Background Data:
The Air War Game—Battle of Britain

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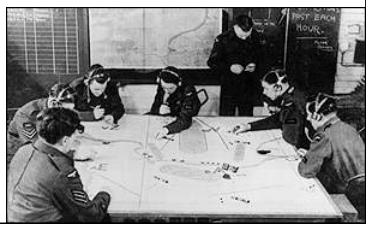
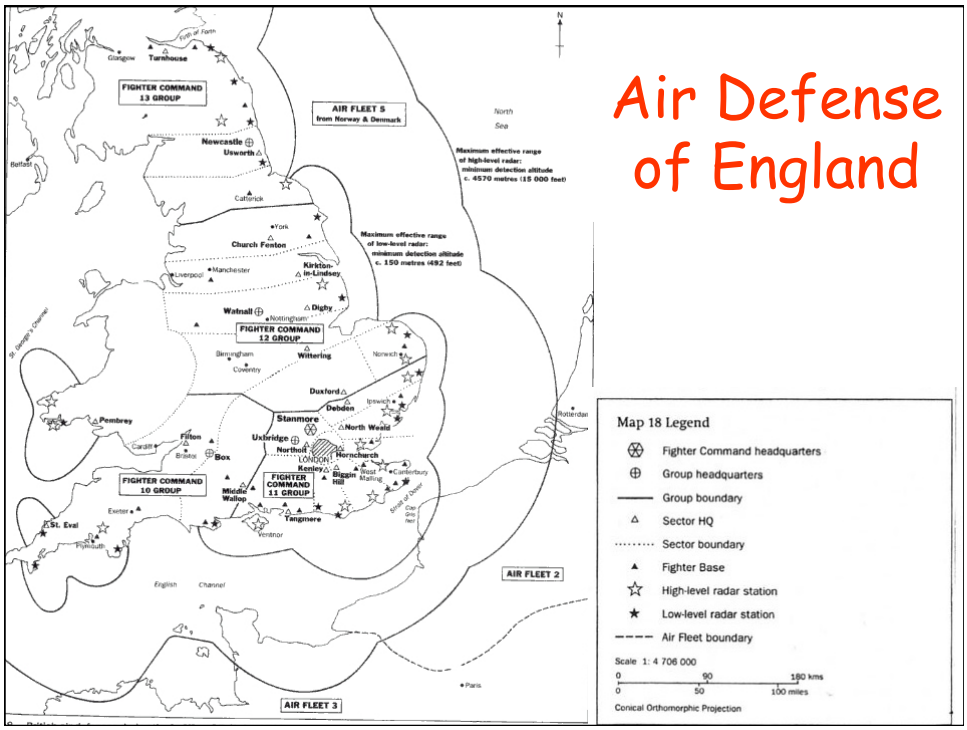


Background History

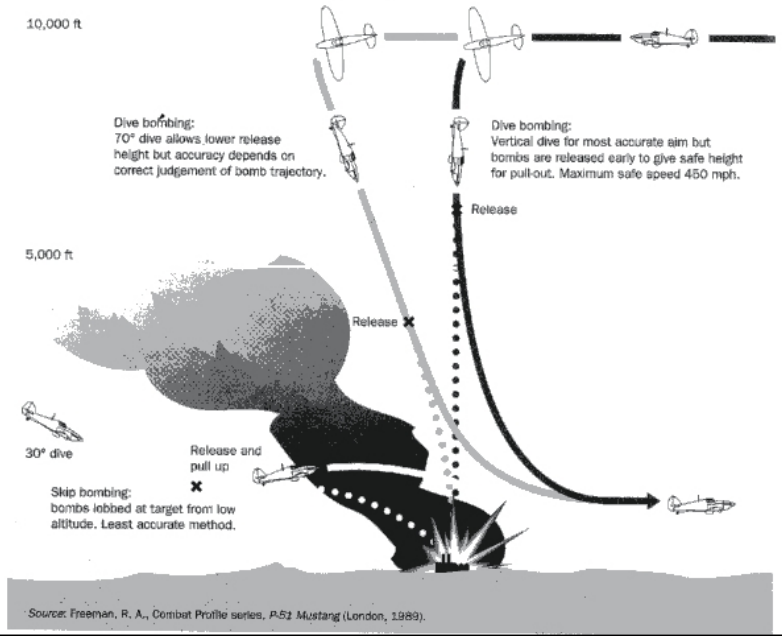
- May 1940: German Blitzkrieg in the West
  - German mechanized warfare shocks the Allies
  - Holland, Belgium fall in days, France defeated in 6 weeks
  - British Expeditionary Force (BEF) miraculously escapes at Dunkirk, leaving most of its equipment behind
- Operation Sea Lion: Germany poised to invade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



