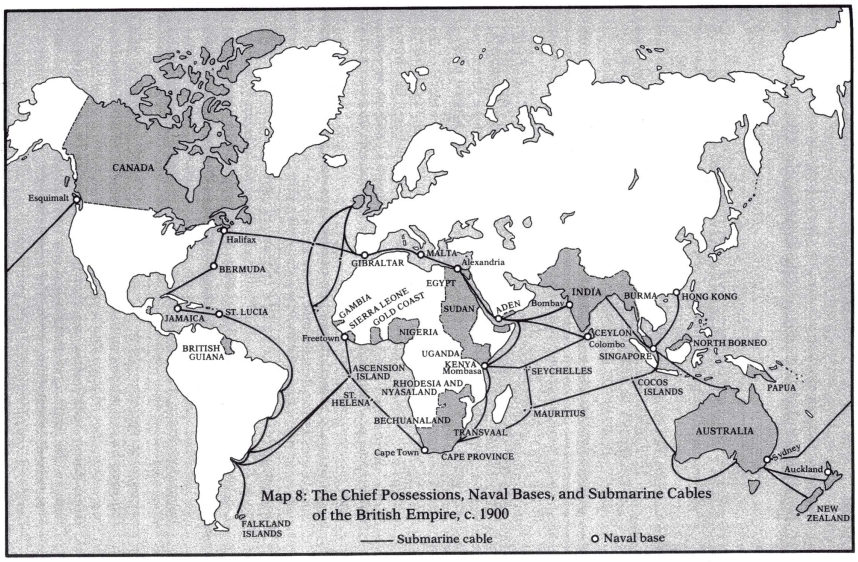
Background Data: The Naval War Game

Randy H. Katz
CS Division, EECS Dept.
University of California, Berkeley
Spring 2013

Data Obtained From

- Paul Kennedy, "The Rise and Fall of the Great Powers," Random House, NY, 1987.
- John Keegan, "The Price of Admiralty: The Evolution of Naval Warfare," Viking Press, NY, 1988.

British Empire in 1900



Population

Table 12. Total Population of the Powers, 1890–1938[17]
(millions)

		1890	*1900*	*1910*	*1913*	*1920*	*1928*	*1938*	
1	Russia	116.8	135.6	159.3	175.1	126.6	150.4	180.6	1
2	United States	62.6	75.9	91.9	97.3	105.7	119.1	138.3	2
3	Germany	49.2	56.0	64.5	66.9	42.8	55.4	68.5	4
4	Austria-Hungary	42.6	46.7	50.8	52.1	—	—	—	
5	Japan	39.9	43.8	49.1	51.3	55.9	62.1	72.2	3
6	France	38.3	38.9	39.5	39.7	39.0	41.0	41.9	7
7	Britain	37.4	41.1	44.9	45.6	44.4	45.7	47.6	5
8	Italy	30.0	32.2	34.4	35.1	37.7	40.3	43.8	6

Urbanization

Table 13. Urban Population of the Powers (in millions) and as Percentage of the Total Population, 1890–1938[19]

	1890	*1900*	*1910*	*1913*	*1920*	*1928*	*1938*	
1 Britain (1)	11.2 (29.9%)	13.5 (32.8%)	15.3 (34.9%)	15.8 (34.6%)	16.6 (37.3%)	17.5 (38.2%)	18.7 (39.2%)	5 (1)
2 United States (2)	9.6 (15.3%)	14.2 (18.7%)	20.3 (22.0)	22.5 (23.1%)	27.4 (25.9%)	34.3 (28.7%)	45.1 (32.8%)	1 (2)
3 Germany (4)	5.6 (11.3%)	8.7 (15.5%)	12.9 (20.0%)	14.1 (21.0%)	15.3 (35.7%)	19.1 (34.4%)	20.7 (30.2%)	3 (3)
4 France (3)	4.5 (11.7%)	5.2 (13.3%)	5.7 (14.4%)	5.9 (14.8%)	5.9 (15.1%)	6.3 (15.3%)	6.3 (15.0%)	7 (7)
5 Russia (8)	4.3 (3.6%)	6.6 (4.8%)	10.2 (6.4%)	12.3 (7.0%)	4.0 (3.1%)	10.7 (7.1%)	36.5 (20.2%)	2 (5)
6 Italy (5)	2.7 (9.0%)	3.1 (9.6%)	3.8 (11.0%)	4.1 (11.6%)	5.0 (13.2%)	6.5 (16.1%)	8.0 (18.2%)	6 (6)
7 Japan (6)	2.5 (6.3%)	3.8 (8.6%)	5.8 (10.3%)	6.6 (12.8%)	6.4 (11.6%)	9.7 (15.6%)	20.7 (28.6%)	3 (4)
8 Austria-Hungary (7)	2.4 (5.6%)	3.1 (6.6%)	4.2 (8.2%)	4.6 (8.8%)	—	—	—	

