th</sup> was directed to oil refineries and distribution networks in Southeastern Europe.**
- **By June 1944, the 15th Air Force was bombing railway networks in south-east Europe in support of Soviet military operations in Romania.**



## **15<sup>th</sup> Air Force Chronology -2**

- **Over 65,000 US airmen served in the 15<sup>th</sup> AF.**
  - **Over 3,364 aircraft were lost with unfortunately more 21,671 personnel killed, wounded, missing and taken prisoner**
- **Over 148,955 heavy bomber sorties and 87,732 fighter sorties dropped 303,842 tons of bombs on enemy targets in nine countries of Europe, including military installations in eight capital cities**
  - **Over 1,836 aerial victories were attained.**
- **The 15<sup>th</sup> repatriated 5,650 personnel by air, surface vessel and on foot through enemy lines**





# B-24s over Ploesti

On August 1, 1943, one of the most famous raids of the war, a rare low-level attack on the oil fields near Ploesti, Romania, delivered a severe blow the main source of German oil.



The cost was high: 53 bombers lost, 55 badly damaged, and hundreds of aircrew either killed or captured.

More B-24s were built than any other American aircraft during WW II.

Not quite as durable as the B-17, the Liberator was faster and had a longer range but was more vulnerable to flak and fighter attacks.



Columbia Aquila refinery burning after the raid of B-24 Liberator bombers.

The nine refineries at [Ploiești](#) provided the Axis with 35% of their petroleum.

A year later, August 1944, Soviets over run the area

## Operation Tidal Wave

The first of a number of air attack by bombers of the [United States Army Air Forces](#) (USAAF) based in Libya on nine [oil refineries](#) around [Ploiești, Romania](#) starting 1 August 1943,

It was a [strategic bombing mission](#) and part of the "[oil campaign](#)" to deny [petroleum](#)-based fuel to the [Axis](#).

The mission resulted in "*no ultimate curtailment of overall product output*", and so was unsuccessful, but it **impacted** the Axis' tight fuel **reserves**.





Courtesy of William Kahan

**The quintessential B-24 bomber crew photo**



## Personal

### The Secretary of War regrets to inform you...Missing-in-Action

- On 3 November 1944 B-24s from 15<sup>th</sup> Air Force, 460<sup>th</sup> Heavy Bombardment Group left Spinazzola Italy and flew north over the Adriatic Sea to attack a major railroad marshalling yard near Graz Austria.
- Serving on one B-24 was T/Sgt Manual Weinstein, the port waist gunner and armorer.
- Over Graz on their bomb run at 22,000 feet, they were hit by a flack burst that took out the two port engines. The B-24 fell-out of formation and turned SE heading overland trying to reach the area near Belgrade held by Marshal Tito's partisan forces.
- With the control surfaces damaged, the starboard engines red-lined and overheating, with wings wet with fuel from shrapnel punctures; the crew struggled to remain airborne barely clearing the high passes in the Slovenian Alps.
- Near Zagreb the other engines finally seized and the 10 man crew bailed out. Luckily on the ground they met a Tito partisan, who helped them hide in the countryside and move south over the next month till they met a British intelligence agent who provided further assistance.
- When the Russians pushed through Yugoslavia in the Spring of 1945, they were repatriated back to Italy on 15<sup>th</sup> AF C-47s.
- The Plan was to go back to the States and regroup for the attack on Japan.

# The Thunderbolt and The Mustang



In these paintings by J. B. Deneen, a Republic P-47 Thunderbolt defeats an Fw 190, and a North American P-51 Mustang defeats a Messerschmitt Bf 109. The **long-range Thunderbolt and Mustang** changed the course of the air war over Europe.



By the winter of 1943, long-range fighter planes had arrived in sufficient numbers to **protect the heavy bombers all the way to Berlin and back.**

# **Lt. Gen James H. “Jimmy” Doolittle**



**After the Tokyo raid Doolittle went to North Africa and then to England. In February 1944, as commander of the Eighth Air Force, ordered a massive attack upon German targets that came to be known as “Big Week.”**

**It included the first of many American 1,000-plane raids. He sent his P-38s, P-51s, and P-47s to “destroy German fighters” rather than simply “bring the bombers back alive.”**

**This air offensive began the demise of the Luftwaffe (Germany’s air forces), much as the Battle of Midway had turned the tide against the Japanese.**

# Tuskegee Airmen [332nd Fighter Group]

## They fought a two front war: at Home and Europe

- 15,533 combat sorties, 311 missions for the Fifteenth Air Force (hundreds more earlier for the Twelfth Air Force)
- 112 German aircraft destroyed in the air, another 150 on the ground
- 950 railcars, trucks and other motor vehicles destroyed
- One destroyer put out of action
- A good record of protecting U.S. bombers losing only 27 over hundreds of missions.
- Many awards and decorations for valor and performance
- 66 pilots killed in action, and 32 were taken as POWs



# Germany Starts the War with a Massive Air Force, but

- Materials are scarce
- Fuel is always tight
- Allied bombing campaign is relentless
  - Many factories driven underground
  - Decentralization helps preserve factories but adds logistic problems
- Technology push to win could not overcome Allied strength and depth
  - Me 262 jet fighter
  - Arado A234 jet bomber
  - Dornier Arrow
  - Me Komet rocket plane
  - V-1 buzz bomb
  - V-2 ballistic missile



# Prominent German Aircraft



**Folk-Wulf Fw 190**



**Messersmitt Bf 109**



**Heinkel He 111**



**Dornier Do 119**

## The Messerschmitt Bf 110

The Germans fall short on a long range fighter and continually rework it during the war



- The Bf 110 served with success in the early campaigns, the [Polish](#), [Norwegian](#) and [Battle of France](#).
- The Bf 110's **lack of agility in the air was its primary weakness**. This flaw was exposed during the [Battle of Britain](#), when Bf 110-equipped units were withdrawn from the battle after very heavy losses and redeployed as [night fighters](#), a role to which the aircraft was better suited.
- The Bf 110 enjoyed a successful period following the Battle of Britain as an air superiority fighter and strike aircraft in other theatres without need for long range



# **Major German Air Shortfalls**

- **Fuel, particularly after the loss of Ploesti**
- **No long range strategic bomber force**
- **No spare fighter escort aircraft for its light bomber force**
  - **Thus, could not attack Russian factories in the east beyond the Urals nor the oil fields in the southern Caspian Sea basin**
  - **And after BoB could no longer maintain sustained attacks on airfields in England. Blitzed cities at night. In 1941 German airpower was directed east to Russia**

# Prominent Russian Aircraft



**Ilyushin IL-2/10 Shturmovik)**  
**Ground attack aircraft**  
**42.330 built**



**Yakovlev Yak-9 Fighter**  
**16,769 built**

In addition to large numbers of Soviet Union built MiG, Yak, Ilyushin and other aircraft, the Soviet Union received:

Bell P-39	5007	Bell P-63	2421	Curtis P-40	XXXX	Hurricane	2962
P-51	XXXX	P-47	196	Spitfire	1331	B-24	XXXX
A-20	2008	B-25	662	B-29	30 impounded		