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.



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

	HP	Max Speed	Climb	Range	Ceiling	Bomb Load
Hurricane IIC	1300	327 mph @ 18K ft	2750 ft/ min	460mi @ 175 mph	35K ft	
Spitfire IA	1175	355	0-20K/9 min	575	34K	
ME BF 109E	1175	348 @ 14.5 233 cruising	3510 ft/ min	410	36.5K	
ME BF 110G	1100x2	349 250 cruising	0-19.6K/ 9.2 min	540	32K	
JU 87D Stuka	1400	195 max 118 cruising		199	24K	3968 lbs
JU 88	1200x2	286 @ 16K 239 cruising		1553	26.5K	5510
DO 17z	1000x2	265 @ 16.5 236 @ 14.5		745 1860 (tanks)	26.7K	2200 1100
HE 111	1350x2	270 @ 19.6		1212 760 (loaded)	27.9K	Up to 5500

Hurricane IIC

JU 87

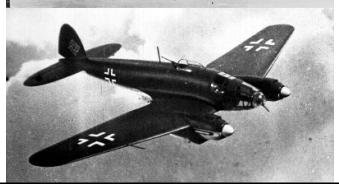
Spitfire IA

JU 88

ME BF 109E

DO 17

ME BF 110G



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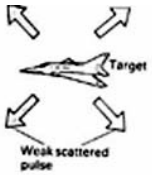
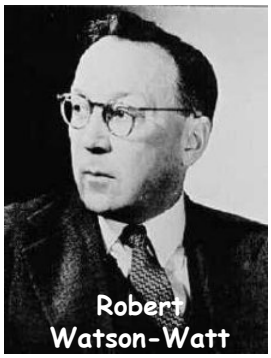
RAdio Detection And Ranging

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





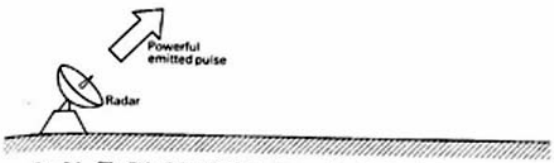
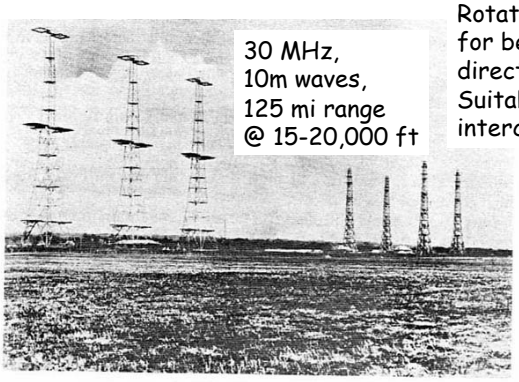


FIG. 7.1 **The Principle of Radar** A powerful pulse of radiation transmitted by the radar antenna induces electric currents in the target. These currents in turn radiate a pulse, but very much weaker, and scattered in all directions. Some of this scattered radiation returns to the radar antenna, which 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.

