

# Notes on Naval Subjects 1900-1920

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# Notes on Naval Subjects 1900-1920

## 1 Ammunition

### General Ammunition

Hit rates of secondary batteries at Jutland, British 0.5%, German 1.0%. 6in (or 5.9in) batteries unlikely to score hits and could endanger ship. (Reference 14, Chapter 3, p43-45)

### British Ammunition

1909: 6 rounds per gun of shrapnel provided for heavy guns for anti-torpedo boat use. (Reference 54, p98)

Ordnance Board calculates that 30-70% of British shells are duds. Duds in this case being shells that fail to penetrate the test armour plate. (Reference 10, Vol III, Chapter V, p207)

1909 APC experiments: "... Lyddite filled APC did not invariably fail to perforate armour..." (Reference 54, p102)

1909-10 British trials show 4in Lyddite shells effective against the destroyer Ferret. (Reference 14, Chapter 2, p30)

October 1910: Ordnance Board remarks on the breakup of AP shells at angles greater than 20 degrees. (Reference 54, p100)

January 1915: Shrapnel fired from 13.5 inch gun at seaplane. (Reference 13, Chapter IX, p153)

HMS Warspite: Design of 6 inch battery ammunition passage; single magazine; no flash-tight doors anywhere in the 6 inch ammunition supply chain until post-Jutland modifications. (Reference 59, p18-21)

Jutland, Southampton narrative: "... the flash had passed below to the ammunition passages..." (Reference 19, Chapter XIV, p291)

Jutland, Yarmouth narrative: "... ammunition was sent up the hoists with so much enthusiasm and energy as to accumulate a dangerous amount at the top." (Reference 19, Chapter XIII, p277)

HMS Hercules, January 1916: 'almost the whole of the ammunition' ... 'common shell' replaced by 'lyddite.' (Reference 21, Chapter V, p60)

HMS Benbow: Ammunition hoist defects. (Reference 21, Chapter XIX, p209-210)

Jutland: "... the suicidal approach to the handling of propellant was common to both Jellicoe's battleships and Beatty's battle cruisers." (Reference 24, Chapter 5, p163-164)

Jutland: Strict enforcement of ammunition handling regulations does not limit Lion's rate of fire. (Reference 25, Chapter 16 p294)

Jutland, HMS Conqueror: Dozens of cordite charges removed from cases to avoid slowing the rate of fire. (Reference 2, Chapter 5, p223)

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Consequence of increased shell allowances in British ships (1913-14?): After Dogger Bank (January 1915) "... unofficial tendency not only to place uncovered cartridges at the foot of the ammunition hoists, but to use the handling room and even the turret as ready-service spaces for Cordite as well as for shells. ... actually done on several ships and probably not only on board battlecruisers..." (Reference 29, Part I/1, p32)

British shell handling at Jutland: "The drill and custom then in force was to keep all cages and waiting positions loaded and magazine doors open, and the evidence seems to show that if a turret was pierced by a shell which exploded inside it the magazine was almost certain to blow up." (Reference 70, p97)

January 1917: Benbow common shell replaced by AP. New fleet instructions that previous 25% AP be increased to 75%. (Reference 21, Chapter XXIII, p249)

Grand Fleet magazine isolation improvements described. All work in the fleet completed by the beginning of 1917. (Reference 21, Chapter XXIII, p249-250, but completion date contradicted by Reference 71, p65)

British flash protection changes after Jutland: "... the arrangements for rendering charges flash-proof, only reduced the risks of cordite fires ..." (Reference 42, p88)

Both Lyddite and black powder fillers exploded spontaneously due to the shock of impact on thicker plates. (Reference 36, p77)

Post Jutland: In oblique tests the [British] shell did not pierce 2-inch plate. (Reference 10, Vol III, Chapter VII, p263)

1917 tests show all British 12, 13.5 and 15 inch shells break up at 20 degrees on 6 inch KC. (Reference 42, p83)

Replacement of Lyddite by T.N.T. 1917-1918. (Reference 10, Vol III, Chapter VII, p264) This is contradicted by Reference 29, Part I/1, p33, which says Shellite (DNP added to Lyddite).

TNT avoided premature detonation, but "...greatly increased the chance of blinds (failure to detonate)." (Reference 54, p102)

Schedule for delivery of improved shells to British ships, February to June or indefinite. Later text says supply delayed. No 14 inch shells listed. (Reference 29, Part I/1, p34)

"As to the British changing their shell, I know from personal experience when I was attached to the British battleship *Ramilles*, of the first battleship squadron, that the gunnery officer talked about expecting to change their shells when I joined in the spring of 1918. They had not yet changed the shells when I left about three months before the armistice." (Reference 31, May, p91)

"The first lot of shells arrived in April [1918], a 30% supply to the more important units," (Reference 39, p167)

HMS *Superb*: APC shells exchanged for new ones (presumably Greenboy) in September 1918, prior to deployment to the Aegean Sea. (Naval Review Vol. VIII No. 4, November 1920, p601)

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## German Ammunition

Krupp and Skoda (A-H) introduced delayed-action fuses in 1911 (Navweaps.com), providing the possibility of reaching target vitals. While I have found no specific information about dates when these fuses replaced older types, or which guns got them, there is an indication in Tirpitz's memoirs that improved AP shells were used at Coronel. (Reference 66, Vol II, Chapter XVIII, p357)

