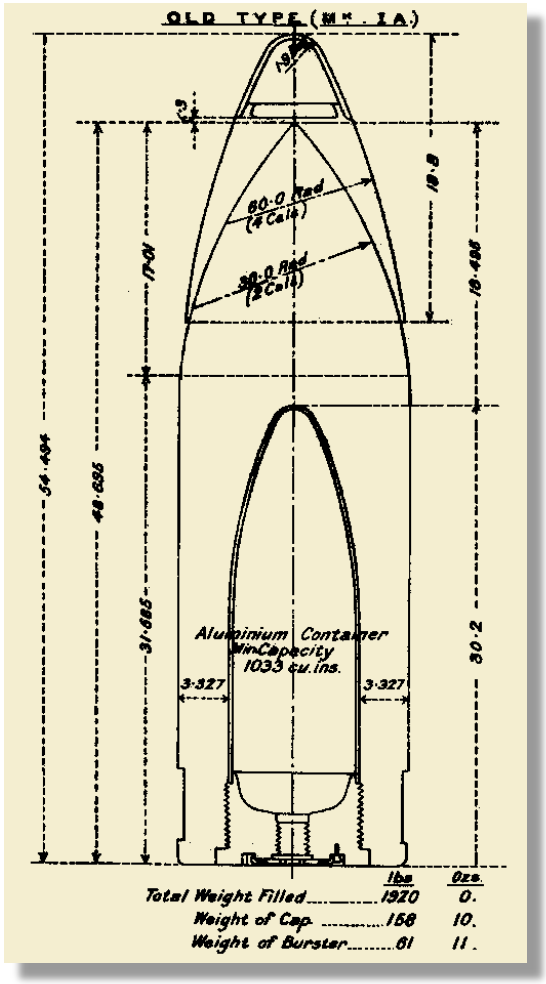
Jutland:
The Impact of Technology

Jack Joyner & Chris Carlson

Historicon 2016

Admiralty Trilogy & Seekrieg Seminar

“The Riddle of The Shells”



British 15” Mark IA Shell

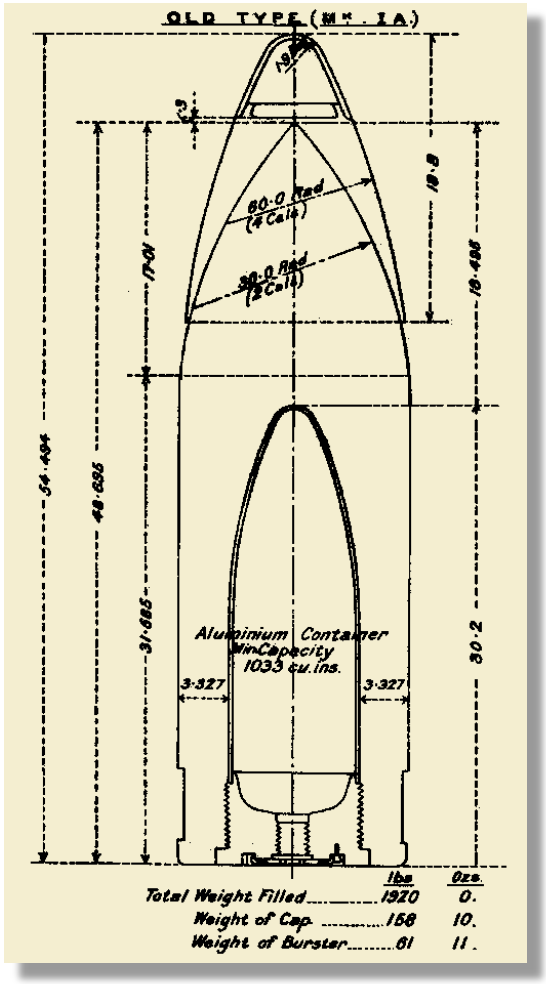
- The Effect of Increased Battle Ranges
- Cap Designs: Soft versus Hard
- Explosive Fillers
- Admiralty/Admiralität Response
- Suggested Reference:

  “The Riddle of the Shells”, McCallum, Iain; Warship 2002-3, 2004, 2005; Copyright 2003, 2004, 2005 Conway Maritime Press