Industrialization

Table 14. Per Capita Levels of Industrialization, 1880–1938[20]

(relative to G.B. in 1900 = 100)

	1880	*1900*	*1913*	*1928*	*1938*	
1 Great Britain	87	[100]	115	122	157	2
2 United States	38	69	126	182	167	1
3 France	28	39	59	82	73	4
4 Germany	25	52	85	128	144	3
5 Italy	12	17	26	44	61	5
6 Austria	15	23	32	—	—	
7 Russia	10	15	20	20	38	7
8 Japan	9	12	20	30	51	6

Steel Production

Table 15. Iron/Steel Production of the Powers, 1890–1938[21]
(millions of tons; pig-iron production for 1890, steel thereafter)

	1890	*1900*	*1910*	*1913*	*1920*	*1930*	*1938*
United States	9.3	10.3	26.5	31.8	42.3	41.3	28.8
Britain	8.0	5.0	6.5	7.7	9.2	7.4	10.5
Germany	4.1	6.3	13.6	17.6	7.6	11.3	23.2
France	1.9	1.5	3.4	4.6	2.7	9.4	6.1
Austria-Hungary	0.97	1.1	2.1	2.6	—	—	—
Russia	0.95	2.2	3.5	4.8	0.16	5.7	18.0
Japan	0.02	—	0.16	0.25	0.84	2.3	7.0
Italy	0.01	0.11	0.73	0.93	0.73	1.7	2.3

Energy

Table 16. Energy Consumption of the Powers, 1890–1938[22]
(in millions of metric tons of coal equivalent)

	1890	*1900*	*1910*	*1913*	*1920*	*1930*	*1938*
United States	147	248	483	541	694	762	697
Britain	145	171	185	195	212	184	196
Germany	71	112	158	187	159	177	228
France	36	47.9	55	62.5	65	97.5	84
Austria-Hungary	19.7	29	40	49.4	—	—	—
Russia	10.9	30	41	54	14.3	65	177
Japan	4.6	4.6	15.4	23	34	55.8	96.5
Italy	4.5	5	9.6	11	14.3	24	27.8

Measure of Industrial Power

Table 17. Total Industrial Potential of the Powers in Relative Perspective, 1880–1938[23]
(U.K. in 1900 = 100)

	1880	*1900*	*1913*	*1928*	*1938*
Britain	73.3	[100]	127.2	135	181
United States	46.9	127.8	298.1	533	528
Germany	27.4	71.2	137.7	158	214
France	25.1	36.8	57.3	82	74
Russia	24.5	47.5	76.6	72	152
Austria-Hungary	14	25.6	40.7	—	—
Italy	8.1	13.6	22.5	37	46
Japan	7.6	13	25.1	45	88

Industrial Might

Table 18. Relative Shares of World Manufacturing Output, 1880–1938[24]
(percent)

	1880	*1900*	*1913*	*1928*	*1938*
Britain	22.9	18.5	13.6	9.9	10.7
United States	14.7	23.6	32.0	39.3	31.4
Germany	8.5	13.2	14.8	11.6	12.7
France	7.8	6.8	6.1	6.0	4.4
Russia	7.6	8.8	8.2	5.3	9.0
Austria-Hungary	4.4	4.7	4.4	—	—
Italy	2.5	2.5	2.4	2.7	2.8

Size of Armed Forces

Table 19. Military and Naval Personnel of the Powers, 1880–1914[26]