German doctrine was to use HE for long range and AP for close range. At Jutland, von Hase initially loaded HE but ordered AP loaded when the range decreased to 165 hm (18,045 yards). Lutzow fired only HE on Lion (Reference 3, Chapter VI, p81, p87 and Reference 28, Chapter 6, p193) Base-fused HE hits on Lion from Lutzow. (Reference 14, Chapter 4, p58)

## French Ammunition

~1910, "... reports from French gunnery trials were showing that their nickel-chrome steel AP shell was successfully breaking through the armor and bursting inside." (Reference 38, p139, but without a source)

## US Ammunition

As of 1917 (Reference 76, Chapters XVI and XVIII):

- Soft steel caps (p290)

- AP shells 6 inch and above loaded with 2-3% by weight Explosive "D" (p291, 296)

- Uncapped shells may cause spalling ('metal forced from the plate' p292)

- No penetration expected beyond 10 degrees from normal (p295)

- All shells except shrapnel are base fused (p296)

- Table of bursting charge weights (p297)

- Only AP shells being produced for guns larger than 5 inch (p298)

- Ammunition supply precautions (p319-320)

## Japanese Ammunition

Russo-Japanese War: Shells and cordite stowed in casemates to minimize the chance of a magazine explosion from a mine. (Reference 57, p143)

Russo-Japanese War: "It does not seem likely that any Japanese shell penetrated armour of 6in thickness or more." ... "Russian shells were less sensitive and hence somewhat better at penetration." (Reference 69, p69)

Earliest Japanese capped AP shells May 26<sup>th</sup> 1915, for Kongo class. (Reference 58, Part III, E, p552)

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## Russian Ammunition

Admiral Makarov's Magnetic Cap developed by 1898; improves penetration of Harveyized nickel-steel from 45% to 60% compared to same shell without cap. (Reference 82, pages xxii, 141)

Visit of Fred Jane to Russian gunnery school: 'magnetic' capped AP shell "now served out for all big guns, and have the same penetration as A.P. shot." (Reference 65, p383 & p524)

Russo-Japanese War: "... cheap shells containing small quantities of explosive material and unreliable fuses." (Reference 60, Chapter 2, p57)

RJW: Most Russian destroyer shells (75mm, 47mm) fail to explode. (Reference 80, p29)

RJW: Russian 75mm shells are AP with fuses not triggered by destroyer hulls. 75mm HE shells only enter service in 1905. (Reference 80, p31)

## 2 Deployment

1905 French commission revises naval tactics:

"Groups" were abolished.

Only such movements were provided after action was joined, as would least disturb gun-fire.

Fleet action was to be conducted by semi-independent squadrons, each in column and maneuvering in accordance with rules laid down in advance by the commander-in-chief of the fleet and guided by his movements.

(Reference 75 p 805)

1907-1908 "A formation in several columns is best for the approach of a large fleet (about twelve ships or more) ... because the fighting line can readily be formed from such a formation. (Reference 73, p587)

18 November 1914 Russian Black Sea Fleet: Fleet Orders had screening cruisers 10 miles ahead of the flagship, destroyers and torpedo boats astern of the battle line. After deploying for action, one cruiser was ahead and two astern of the battle line, destroyers and torpedo boats on the disengaged bow and astern of the main force. (Reference 55, Chapter 6, p29-30)

Austro-Hungarian daytime fleet deployment: Armored cruiser as lead ship 10-12 NM ahead of main body. Three scout groups of one light cruiser and one destroyer within 10 NM of lead ship. Torpedo flotillas in the rear. Main body 'squadron in line' abreast or echelon. Not clear if this means all ships in a squadron abreast or just the division lead ships. (Reference 8, Chapter 1, p23-24)

"... the assumption, which the British held in varying degrees down to about 1913, that destroyers would always operate separately from the battle fleet..." (Reference 18, Chapter 1, p23)

Jutland: High Seas Fleet 700m between ships, 3500m between divisions. Under full power and cruising at 14 knots. Closed up to 500m between ships when the battlecruiser combat started. (Reference 28, Chapter 6, p154 and p161) (also see Section 5)

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Jutland: ... Jellicoe would have disposed the leaders of columns on a bearing at right angles to the enemy's bearing and so have simplified his deployment. (Reference 10, Vol III, Chapter III, p108)

Jutland: "There is some evidence [not cited] that Beatty expected Jellicoe to deploy on the 4<sup>th</sup> Division..." (Reference 61, Chapter 8, p169) "A new signal for deployment on a centre column ... was introduced, and it is fair to guess that this also owed a good deal to Beatty – since he indicated to Pollen that he had expected Jellicoe to deploy in that manner..." (Reference 61, Chapter 9, p195)

March 1917 Grand Fleet exercises. (Reference 21, Chapter XXV, p270-273)

November 17, 1917: Grand Fleet cruising order; divisions one behind the other in line abreast. (Reference 21, Chapter XXX, p321)

### 3 Fire Control

#### General Fire Control

"Both British and German sources emphasized ... that steady course which is so important to gunnery." (Reference 36, p73)

Differences between British and US fire control systems. (Reference 45, Chapter 4, p79)

Rule of thumb for a discernible difference in caliber:  $\sqrt{2}:1$  (~1.414:1). (Reference 47, p342)