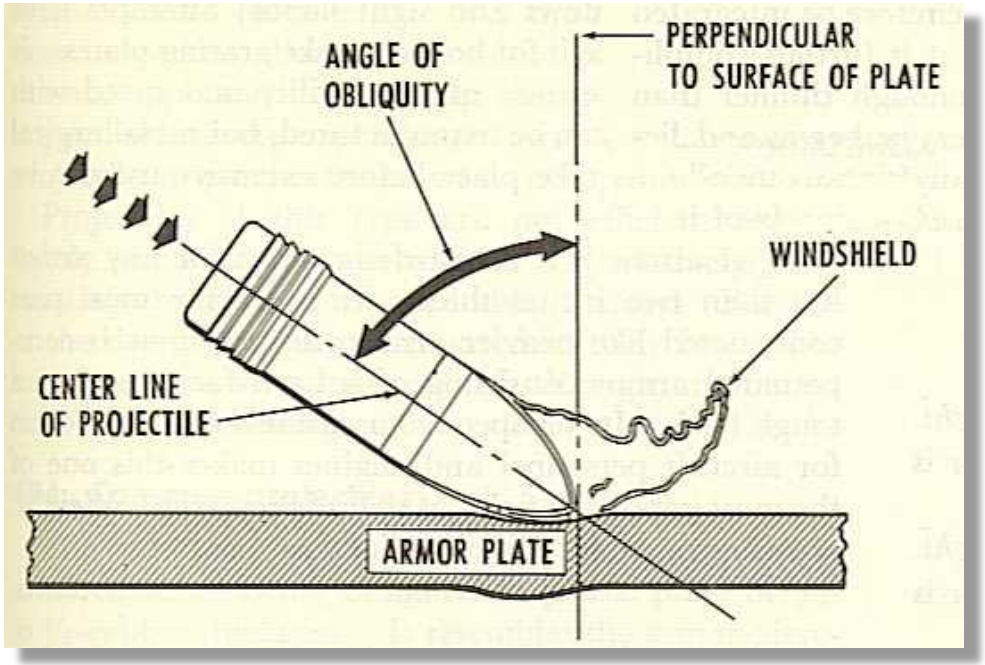
“The Riddle of The Shells”

Cap Designs

- Increased battle ranges caused increase failure due to increased impact angle
- British soft caps failed more often than German hard caps at impact angles of 20° or greater

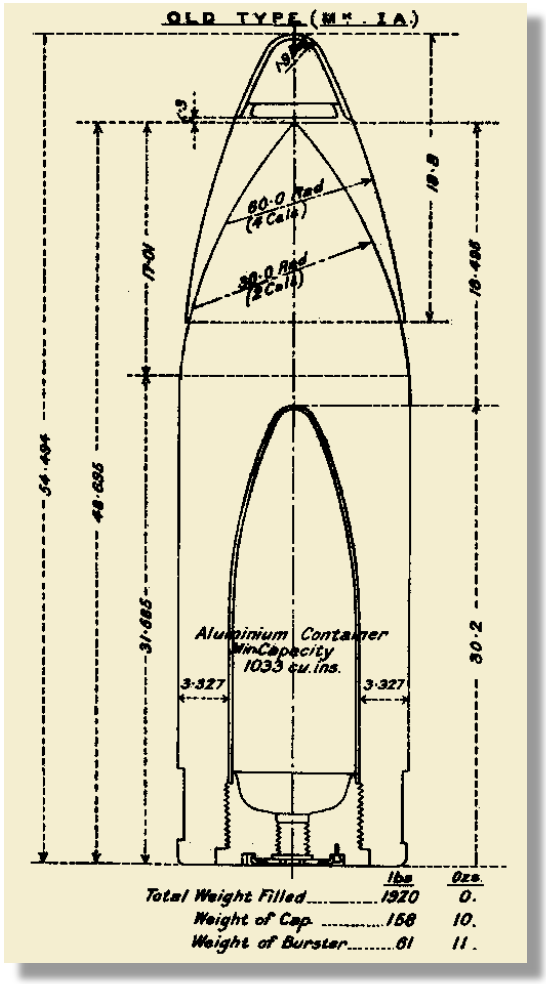


British 15” Mark IA Shell



http://www.navweaps.com/Weapons/Gun_Data_p3.php

"The Riddle of The Shells"



