Background Data:
The Air War Game—Battle of Britain

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Background History

• **May 1940: German Blitzkrieg in the West**
  - German mechanized warfare shocks the Allies
  - Holland, Belgium fall in days, France defeated in 6 weeks
  - British Expeditionary Force (BEF) miraculously escapes at Dunkirk, leaving most of its equipment behind

• **Operation Sea Lion: Germany poised to invade England**
  - Triumphant Luftwaffe operates from airbases in Northern France through Norway
Air War Game
Early War Version

• Britain on defense
  – Defend on the sea and in the air

• Germany on offense
  – Neutralize the Royal Navy and soften the defenses in preparation for an amphibious assault against Southeastern England
Air Defense of England
**Bombers 2, Figure 1:** Bombing techniques used by Mustang pilots engaged on fighter-bomber operations. Methods used by pilots of other types of aircraft were similar. Rockets were launched in a 45° dive, followed by a pull up to regain height.

10,000 ft

Dive bombing:
70° dive allows lower release height but accuracy depends on correct judgement of bomb trajectory.

5,000 ft

Dive bombing:
Vertical dive for most accurate aim but bombs are released early to give safe height for pull-out. Maximum safe speed 450 mph.

Release

30° dive

Release and pull up

Skip bombing:
bombs lobbed at target from low altitude. Least accurate method.

*Source: Freeman, R. A., Combat Profile series. P-51 Mustang (London, 1989).*
Decisions Made in the 1930s

- Have the sides invested in the right technologies to achieve their goals?
  - Planes and pilots
  - Strategic vs. tactical capabilities
  - Offensive vs. defensive focus
  - Detection measures and countermeasures
  - Interception methods
Battle of Britain: The Movie
## Planes vs. Planes

<table>
<thead>
<tr>
<th>Plane</th>
<th>HP</th>
<th>Max Speed</th>
<th>Climb</th>
<th>Range</th>
<th>Ceiling</th>
<th>Bomb Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hurricane IIC</td>
<td>1300</td>
<td>327 mph @ 18K ft</td>
<td>2750 ft/min</td>
<td>460mi @ 175 mph</td>
<td>35K</td>
<td></td>
</tr>
<tr>
<td>Spitfire IA</td>
<td>1175</td>
<td>355</td>
<td>0-20K/9 min</td>
<td>575</td>
<td>34K</td>
<td></td>
</tr>
<tr>
<td>ME BF 109E</td>
<td>1175</td>
<td>348 @ 14.5</td>
<td>3510 ft/min</td>
<td>410</td>
<td>36.5K</td>
<td></td>
</tr>
<tr>
<td>ME BF 110G</td>
<td>1100x2</td>
<td>349 250 cruising</td>
<td>0-19.6K/9.2 min</td>
<td>540</td>
<td>32K</td>
<td></td>
</tr>
<tr>
<td>JU 87D Stuka</td>
<td>1400</td>
<td>195 max 118 cruising</td>
<td>199</td>
<td>24K</td>
<td>3968 lbs</td>
<td></td>
</tr>
<tr>
<td>JU 88</td>
<td>1200x2</td>
<td>286 @ 16K</td>
<td>239 cruising</td>
<td>1553</td>
<td>26.5K</td>
<td>5510</td>
</tr>
<tr>
<td>DO 17z</td>
<td>1000x2</td>
<td>265 @ 16.5</td>
<td>236 @ 14.5</td>
<td>745</td>
<td>26.7K</td>
<td>2200 1100</td>
</tr>
<tr>
<td>HE 111</td>
<td>1350x2</td>
<td>270 @ 19.6</td>
<td></td>
<td>1212 760 (loaded)</td>
<td>27.9K</td>
<td>Up to 5500</td>
</tr>
</tbody>
</table>
RAdio Detection And Ranging