US Naval War College Maneuver Rules:

- 50% penalty to open mount secondaries if primary battery firing

- 20% bonus for 'not being under equivalent fire'

- (unspecified) penalty on 3 gun salvo due to spotting difficulty

- 30% penalty if within 3 knots of maximum speed due to funnel gasses (presumably oil)

- up to 40% penalty for 3 minutes after change of target

(Reference 50, p35, p36, p38, p44)

Turret location rationale: "... two turrets so close together practically form one target, when sufficiently separated ... the enemy has three separate targets to fire at which complicates his fire control, this is important up to 10,000 yards." (Reference 54, p37)

#### British Fire Control

Blast effects of superimposed turrets. (Reference 54, p91)

British fire control methods 1910-1912 (Reference 23, p92-95)

Chatfield gunnery recommendations to Beatty Oct 1913: "The 'T' must never be crossed at too broad an angle as this ... causes a big and difficult [range] rate." (Reference 34, Part II, No. 49, p93)

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Use of capital ship 6 inch guns, Jellicoe to Churchill 14 July 1914:

“(1) We do not use our 6” guns in a Fleet action;

(2) Our complement of officers is insufficient to control the fire of these guns even if we desired to use them.”

(ADM 116/3091 quoted in Reference 77, p480)

Grand Fleet fire control equipment 1914-15. (Reference 23, p116-117)

Main and secondary fire control director installation dates for British battlecruisers. (Reference 54, p94)

Methods of fire control defined. (Reference 23, p134)

Methods of fire control discussed. (Reference 54, p94-97)

British destroyer guns individually laid and trained up to 1916. ‘... merely waste ammunition ... over 6000 yards.’ British efforts to fit improved fire control systems lagged [German] somewhat... (Reference 56, Chapter 3, p38-39)

Scarborough Raid, December 1914, HMS Southampton: “We opened fire with all guns bearing, but the gun- layers became confused at the number of targets and each gun was firing more or less independently.” (Reference 20, Chapter VI, p76)

Dogger Bank lessons learned: Lee position, spray, range, spread. (Reference 34, Part III, No. 120, p223) Necessity for director control due to spray, cordite smoke and green water hinders gunlayers. (Reference 62. Chapter 12, p232-233)

Jutland: Fitting of director firing gear for battleship secondaries 'only just begun.' (Reference 2, Chapter 6, p282)

Jutland: only 6 Grand Fleet ships had both primary and secondary director firing. (Reference 10, Vol II, Chapter XIII, p301)

Disadvantages of a turn in succession under fire exaggerated. (Reference 10, Vol III, Chapter II, p74)

Jutland: The battle cruisers were steaming at 25 knots during the run to the south, and the Germans at 18 knots. This gave the Germans a steadier gun platform. (Reference 10, Vol III, Chapter II, p83)

By the time of Jutland, all dreadnoughts and battle cruisers except Erin and Agincourt had main armament directors [contradicted by Bellerophon narrative below]; but no cruisers. By May 1918 Weymouth and later classes of light cruisers were fitted. See text for other director additions. (Reference 10, Vol III, Chapter VII, p261)

Jutland, Lion narrative: Enemy shells falling short ... result in a slow rate of fire. (Reference 19, Chapter VI, p112)

Jutland, Tiger Gunnery Officer narrative: 3:53 pm “Spotting was very difficult, but I increased the rate of fire as much as possible, firing double salvos.” (Reference 19, Part IV, p397)

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Jutland, Tiger Gunnery Officer narrative: 5:42 pm “There were very large splashes, presumably 15-inch salvos from our 5<sup>th</sup> B.S., falling near the rear enemy battle cruisers.” [implies that he can distinguish between 13.5 inch heavy and 15 inch splashes] (Reference 19, Part IV, p402)

Jutland, Indomitable turret narrative: “... went into 'Independent' at a range of 8,600 yards ... reverting to controlled fire at a range of 10,700 yards.” (Reference 19, Chapter XI, p240-241)

Jutland, Southampton narrative: “... our gun sights stopped at 14,500 [yards].” (Reference 19, Chapter IV, p84)

Jutland, Warrior narrative: “... concentrated pair ship fire organization which the squadron had worked up ...” (Reference 19, Chapter VIII, p162)

Jutland, Bellerophon narrative: 4<sup>th</sup> Division firing on a cruiser, “... as none of us had the faintest idea as to which salvos were whose, fire control was rather hopeless.” Bellerophon not fitted with director firing. (Reference 19, Chapter IX, p181)

Jutland, Cochrane: “... not fitted with director firing...” (Reference 19, Chapter XIII, p280)

Jutland, Cochrane: “... not usually considered advisable for an armoured cruiser to get within 10,000 yards of an enemy battleship.” (Reference 19, Chapter XIII, p280)

Jutland: British [battle cruiser] fire control suffered from worse vibration [at 25 knots] than German [at 18 knots]. (Reference 61, Chapter 8, p166)

British battle cruiser fire control systems installed at Jutland, and some battleship installations. (Reference 61, Chapter 8, p167, note \*)

Jutland: Range rate high and constantly varying during the run to the south, “probably beyond the capacity of the Dreyer Fire Control Tables to cope with.” (Reference 61, Chapter 8, p167)