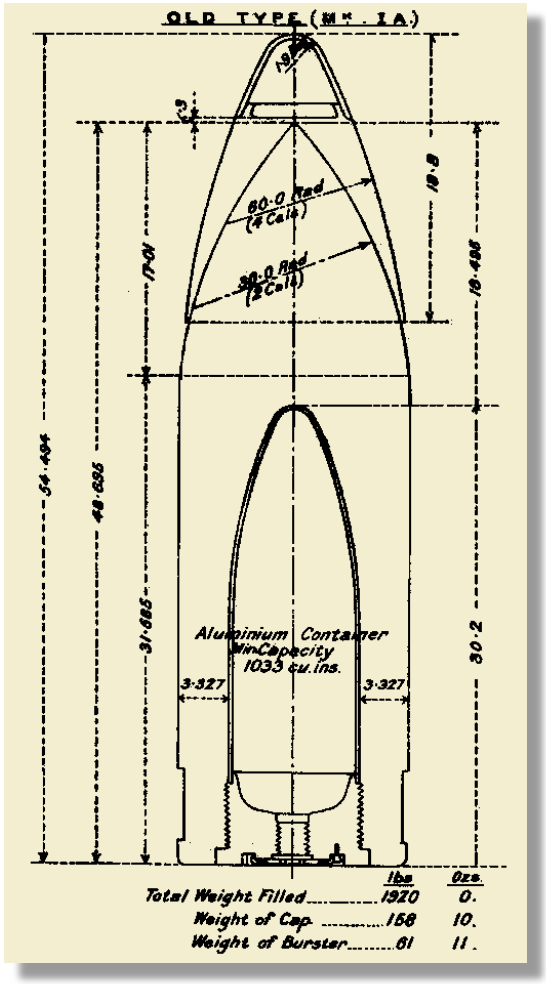
British 15" Mark IA Shell

Explosive Fillers in APC Shells

- German adoption of TNT (Trotyl) for improved stability beginning in 1902 with improved fuzing
- Shortcomings of APC with Lyddite burster known as early as Russo-Japanese War
- Overall failure rate at Jutland for German APC shells ~22%, *i.e.* 12% "duds" and 10% premature or incomplete detonation
- British shell performance poorer; *e.g.*, Campbell[1] shows that for 14 hits on German heavy armor (> 9") only one penetrated and exploded inside
- Similar results for hits on lighter armor

1. Campbell, John, "Jutland: An Analysis of the Fighting", NIP 1986, pp. 386-7

“The Riddle of The Shells”

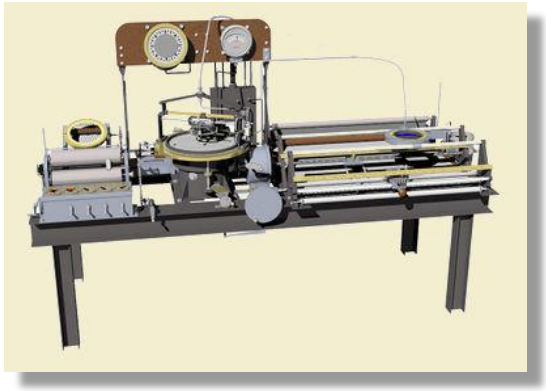


British 15” Mark IA Shell

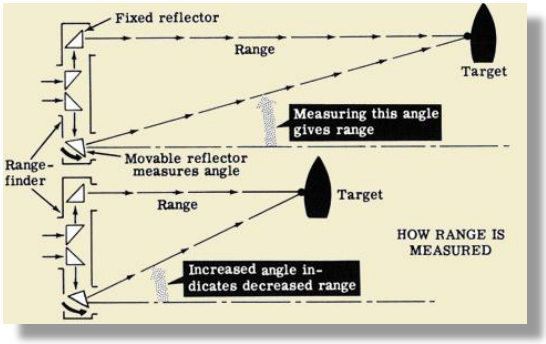
Admiralty Response

- Effects of Lyddite, but Lyddite retained due to:
  - TNT manufacturing process in control of German firms
  - Technology lacking to produce fuze for TNT shells
  - Flawed acceptance testing and restrictions on practice with Lyddite shells
  - Insufficient time for correction once issue was agreed upon
  - Orders for Lyddite HE and AP had already been placed.
  - Cost of APC three times that of Common shells
- Focus on continuing to attempt to improve existing APC design.