	1880	*1890*	*1900*	*1910*	*1914*
Russia	791,000	677,000	1,162,000	1,285,000	1,352,000
France	543,000	542,000	715,000	769,000	910,000
Germany	426,000	504,000	524,000	694,000	891,000
Britain	367,000	420,000	624,000	571,000	532,000
Austria-Hungary	246,000	346,000	385,000	425,000	444,000
Italy	216,000	284,000	255,000	322,000	345,000
Japan	71,000	84,000	234,000	271,000	306,000
United States	34.000	39.000	96,000	127,000	164,000

Relative Fleet Sizes

Table 20. Warship Tonnage of the Powers, 1880–1914[27]

	1880	*1890*	*1900*	*1910*	*1914*
Britain	650,000	679,000	1,065,000	2,174,000	2,714,000
France	271,000	319,000	499,000	725,000	900,000
Russia	200,000	180,000	383,000	401,000	679,000
United States	169,000	?240,000	333,000	824,000	985,000
Italy	100,000	242,000	245,000	327,000	498,000
Germany	88,000	190,000	285,000	964,000	1,305,000
Austria-Hungary	60,000	66,000	87,000	210,000	372,000
Japan	15,000	41,000	187,000	496,000	700,000

Cost of War

Table 25. War Expenditure and Total Mobilized Forces, 1914–1919[235]

	War Expenditure at 1913 Prices (billions of dollars)	*Total Mobilized Forces (millions)*
British Empire	23.0	9.5
France	9.3	8.2
Russia	5.4	13.0
Italy	3.2	5.6
United States	17.1	3.8
Other Allies*	– 0.3	2.6
Total Allies	57.7	40.7
Germany	19.9	13.25
Austria-Hungary	4.7	9.00
Bulgaria, Turkey	0.1	2.85
Total Central Powers	24.7	25.10

*Belgium, Rumania, Portugal, Greece, Serbia.

Richest Countries
Early 20th Century

Table 21. National Income, Population, and per Capita Income of the Powers in 1914

	National Income	*Population*	*Per Capita Income*
United States	$37 billion	98 million	$377
Britain	11	45	244
France	6	39	153
Japan	2	55	36
Germany	12	65	184
Italy	4	37	108
Russia	7	171	41
Austria-Hungary	3	52	57

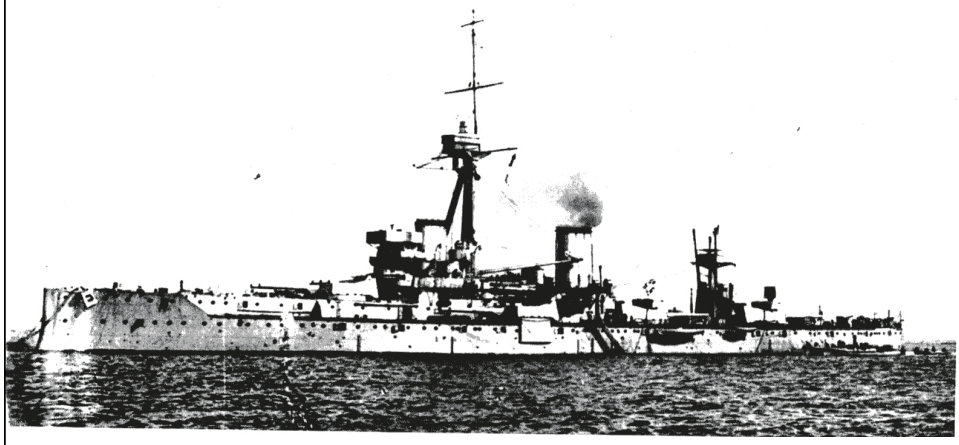
Naval Game Data

- Battleships are good against other battleships, heavy armored, big guns, slow
- Cruiser are faster, less well armored, are fair against battleships, best used in hit-and-run tactics and recon
- Torpedo boats are good against battleships if they can get close enough!
- Minelayers deny sea lanes to other ships
- Minesweepers open up mined sea lanes
- Destroyers good against torpedo boats & subs, other destroyers but not cruisers or battleships (guns not big enough, too slow to get in close with torpedoes)
- Subs are slow, vulnerable to destroyers, but deadly versus anything they can close with