Jutland, Dreyer Table non-use: Iron Duke spotted all salvos on. One battle cruiser had its table stripped of parts. (Reference 62. Chapter 13, p247)

Salvo firing, HMS Hercules 1916: 5 gun salvos used since the shock from 10 guns damaged technical equipment. (Reference 21, Chapter X, p104)

August 1916: Range-indicators (which trained all turrets and batteries on the same target) fitted to all ships including light cruisers. “Without this mechanical device continual confusion of target occurred, and fire could not be concentrated with sufficient certainty.” Director firing fitted in Minotaur class ACs. (Reference 21, Chapter XVIII, p193)

Renown gunnery trials, January 1917: “.. particularly strong” vibration in the tripod foretop. (Reference 21, Chapter XXIII, p247)

November 1917: Damage to Glorious and Courageous due to firing aft turrets on forward bearing. (Reference 21, Chapter XXX, p323)

Grand Fleet: 1916 Spotting Rules for capital ships (see Reference). Early 1917, concentration systems begin testing. (Reference 42, p82)



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Grand Fleet concentration firing method needs guns of the same caliber, range and muzzle velocity. "Recent experimental firing with Marlborough and Iron Duke had proven its efficacy," (memo of 11 March 1918) (Reference 45, Chapter 2, p40, p42)

British concentration system not fully ready until 1918. (Reference 56, Chapter 4, p58)

British fire salvos of one gun per turret due to lack of power to load both guns simultaneously. (Reference 45, Chapter 4, p86, but contradicted on p87 and by Tiger narrative above)

Third hydraulic pump added to Lion in 1912 and to and later battlecruisers since "... the existing pumping system could not cope with simultaneous loading operations." (Reference 54, p91)

Usual British salvo spread October 1918, 300 yards single barrel, 400 yards double barrel. (Reference 45, Chapter 4, p87)

### German Fire Control

German navy adopted director firing in 1911, using a training director only. Individual gunlayers sighted the target with their own sights. (Reference 45, Chapter 4, p78)

New range-finders fitted to Kaiser and Konig classes, late 1915. (Reference 22, Chapter 7, p207)

German doctrine was to fire two salvos from the secondary armament after each salvo of the heavy guns. (Reference 3, Chapter VI, p83)

Jutland, run to the south: German 'hit indicators' prevented confusing shots from Derfflinger and Seydlitz. If the 15-cm guns had fired in between it would have been impossible to distinguish the fall of the shots. (Reference 3, Chapter VI, p90)

Jutland, run to the south: German rangefinders give good ranges starting at 240 hm (26,247 yards). (Reference 2, Chapter 3, p80)

Turkey: Goeben lacked latest fire-control equipment, shells and propellant until 1918. (Reference 8, Chapter 8, p317)

Director firing installed on board Moltke, Von der Tann, Grosser Kurfurst, Friedrich der Grosse and Ostfriesland about June 1915. (Reference 18, Chapter 7, Note 55, p377)

Jutland, Oldenberg report: ... hits accurately differentiated from those of other ships by the impact meter. (Reference 28, Chapter 6, p250)

Jutland, von der Tann shooting: Rapid fire ordered after straddle, zigzag of target recognized and corrected for. (Reference 33, p56)

March/April 1909: Trials of superimposed turrets at worst imaginable angles pose no health hazard. Later confirmed by live tests on Moltke. (Reference 46, p211)

Photo shows no sighting gear atop Prinzregent Luitpold D turret (under superimposed C turret). (Reference 46, p226)

Photo shows crossdeck firing of B turret on Konig Albert. (Reference 46, p242)

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Pros and cons of fire control from tops. Two of the Kaiser class get tripod masts summer 1918. (Reference 46, p225)

By 1917 German torpedo boats had limited centralized control... (Reference 56, Chapter 3, p39)

### French Fire Control

French range finders and fire control were poor; English B&S range finders purchased at the beginning of the war. (Reference 8, Chapter 2, p71)

Rangefinders in place by 1910. Range clock adopted end of 1906. German order transmitter system permitted simultaneous (secondary?) engagement on either beam. (Reference 44, p96-97)

4.57m rangefinder adopted for Danton class 1914-1916, effective 'eventually' up to 12,500m. (Reference 44, p128, p283)

Bretagne class first to be designed with central FC. Main and secondaries can co-ordinate on the same target. Enhanced 14cm gun FC to engage torpedo craft. (Reference 44, p170-171)

### Italian Fire Control

Procedures behind Britain/Germany/US by 1914. Only manual FC table calculations until 1919. 1915 battle ranges would not exceed 10,000 meters. (Reference 8, Chapter 5, p193-194)

### US Fire Control

1916 effective range of 12 inch guns about 16,000 yards. It was expected that this could be increased to 20,000 yards with practice. (Reference 8, Chapter 7, p275)

Summer 1916: Texas first US battleship fitted with director system. (Reference 45, Chapter 4, p78)

US began installing follow the pointer system for train only in 1917, for elevation in late 1918. (Reference 45, Chapter 4, p80)

US rangefinders poorly positioned for spray, but have longer bases than British. (Reference 45, Chapter 4, p81)

Adoption of British gunnery training methods (course changes, maximum speed, concentration) in Atlantic Fleet in 1918. (Reference 45, Chapter 4, p84-85)