“Dreadnought Gunnery at the Battle of Jutland”



Dreyer Table Mark III



Rangefinder Principles

- **System design differences**
  - The German system
  - The British system
- **Rangefinder Types**
  - Coincidence
  - Stereoscopic
- **Outcomes**
- **Suggested References:**
  - “The Battle of Jutland”, Brooks, John; Cambridge University Press, 2016
  - Campbell, John, “Jutland: An Analysis of the Fighting”, Naval Institute Press, 1986
  - “Kiel and Jutland, Von Hase, Georg, Skeffington & Son, Ltd., 1921 https://archive.org/details/kieljutland00haseuoft

"Dreadnought Gunnery at the Battle of Jutland"

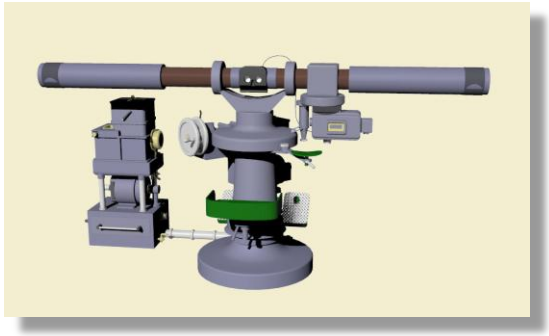
Ship	Dreyer Table	Director	9-ft R.F.s	15-ft R.F.s
Lion	III	yes	4	0
Princess Royal	III	yes	4	0
Queen Mary	II	yes	6	0
Tiger	IV	yes	7	0
New Zealand	none?	yes	3	0
Indefatigable	none?	yes	3	0
Barham	IV*	yes	1	5
Valiant	IV*	yes	1	5
Warspite	IV*	yes	1	5
Malaya	IV*	yes	1	5

British FC at "The Run To The South"

System design differences

- The German System
  - Less advanced than British system, but better focus on procedures, drill and practice
  - Training director integrated target selection, training and spotting; laying (defection) and firing managed in individual turrets
- The British System
  - Heterogeneous collection of advanced systems; differing equipment some lacking director
  - Most dreadnoughts at Jutland used director control for transmitting aiming data and firing
  - Control from elevated position advantageous

"Dreadnought Gunnery at the Battle of Jutland"



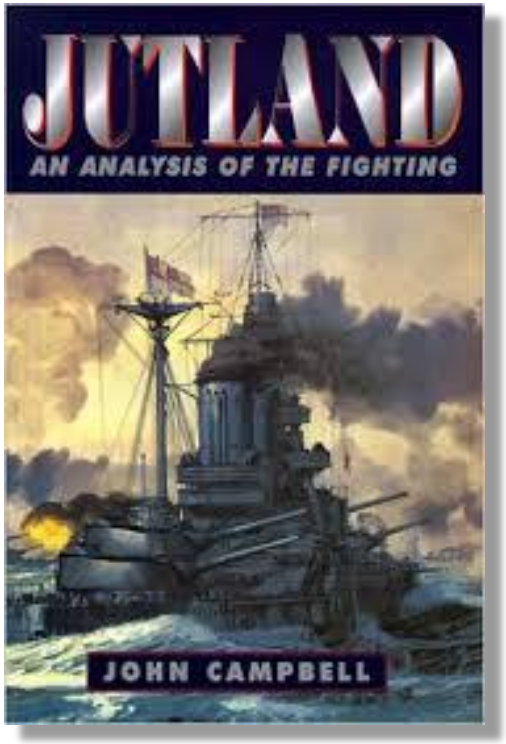
Argo Gyro-stabilized Rangefinder Mounting
http://www.dreadnoughtproject.org/tfs/index.php/Argo_Mounting