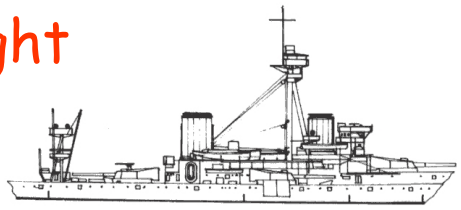
Naval Game Data
1899-1905 Programme

- Germany: 58 million marks per year
- 3 ship yards, 20 million marks of construction per year in each
  - Battleship: 20 million/3 years
  - Cruiser: 20 million/3 years
  - Torpedo Boat: 0.5 million/.5 year
  - Minelayer: 0.5 million/.5 year
  - Minesweeper: 0.5 million/.5 year
  - Destroyer: 1.5 million/1 year
  - Submarines: 0.5 million/2 years

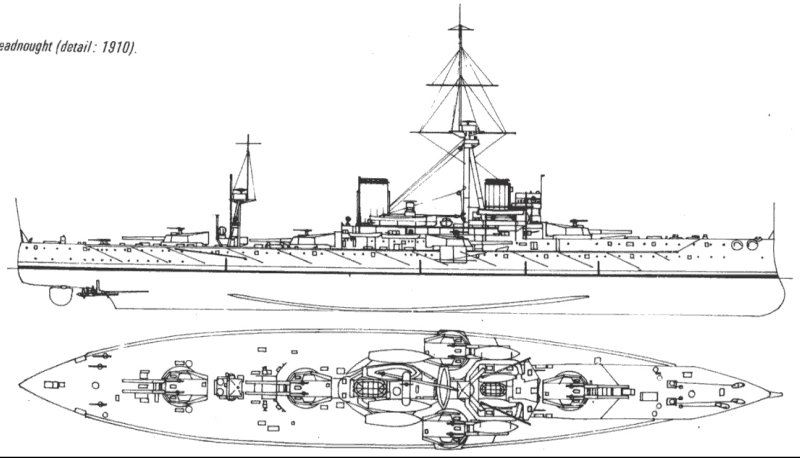
Dreadnought



Dreadnought



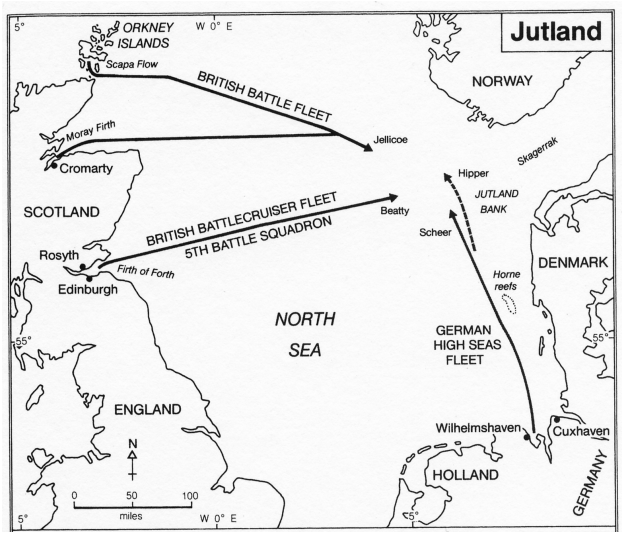
Dreadnought (detail : 1910).



Naval Game Data 1901-1917

- 1906: Dreadnought—bigger, better armed and gunned battleship, able to destroy any existing battleship
- Germany: Ship building program upped to 78 million marks per year, fourth ship yard constructed
- Dreadnought-class ships: 20 million/3 years PLUS you must widen Kiel Canal (see http://www.kiel-canal.org/english.htm) at a cost of 3 years/240 million mark
- New Ship Class—BATTLE cruiser: 20 million/3 years
- Improved Submarines: .5 million/2 years