About September 1918: US Division 6 (Utah, Nevada, Oklahoma) using kite balloons for gunnery spotting. (Reference 45, Chapter 6, p104)

US salvo spread October 1918, 600 yards. (Reference 45, Chapter 4, p87)

Training hit rates 1919: 0.099 hits/gun/minute, 1922: 0.104. (Reference 45, Chapter 4, p86)

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## Japanese Fire Control

Russo-Japanese War, Tsushima: “With several ships firing at one, and firing fairly rapidly, spotting was impossible.” (Reference 57, p426-7)

Russo-Japanese War, Tsushima: “ ... hits on Russian ships only occurred when the rate of change of range was low.” (Reference 69, p67)

Britain stops sharing advanced fire-control methods and mechanisms with Japan in 1909. Domestically constructed fire-control directors and clocks of Vickers design appear in 1915. Japan remains well behind British standards of fire control throughout this period. (Reference 8, Chapter 8, p311-312)

## Russian Fire Control

Effects of engine vibration on accuracy. (Reference 82, p149-151)

1904: “... only some vessels carried contemporary range finders ... telescopic sights were only installed on one ship ...” (Reference 60, Chapter 2, p57)

1912 gunnery practice at 12,400 yards. 1914 expected battle range 16-20,000 yards. (Reference 8, Chapter 6, p232)

18 November 1914 Black Sea Fleet: System of radio coordinated fire by three battleships. (Reference 55, Chapter 6, p30-31)

18 November 1914: Battleship Sv. Evstafi firing 12 inch, 8 inch and 6 inch at Goeben. Goeben returning fire without using 15 cm guns. (Reference 55, Chapter 6, p31)

8 January 1916: Imperatriza Ekaterina fires on Goeben from 21,300 to 25,900 yards, achieving several straddles. Fire affected by several defects in turrets. (Reference 55, Chapter 12, p68)

Russian fire control practices were relatively sophisticated, in many ways comparable to the best elements of both British and German systems. (Reference 56, Chapter 3, p39)

## 4 Formation

### Line ahead spacing:

British Mediterranean Squadron 1890's: “... spaced at intervals of 300 yards ...” (Reference 72, p66)

Russian tactical doctrine 1898 – examples based on 2 cable or 400 yard intervals. (Reference 82, pages xxii, 172, 247, 253)

US Signal book at Manila Bay (1898) – distance 400 yards, half distance 200 yards, double distance 800 yards. (Reference 75, p762)

US Fleet in 1902 “The nearest that ships can steam in column, and do anything else, is 200 yards, or ‘half distance,’ as we call it...” implying that 400 yards was the nominal column distance (Reference 81, “The Tactics of the Gun,” p316)

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Russo-Japanese War, action of August 10, 1904: “The distance apart of the ships in line in both fleets appeared to be 400 meters.” (Reference 57, p149)

1908 US Navy tactical study: “In the diagrams ships are placed 400 yards apart... curves are for a tactical diameter of 600 yards..” (Reference 74, Page 1)

~1910 tactical theory by Italian Lt. Romeo Bernotti: “.. increase of effective gun range decreases the value of close order in a battle line... distance should never be closer than 400 meters, that at ranges from 6,000 to 10,000 meters it might be as much as 600 meters, and that it should always be greater than the minimum safe maneuvering distance.” (Reference 75, p806)

1910 Minute on torpedo hit chance in ADM 1/8120 “... ships 2 cables apart...” (Reference 77, p383)

Grand Fleet at Jutland, ‘close order’ 2.5 cables stem to stem (Reference 36, p145)

High Seas Fleet at Jutland, ‘open order’ 700 meters (Reference 36, p145)

5<sup>th</sup> BS at Jutland, complaint about over-extended line at time 2.35, 3.5 cables ordered at time 3.05, 3 cables ordered at time 4.18. (Reference 36, p170, p179, p221)

British battlecruisers 500 yards astern of each other. (Reference 19, Chapter II, p28, p37)

I.A.G. at Jutland, 500 meters ordered at time 3.42 (Reference 36, p183)

High Seas Fleet at Jutland, 700 meters ordered at time 3.25, 500 meters ordered at time 4.11 (Reference 36, p217)

### **Line abreast spacing:**

October 1918: US division in line abreast at 600 yards, later scouting line 3 miles apart. (Reference 45, Chapter 6, p105)

### **Squadron or division spacing:**

Grand Fleet at Jutland, (cruising) columns 8 cables apart, (maneuvering) 10 cables or column spacing times the number of ships in the longest column (Reference 36, p145)

High Seas Fleet at Jutland, ‘open order’ 3,500 meters between squadrons, closed up to 1,000 meters when column spacing reduced (Reference 36, p145, p218)

Grand Fleet at Jutland, columns to be 1 mile apart ordered at time 3.16 (Reference 36, p216)

## 5 Maneuver

Jutland, run to the south, New Zealand narrative: “ ... being led by the flagship [Lion] on a snake-like course, to reduce the chances of being hit.” (Reference 19, Chapter II, p39)

Jutland, Nottingham narrative: description of salvo chasing. ‘little helm ... alteration of 20 degrees ...would not notice and so would not allow for.’ (Reference 19, Chapter IV, p76)

Jutland, Inflexible: Invincible’s helm jammed while dodging torpedoes. (Reference 19, Chapter XI, p227)