Coincidence Rangefinder View

Rangefinder Types

- British equipped with Barr & Stroud coincidence type
  - 9-foot model (FQ2) until *Queen Elizabeth* class introduced 15-foot design (FT24)
  - 15 – 17,000 yd limit for accuracy in most instances
  - More affected by visibility issues (*e.g.*, smoke)
  - Emphasis on rapid determination of plot made spotting greater focus in practice to achieve rapid fire
- Zeiss 3-meter (Bg3m) stereoscopic type installed on German dreadnoughts
  - Not dependent on visibility of vertical or horizontal elements of target, so less impacted by visibility issues
  - German operators heavily trained and rejected from program if errors exceeded 400 meters at 20,000 meters

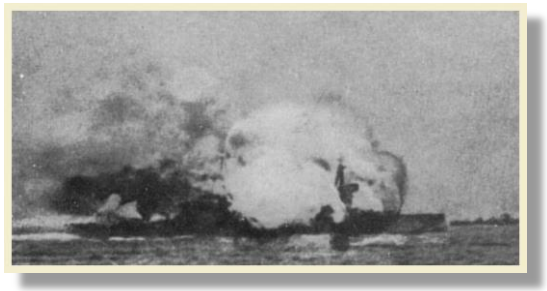
"Dreadnought Gunnery at the Battle of Jutland"



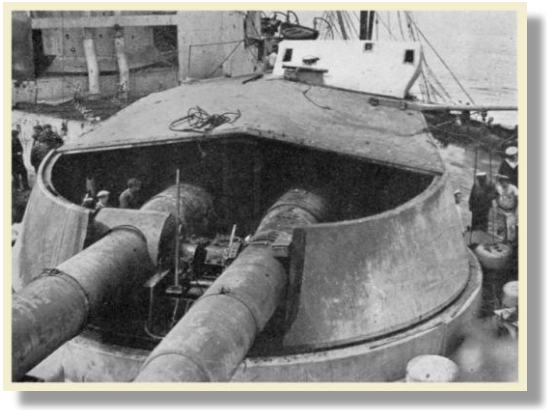
- **Outcomes**
  - **Grand Fleet and German High Seas Fleet achieved roughly same average hit rate of 3-3.5% [1]**
  - **The 1SG performed best for the Germans with 3.89%, but fired at shorter ranges for a fair portion of their shooting**
  - **By contrast, the BCF (1st and 2nd BCS) shot extremely poorly, with 1.43% hit rate.**

1. Campbell, John, "Jutland: An Analysis of the Fighting", NIP 1986, pp. 354-5

"Our Bloody Ships Or Our Bloody System?"



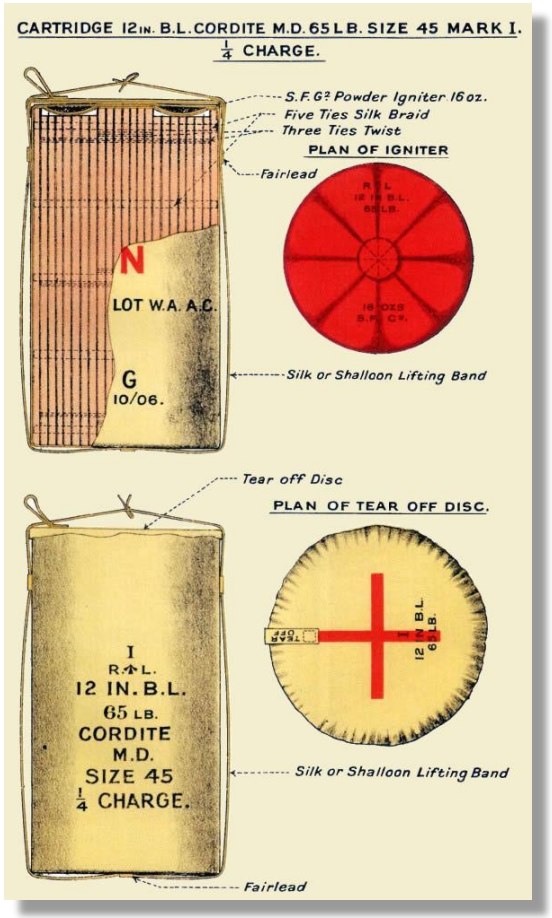
HMS Invincible



HMS Lion's "Q" Turret

- Propellants
  - British Cordite characteristics versus German and impact of aging
  - Handling and "ready use" procedures
  - Lessons learned from earlier battles
- Ship Design Considerations
  - Compartmentalization
  - Armor
- Suggested Reference:
  - "'Our Bloody Ships' or 'Our Bloody System'?", Lambert, Nicholas; The Journal of Military History 62 (January 19980: pp. 29 - 56

"Our Bloody Ships Or Our Bloody System?"