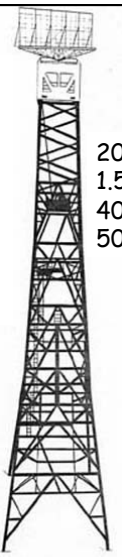
Chain Home vs. Chain Home Low

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



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

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*)



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

FIG. 8.1 **Chain Home Low** British radar technology leapt 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.

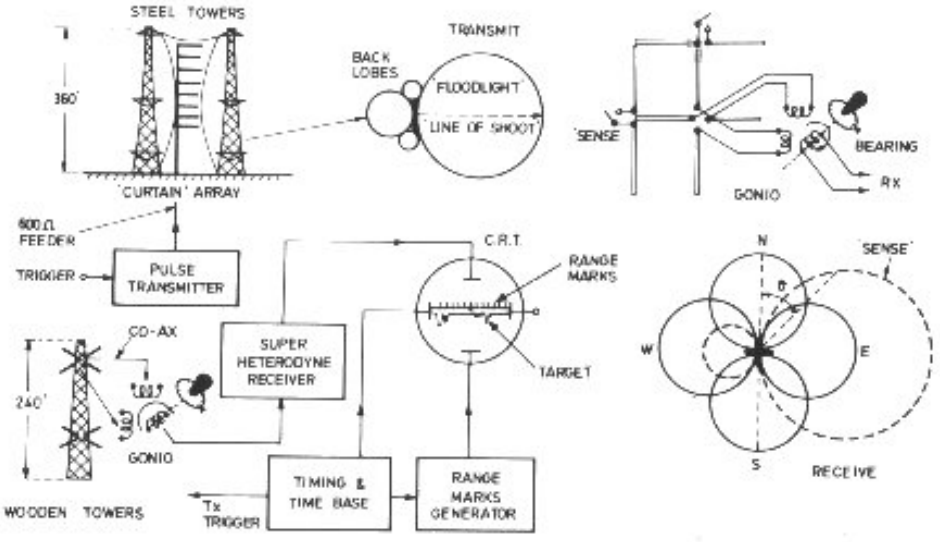


Fig. 1. Principles of CH (Chain Home) R.D.F. system

Ground Control Intercept