Jutland, Chester narrative: Helm jam while zigzagging. (Reference 19, Chapter XI, p232)

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If Lion had turned 32 points she would, about eleven minutes after commencing the turn, have been in the same position as when the turn commenced... (Reference 10, Vol III, Chapter III, p148)

... both Jellicoe and his Master of the Fleet were opposed to the use of the turn together because of the risk of collision, and it was never used in Grand Fleet exercises and maneuvers. (Reference 16, Chapter 6, p65)

### 6 Mines

August 1914. Danish king mistakenly tells British king that Danish mines laid in the Great Belt are not armed. (Reference 11, p103)

Early WWI: ...a mile or two ahead of the battlefleet is a division of old battleships known as 'mile bumpers', since their function was to indicate, by blowing up, the presence of mines. (Reference 4, Chapter 4, p47). "At the head of each division... a King Edward VII class battleship was placed..." (Reference 20, Chapter III, p46)

Dardanelles, end of April 1915: Half of the 80 minesweepers could sweep at 14 knots. (Reference 10, Vol II, Chapter X, p264)

March 1916, HMS Hercules mine experiments: Above 12 knots floating mines are deflected by the bow wave. (Reference 21, Chapter VIII, p83)

May 1916: Grand Fleet tests new mine-sweeping gear. Destroyers sweep at 24 knots. (Reference 21, Chapter X, p109)

Jutland: Armoured cruisers described as 'mine bumpers.' (Reference 2, Chapter 5, p166)

British mines not effective until German mines copied; available end of 1917. Russian pre war mines reliable. (Reference 56, Chapter 3, p51-52)

### 7 Navigation

Expected navigation position error 5 NM over 8 hours. (Reference 56, Chapter 3, p32)

Dogger Bank lightships used by both sides. Depth soundings as points of reference. (Reference 56, Chapter 3, p34)

Destroyers could not do dead reckoning in action. (Reference 56, Chapter 3, p35)

### 8 Operations

#### General Operations

Possible German/Russian pre-dreadnought clash in the Baltic, August 1914. (Reference 22, Chapter 6, p190)

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Lowest point of Grand Fleet numerical superiority over High Seas Fleet in January 1915. Dreadnoughts 18-17, Battlecruisers 5-4. (Reference 15, Chapter 20, p372)

November 1917: Minefield battle. See notes for orders of battle. (Reference 18, Chapter 7, p177 and notes 135-136)

### British Operations

March 1912 FO 371/1476, "... Swedes are firmly possessed of the idea that in the event of war between England and Germany, the English would seize bases in the vicinity of Marstrand and the Skaw respectively, ..." (Reference 77, p433)

June 1914: Vice Admiral Warrender with King George V, Ajax, Audacious, Centurion at Kiel, Rear Admiral Beatty with Lion, Princess Royal, Queen Mary, New Zealand at Kronstadt. (Reference 15, Chapter 5, p94)

British plans for operations against German coasts: (Reference 18, Chapter 9)

Wholesale exit of Grand Fleet from Scapa was "difficult, ... and rarely attempted." Battle squadrons leave separately and rendezvous later. (Reference 25, Chapter 15 p259)

August 1914, BEF crossing. 10 French armoured cruisers and 4 light cruisers patrol Land's End to Ushant, with 4 armoured cruisers as a covering group. (Reference 25, Chapter 7, p83-84)

August 1914, BEF crossing. No destroyer escort for Channel Fleet battleships. (Reference 25, Chapter 7, p84)

August 15-18 1914: Heaviest days of BEF transport – Heligoland Bight closely blockaded by British submarines and destroyers, supported by Grand Fleet in the central North Sea. Feasibility of a German operation. (Reference 15, Chapter 4, p79-80)

November 1914, unavailable British capital ships: Audacious (sunk), Ajax, Iron Duke, Orion, Conqueror, New Zealand, Invincible, Inflexible, Princess Royal. (Reference 10, Vol II, Chapter III, p43)

December 2, 1914: Churchill proposes attack on northern end of Sylt Island. Sylt was protected by guns, well-protected troops and an armoured train. (Reference 10, Vol II, Chapter VIII, p187) German reinforcement by barge 'quite easy.' (Reference 24, Chapter 4, p112)

December 1914 Proposal to destroy the Heligoland dockyard. January 1915: Proposal to bombard and attack with torpedoes the High Seas Fleet in Schillig Roads. (Reference 10, Vol II, Chapter XVI, p414-415)

Endurance of Grand Fleet limited to about 2.5 days by destroyers. (Reference 10, Vol II, Chapter XVI, p434)

March 1916: Orders for the Grand Fleet in the event of an invasion. (Reference 10, Vol II, Chapter XVI, p411)

May 1916 Jellicoe's plan for a sweep into the Skagerrak. (Reference 21, Chapter X, p110-111)

## Notes on Naval Subjects 1900-1920

Jutland, July 1 1916: The 6<sup>th</sup> Battle Division (less Marlborough, detached due to damage) was separated during the night and was not able to rejoin the battle fleet until 7pm on July 1. (Reference 21, Chapter XIV, p153)

August 19 1916, Grand Fleet cruising order. (Reference 21, Chapter XVIII, p193)