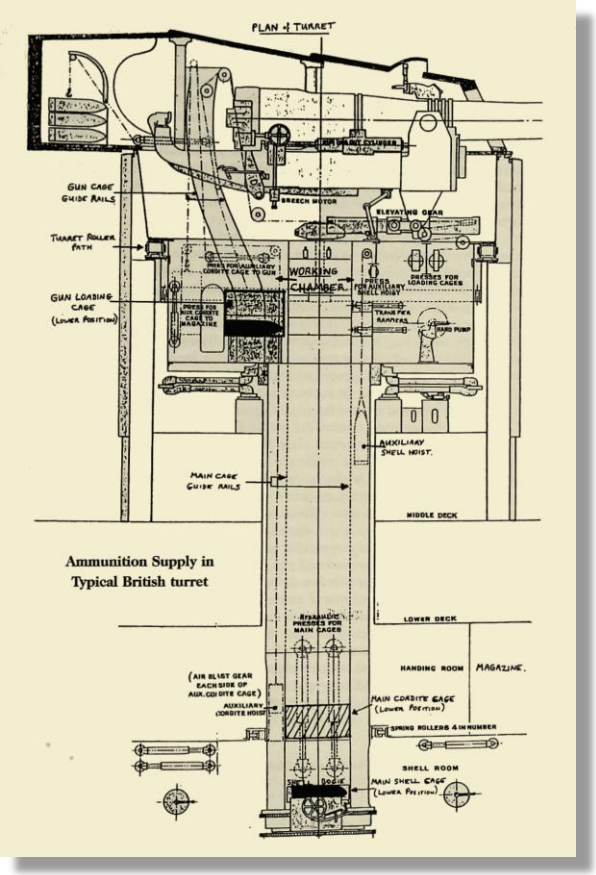


http://www.jutland1916.com/tactics-and-technologies-4/ordnance-2/

Propellants

- British Cordite MD known to become unstable as it aged; German RP C/12 more stable
- Management of Cordite in magazines disorganized
- Explosions of aged Cordite caused loss of pre-dreadnought *Bulwark* and cruiser *Natal;* inquiry into the latter concluded in September 1916 that: "Some of the 'First Use' Cordite . . . Was neither tested, fired nor returned for over 20 months."
- By 1916, eight-gun battle cruisers carried a total of 960 shells and 290,000 pounds of Cordite, 50% more than design

"Our Bloody Ships Or Our Bloody System?"