Battle of Jutland:
The Search



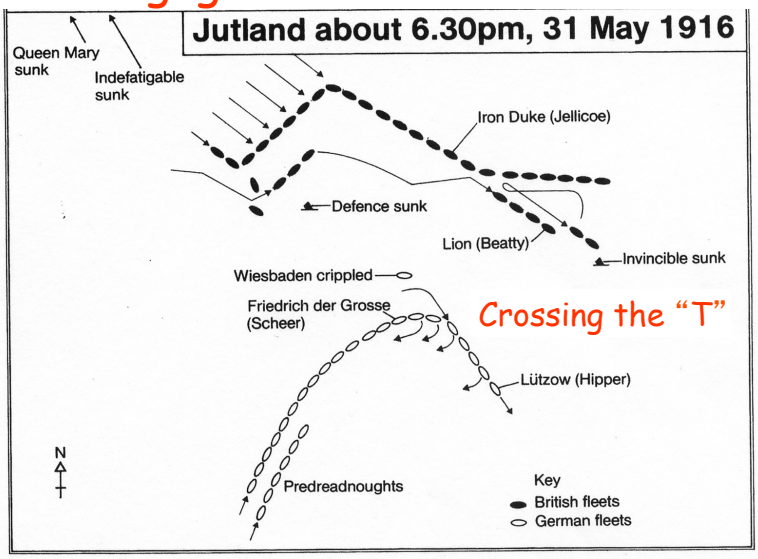
Battle of Jutland
Scheer's vs. Jellicoe's Plans

- High Seas Fleet sortie lures Grand Fleet into a submarine/mine trap (it didn't work
- Grand Fleet tries to engage and sink the High Seas Fleet, by getting between it and its home port
  - Intelligence bust: takes 8 hours before Admiralty realizes that the Germans have put to sea

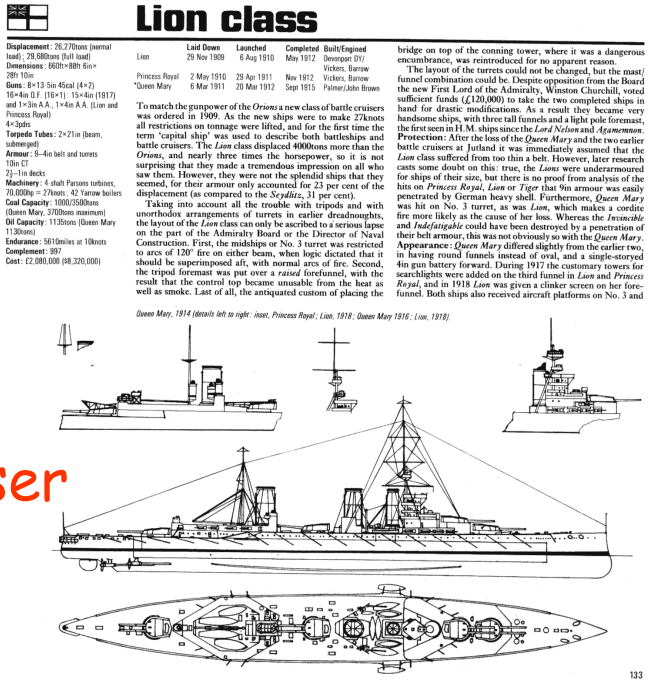
Battle of Jutland

- Battlecruiser action—"The British run to the South"
- Encounter the High Sea Fleets—"The German run to the North"
- First encounter of the Battleships
- Second encounter of the Battleships
- Night action

Battle of Jutland:
Engagement and Breakoff



Lion Battlecruiser Class



Lion class

Displacement: 26,270tons (normal load); 29,680tons (full load)
Dimensions: 660ft×88ft 6in×28ft 10in
Guns: 8×13·5in 45cal (4×2) 16×4in D.F. (16×1); 15×4in (1917) and 1×3in A.A., 1×4in A.A. (Lion and Princess Royal)
4×3pdrs
Torpedo Tubes: 2×21in (beam, submerged)
Armour: 9–4in belt and turrets 10in CT
2½–1in decks
Machinery: 4 shaft Parsons turbines, 70,000hp = 27knots; 42 Yarrow boilers
Coal Capacity: 1000/3500tons (Queen Mary, 3700tons maximum)
Oil Capacity: 1135tons (Queen Mary 1130tons)
Endurance: 5610miles at 10knots
Complement: 997
Cost: £2,080,000 ($8,320,000)