October 1917 demonstration to aid Russians: light cruisers, destroyers and submarines enter central Kattegat with battlecruisers and 2<sup>nd</sup> Battle Squadron in support, well behind. (Reference 10, Vol IV, Chapter IX, p244)

October 1917, Operation Albion: British operation in the Kattegat to draw German forces away from the Baltic. (Reference 21, Chapter XXIX, p308)

November 17, 1917, Sweep of the Bight by light battlecruisers. (Reference 7, Vol. II, Chapter XXVII, page 207)

January 1918: Norway convoy escort by Grand Fleet battleships. (Reference 21, Chapter XXXI, p334-335) (Reference 45, Chapter 2, p34-38)

April 15-16 1918: Mine laying in the Skaw covered by 1<sup>st</sup> BCS, 5<sup>th</sup> BS, 3 light cruiser squadrons and 24 destroyers. (Reference 56, Chapter 14, p261)

April 25 1918: Near intercept of High Seas Fleet by Grand Fleet with US 6<sup>th</sup> Battle Squadron temporarily leading. (Reference 45, Chapter 2, p49)

### German Operations

1907: Squadron of German battleships passes through the Little Belt. It had been assumed to be impassible for deep draught vessels. (Reference 49, Chapter 5, p222)

March 1912 FO 371/1476, "... The unceasing attention which the German fleet has paid of late years to the west coast of Norway has created a widespread impression that upon an outbreak of war an attempt will be made to seize a base in these waters. Opinions differ as to where this base will be; some say Molde, others the Sogne Fjord., ...” (Reference 77, p432)

High Seas Fleet in the Skagerrak July 15 to about July 23 1914 in preparation for visits to Norwegian ports in pairs, as was done in the summer of 1911. High Seas Fleet left Norway and concentrated at 59°N, 4°20'E at 7 pm July 27. (Naval Review Vol. VIII No. 4, November 1920, p621)

“Prior to the outbreak of war it had been planned for Derfflinger to be completed on 13 September and the Kaiser had ordered the new Panzerkreuzer to be dispatched to the opening of the Panama Canal, which meant the cruiser would have to be in service on 1 October 1914. After that Derfflinger was scheduled to visit the 1915 Panama–Pacific International Exposition in San Francisco.” (Weaponsandwarfare.com, Derfflinger II article)

July 31, 1914: German dreadnoughts begin moving from Kiel to North Sea via canal. (Reference 15, Chapter 1, p15)

Several days preparation required to move capital ships through the Kiel Canal 'initially'. (Reference 11, p77)

## Notes on Naval Subjects 1900-1920

4-5 days required for I, III Battle Squadrons and Scouting Group I to transit Kiel Canal in 1914. (Reference 25, Chapter 6, p72)

2 days required for one battle squadron to transit Kiel Canal in 1914. (Reference 25, Chapter 10, p142)

Due to the time to lighten ship, 4-5 days required to move a dreadnought squadron through the Kiel Canal. (Reference 40, p76)

Admiralty DOD expected Germans to use pre-dreadnoughts to block Channel ports. (Reference 10, Vol III, Chapter II, p50)

Scarborough Raid, December 16, 1914: Possibility of an encounter at close range in low visibility at 1pm. Lion, Queen Mary, Tiger, New Zealand vs Seydlitz, Moltke, Derfflinger, Von der Tann. (Reference 15, Chapter 19, p349)

December 15, 1914, Hartlepool Raid. (Reference 7, Vol. II, Chapter XXI, page 85)

January 24, 1915: Wangeroog Island not yet fortified and Germans anxious about a blockade of the Jade. (Reference 13, Chapter XIII, p215)

Baltic July 1915: Forces transferred from the North Sea to the Baltic for an operation to penetrate the Gulf of Riga; Battle Squadron I (8 dreadnoughts), Scouting Group I (3 battlecruisers) Scouting Group II (4 light cruisers), 32 torpedo boats, 13 minesweepers. (Reference 11, p87)

German sortie toward the channel, March 5-6 1916. (Reference 22, Chapter 7, p208)

German sortie to Lowestoft and Yarmouth, April 24-25 1916. Possibility of encounters with dispersed Grand Fleet elements. (Reference 22, Chapter 7, p210)

April 24, 1916, Lowestoft Raid. (Reference 7, Vol. II, Chapter XXIII, page 124)

Lowestoft raid, April 25, 1916: "... Admiralty considered... Germans might push into the Channel under the protection of the High Seas Fleet, attacking the lines of communication ...” (Reference 18, Chapter 7, p160, also see relative force locations p161)

April 25, 1916: Positions of forces, Lowestoft raid. (Reference 10, Vol II, Chapter XVI, p425-426)

December 1916 plans: At least 40 hours required to deploy High Seas Fleet to the Baltic via the Kiel Canal. (Reference 11, p163)

March 1917: Proposed German raid into the Hoofden to attack the convoys between Holland and England. (Reference 18, Chapter 7, p176)

By June 1917 Germans were sometimes keeping battleships in support near Heligoland. By November 1917 usually a whole battle squadron. (Reference 10, Vol IV, Chapter X, p299)

October 1917: Brummer and Bremse moved from Wilhelmshaven to Lister Tief (Sylt Is.) for attack on Norway convoy. (Reference 10, Vol IV, Chapter X, p295)