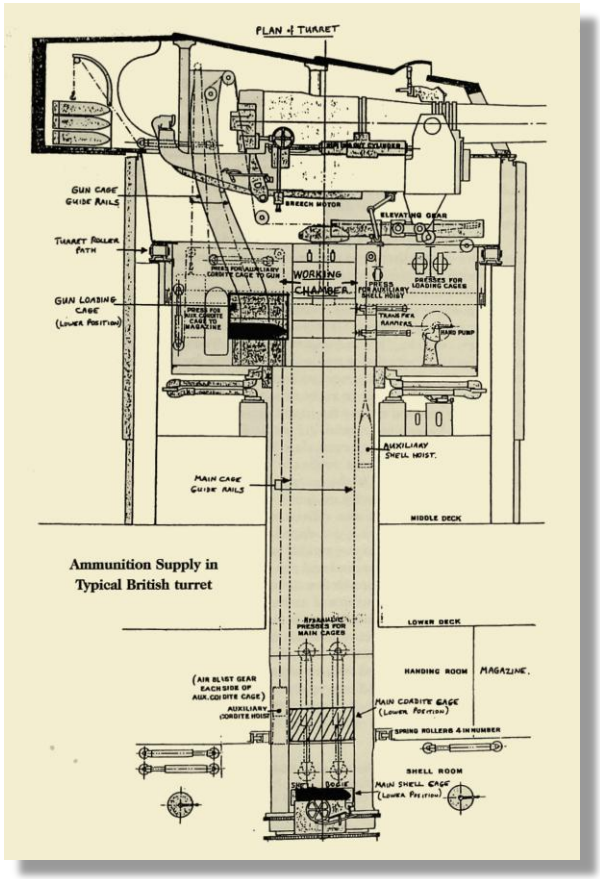


Ammunition Supply in Typical British turret

- **Handling and "Ready Use" procedures**
  - **Handling and "ready use" procedures (especially in BCF) emphasized rapidity of fire and limits on storage in turret and working spaces ignored**
  - **Near loss of *Seydlitz* at Dogger Bank lead to redesign of anti-flash doors and tightening of ammunition and propellant handling**
  - **After Falklands, Admiralty warning of handling procedures that nearly lead to the loss of *Kent* were ignored**

Journal of Military History, Vol. 62 Issue 1, p. 35

"Our Bloody Ships Or Our Bloody System?"

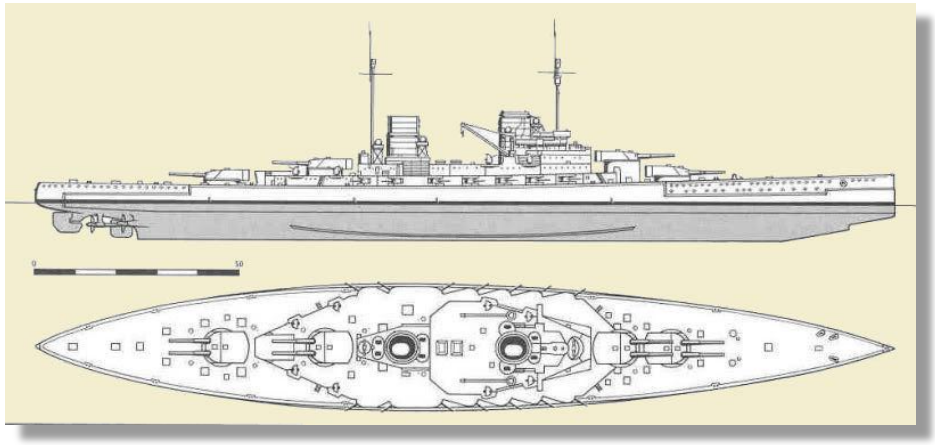


- **Handling and "Ready Use" procedures**
  - ***Invincible*** **and** ***Queen Mary*** **had reputations as the fastest gunnery ships in the RN; surviving gunnery officer confirmed that magazine doors were left open during the battle**
  - ***New Zealand*** **fired 442 shells during the battle while using only three of her four turrets; she scored two (possibly three) hits**
  - **Initial reports faulted propellant quality and ammunition handling, but over time focus was changed to lack of adequate armor, until DNC investigation renewed the issue**

Journal of Military History, Vol. 62 Issue 1, p. 35

"Our Bloody Ships Or Our Bloody System?"

Ship	Disp. (T)	Belt (In.)	Turret (In.)
Iron Duke	25,000	12	11
König	25,390	14	14
Lion	26,350	9	9



SMS *Lützow*

- **Ship design differences**
  - German fleet primarily developed for short-distance operations which meant less fuel
  - Better compartmentalization, broader beamed due to limitations in the size of British shipyards
  - German ships lighter-gunned overall; slower but more heavily armored as a ratio to total displacement; examples:
  - British battle cruiser designs based on concept "Speed is armor."

Conclusions

- Each opponent had some technological advantages
- German use of technology was more uniform due to better focus on procedures, drill and practice
- British had key issues related to shell and ship design exacerbated by errors in leadership

" It was mainly the Admiralty's research and development organization, and the British steel, chemical and armament industries that robbed Jellicoe of sunk ships during his 40 minutes of bombardment at Jutland."[1]

1. Barnett, Correlli, "The Swordbearers", Indiana University Press; 1975