- Over the horizon detection
- Based on the principle of radio reflection

Fig. 7.1 The Principle of Radar: A powerful pulse of radiation transmitted by the radar antenna induces electric currents in the target. These currents in turn radiate a pulse, but very much weaker, and scattered in all directions. Some of this scattered radiation returns to the radar antenna, which now functions as a receiving antenna. The time between the transmission and return of the pulse measures the target range. The return pulse is only detected when the radar is ‘looking’ at the target.
Chain Home vs. Chain Home Low

30 MHz, 10m waves, 125 mi range @ 15-20,000 ft

200 MHz, 1.5m waves 40 mi range 5000 ft alt.

Shorter wavelengths, higher frequencies, greater precision in ranging
Rotating antenna for better directional accuracy
Suitable for night interception

Plate 7.1 Chain Home. Chain Home provided the world’s first strategic air defence radar network, erected along the east and south coasts of Britain (later extended to the west coast). It used High Frequency and consequently demanded large installations. 360-foot-high transmitter masts are seen on the left of the photograph above and 240-foot receiver masts on the right. (Photo: By courtesy of GEC-Marconi)

Fig. 8.1 Chain Home Low. British radar technology kept forward from Chain Home to Chain Home Low (CHL), which became the most numerous equipment during 1940. Working on the much higher frequency of 200 megahertz, it was compact and was mounted on rotating turntables to provide 360° scanning. It was mounted on 185-foot towers (as above) or cliff tops to improve performance against low-altitude intruders. Like Chain Home, CHL used horizontal polarisation, a good choice for long-range surveillance out to sea, but prone to ground clutter inland, and it remained chiefly a coastal radar. CHL was the first radar to make ground-controlled interception (GCI) possible at night.
Fig. 1. Principles of CH (Chain Home) R.D.F. system
Ground Control Intercept

**Fig. 7.2** *Forms of Radar Display*  On the left above, the ‘A’ scope, with a baseline corresponding to a fixed time interval. The transmitted pulse registers at the left, the returned echo showing as a ‘blip’ at some distance to the right – the distance being proportional to the range to the target. On the right, the ‘PPI’ (plan position indicator), in which the radar is at the centre of the display, which shows not only distance but the direction of the target. In this illustration, North is assumed to be at the top.
Battle of Britain: British Command and Control System, 1940

1. Radar station
2. Dowding, Fighter command
3. Park, Number 11 group
4. Sector station
5. Observer Corps HQ
6. AAA (Army)
7. Observer post (constabulary)
8. Barrage balloons

Land-line:
- Information
- Information and orders
- Information, launch orders
What Really Happened – Part I

The Luftwaffe concentrated on offensive reconnaissance during this period, attacking convoys in the Channel, RDF stations and the coastal towns in the planned invasion area.

Phase 1 - July 10th to August 7th
Having tested the defences, Phase 2 of the plan was to destroy the aircraft of Fighter Command, on the ground or in the air. The airfields of 11 Group in particular came in for heavy attacks.
What Really Happened – Part III

Massed attacks began against London and other major cities, as well as aircraft factories and other strategic targets. As large numbers of fighters met the day raids, the Luftwaffe switched to night bombing.

Phase 3 - 7th September to October 5th
What Really Happened - Part IV

Heavy bomber raids against cities continued at night. During the day fighter-bombers flew nuisance raids against coastal towns, airfields and other military targets. The raids petered out as the weather worsened.

Phase 4 - 6th October to October 31st
Next Week: Strategic Bombing
Offensive vs. Germany

• Fighters vs. Bombers
  - What are good targets?
    • Strategic vs. tactical plans
  - Precision bombing
    • Daylight vs. nighttime raids, formation flying, escorts
    • Minimizing plane and crew losses while maximizing enemy destruction
  - How do you intercept attackers?
    • Where is the enemy? Radar to observe planes at a distance, searchlights to track plans nearby
    • How to confuse the defender as to attacker’s plans and intentions?
    • Getting the fighters to arrive at where you expect to the bombers to be