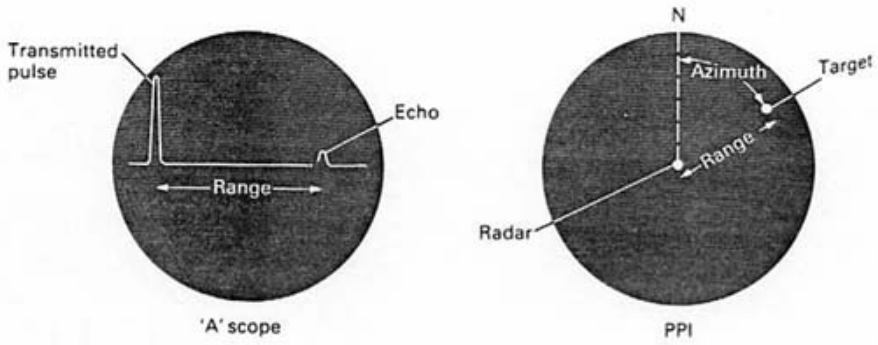
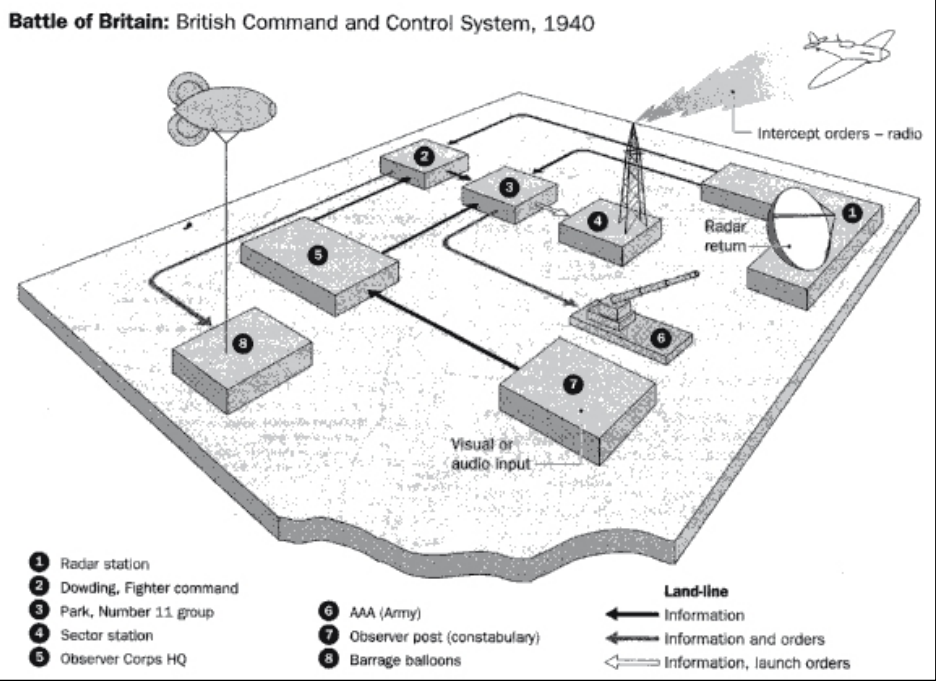
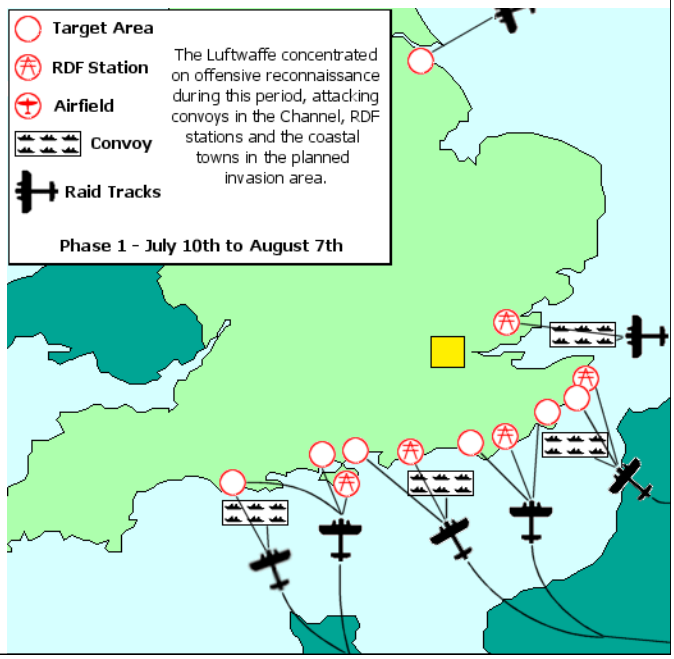


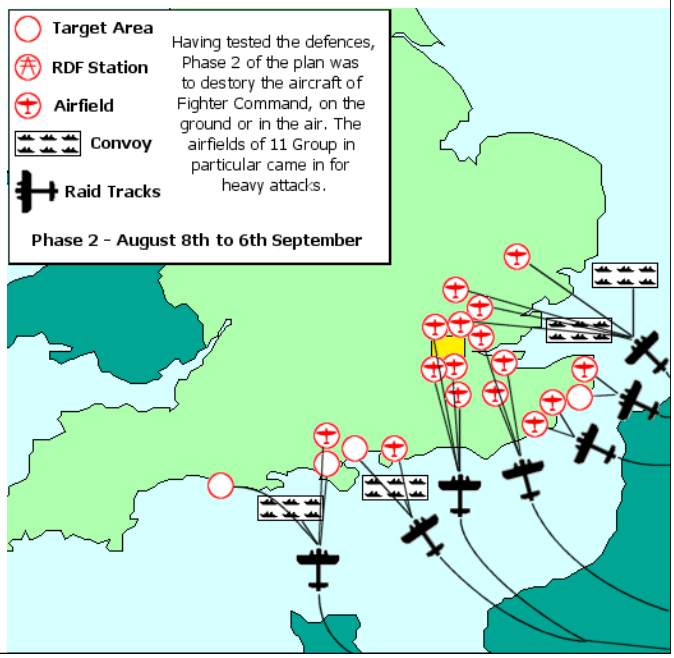
FIG. 7.2 **Forms of Radar Display** On the left above, the 'A' scope, with a baseline corresponding to a fixed time interval. The transmitted pulse registers at the left, the returned echo showing as a 'blip' at some distance to the right – the distance being proportional to the range to the target. 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.