	Laid Down	Launched	Completed	Built/Engined
Lion	29 Nov 1909	6 Aug 1910	May 1912	Devonport DY; Vickers, Barrow
Princess Royal	2 May 1910	29 Apr 1911	Nov 1912	Vickers, Barrow
*Queen Mary	6 Mar 1911	20 Mar 1912	Sept 1915	Palmer/John Brown

To match the gunpower of the *Orions* a new class of battle cruisers was ordered in 1909. As the new ships were to make 27knots all restrictions on tonnage were lifted, and for the first time the term 'capital ship' was used to describe both battleships and battle cruisers. The *Lion* class displaced 4000tons more than the *Orions*, and nearly three times the horsepower, so it is not surprising that they made a tremendous impression on all who saw them. However, they were not the splendid ships that they seemed, for their armour only accounted for 23 per cent of the displacement (as compared to the *Seydlitz*, 31 per cent).

Taking into account all the trouble with tripods and with unorthodox arrangements of turrets in earlier dreadnoughts, the layout of the *Lion* class can only be ascribed to a serious lapse on the part of the Admiralty Board or the Director of Naval Construction. First, the midships or No. 3 turret was restricted to arcs of 120° fire on either beam, when logic dictated that it should be superimposed aft, with normal arcs of fire. Second, the tripod foremast was put over a *raised* forefunnel, with the result that the control top became unusable from the heat as well as smoke. Last of all, the antiquated custom of placing the bridge on top of the conning tower, where it was a dangerous encumbrance, was reintroduced for no apparent reason.

The layout of the turrets could not be changed, but the mast/funnel combination could be. Despite opposition from the Board the new First Lord of the Admiralty, Winston Churchill, voted sufficient funds (£120,000) to take the two completed ships in hand for drastic modifications. As a result they became very handsome ships, with three tall funnels and a light pole foremast, the first seen in H.M. ships since the *Lord Nelson* and *Agamemnon*.

Protection: After the loss of the *Queen Mary* and the two earlier battle cruisers at Jutland it was immediately assumed that the *Lion* class suffered from too thin a belt. However, later research casts some doubt on this: true, the *Lions* were underarmoured for ships of their size, but there is no proof from analysis of the hits on *Princess Royal*, *Lion* or *Tiger* that 9in armour was easily penetrated by German heavy shell. Furthermore, *Queen Mary* was hit on No. 3 turret, as was *Lion*, which makes a cordite fire more likely as the cause of her loss. Whereas the *Invincible* and *Indefatigable* could have been destroyed by a penetration of their belt armour, this was not obviously so with the *Queen Mary*.

Appearance: *Queen Mary* differed slightly from the earlier two, in having round funnels instead of oval, and a single-storyed 4in gun battery forward. During 1917 the customary towers for searchlights were added on the third funnel in *Lion* and *Princess Royal*, and in 1918 *Lion* was given a clinker screen on her fore-funnel. Both ships also received aircraft platforms on No. 3 and

Queen Mary, 1914 (details left to right: inset, Princess Royal; Lion, 1918; Queen Mary 1916; Lion, 1918).

133

Battle of Jutland
Points for Discussion

- Room 40 (British codebreakers) and intelligence assessment during the battle: the discovery of the German's plans and intensions
- General confusion of the battle situation: Where is the enemy? Where are my forces? Can I get them engaged in time? Observation-Orientation-Decision-Action
- Difficulty of signaling and maintaining command and control

Battle of Jutland
More Points

- Weapons systems assessment: range finding, fire control, and ship design
- Command assessment: initiative of subordinates, level of training—who was better?
- Operational difficulty of night engagements
- In the verdict of history, who won?

Battle of Jutland
Final Assessment

- Last great ship-to-ship fleet action in history
- Jellicoe: "He was the one man who could have lost the war in an afternoon."
- Newsman's assessment: "The Germans assaulted their jailer, and found themselves back in jail at the end of the day."
- German's resulting naval strategy: unrestricted submarine warfare—with the result of bringing in the US on the British side