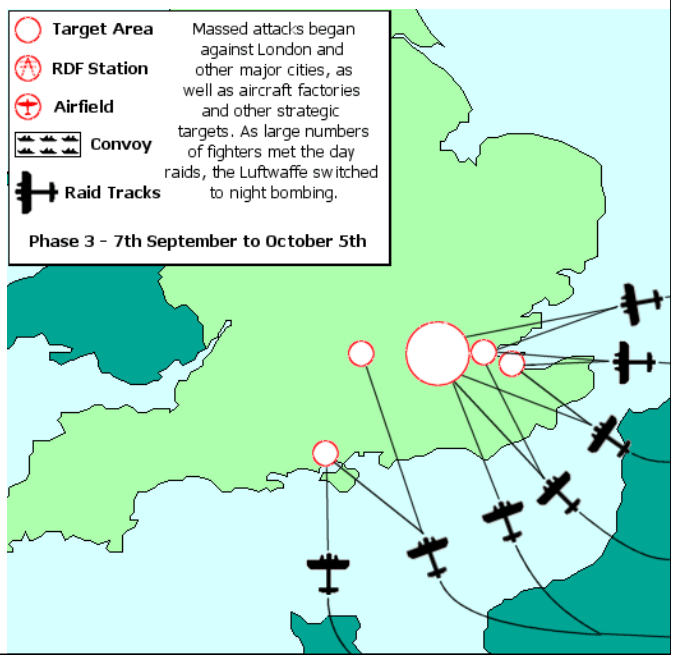
What Really Happened - Part I



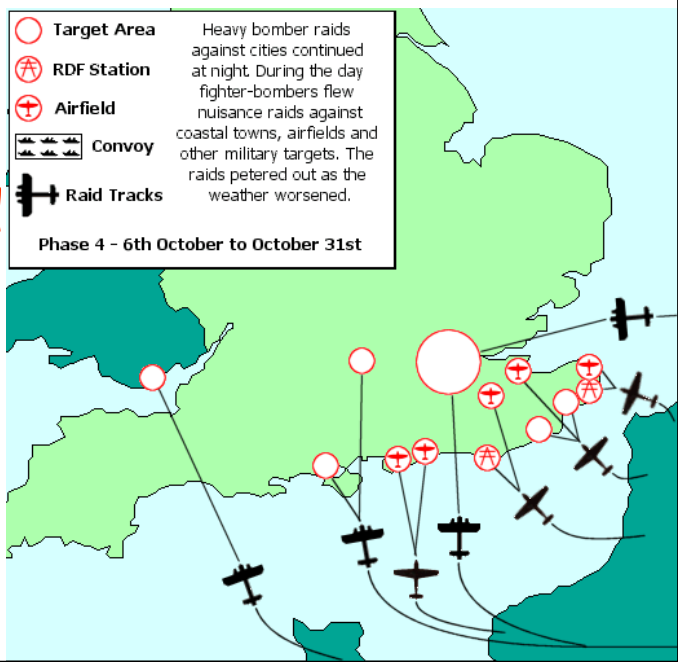
What Really Happened - Part II



What Really Happened - Part III



What Really Happened - Part IV



Next Week: Strategic Bombing Offensive vs. Germany

- Fighters vs. Bombers
  - What are good targets?
    - Strategic vs. tactical plans
  - Precision bombing
    - Daylight vs. nightime 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