June 1918: Battle cruisers train to use Little Belt since Heligoland Bight might be closed by British mines. (Reference 56, Chapter 14, p258-259)



## Notes on Naval Subjects 1900-1920

“If our Fleet [the High Seas Fleet] went into the English Channel by the Dover-Calais Straits its tactical situation would be simply hopeless.” (Reference 41, Chapter V, p86)

### French Operations

Operational dates of French dreadnoughts:

|          |               |
|----------|---------------|
| France   | 7 August 1914 |
| Provence | 7 May 1916    |
| Bretagne | 18 May 1916   |
| Lorraine | 9 August 1916 |

Fleet anchorages:

|                                     |
|-------------------------------------|
| Navarino till end of 1914           |
| Malta 1915                          |
| Corfu from January 1916             |
| Corfu and Argostoli from April 1916 |

(Reference 8, Chapter 2, p76-77)

French operations in the Adriatic, 1914-1915. (Reference 22, Chapter 4, p128-133)

### Russian Operations

1900-1903: Wargames or maneuvers studying operations against Japan, Britain or Turkey. (Reference 60, p173, 207-8, 236, 253)

December 1914: Minelayng operations by Russian armoured cruisers (Reference 25, Chapter 13 p232)

### US Operations

12 August 1918: Nevada, Oklahoma leave for Berehaven, Ireland. (Reference 45, Chapter 5, p95)

## 9 Organization

### British Organization

British Home Fleet 1907 includes Dreadnought, Achilles, Cochrane, Natal, Warrior and Leviathan. By the end of 1908 it was Dreadnought, Inflexible, Indomitable, Achilles, Natal, Warrior Defence, Minotaur and Shannon. (Reference 64, Chapter 9)

British Cruiser Force K, August 1914. Invincible and New Zealand. (Reference 25, Chapter 7, p98-99)

January 1915: Battlecruiser squadron split into two, 1BCS Lion, Princess Royal, Queen Mary, Tiger, 2BCS Invincible, New Zealand, Indomitable. Invincible abroad and QM refitting. (Reference 13, Chapter IX, p151)

## Notes on Naval Subjects 1900-1920

Jutland: 13<sup>th</sup> Flotilla in 3 divisions. (Reference 19, Chapter III, p54-55)

Jutland, Maenad narrative: 2<sup>nd</sup> Division of first half of 12<sup>th</sup> Flotilla lead by Maenad and includes Narwhal, Nessus, Noble. (Reference 19, Chapter XVIII, p368)

Grand Fleet squadrons reorganized after Jutland. Slow 12" gunned dreadnoughts shifted to 4<sup>th</sup> Battle Squadron. (Reference 56, Chapter 4, p58-59)

### German Organization

German flotillas organized with 11 boats with one in reserve, all the same class. One boat as flotilla lead, with two five-boat half-flotillas. A half-flotilla had one boat as lead and two two-boat groups. Five flotillas in 1909, seven by May 1914. Ideally a light cruiser was assigned to support two flotillas. (Reference 80, p53-54)

High Seas Fleet Squadron II (pre-dreadnoughts) removed from High Seas Fleet 'towards the end of the year' [1916]. New organization when Baden and Bayern joined listed. (Reference 41, Chapter XI, p241-242)

Reorganization of German I-AG and IV-AG to include only the most modern light cruisers. (Reference 56, Chapter 7, p122)

### French Organization

March 18, 1915: Organization of French naval forces in the Middle East. (Reference 51, p81)

### Russian Organization

Russian: Battleships and cruisers, four ships per brigade. Destroyers, nine ships per flotilla, two flotillas per brigade, two brigades per division.

18 March 1915 Russian Black Sea Fleet organization. (Reference 55, Chapter 9, p49)

November 1915 Russian Black Sea Fleet organization: Maneuvering groups consist of one dreadnought, one cruiser, a destroyer squadron and one or two seaplane carriers. (Reference 55, Chapter 12, p67)

## 10 Plans

### General Plans

1910 Danish naval thinking on British and German operations. (Reference 11, p109-110)

1912 Danish analysis: The only place threatened by Britain early in a war is Esbjerg. (Reference 11, p113)

November 1, 1913 Triple Alliance naval convention: Assemble at Messina, engage French fleet and block Algerian transports. Ships included. (Reference 22, Chapter 2, p55)

## Notes on Naval Subjects 1900-1920

April 1917: British concern that Russian capital ships would surrender and be used by Germans. (Reference 10, Vol IV, Chapter IX, p242)

### British Plans

Fisher war planning, 1904-1910: Destruction of the High Seas Fleet a precondition for any serious Baltic operations. Attacks on Frisian Islands, Sylt or Heligoland were never serious operations, but threats to distract the enemy. (Reference 11, p37, p108)

Fisher planned to use Christiansand or Stavanger as an advanced destroyer base if Germany occupied Denmark. (Reference 11, p48)

June 1908: Plan W2 capture of an advanced flotilla base for observational blockade of the German coast. Sylt already a German torpedo-boat station, heavily defended. (Reference 48, Chapter 4, p117)

December 1908: Plans W4-W6 England vs Germany and the US. US fleet crosses the Atlantic to join High Seas Fleet. (Reference 48, Chapter 4, p123-124)

1912: Beatty expectations of German action when war starts and recommended responses. (Reference 34, p28-45)

Churchill/Bayly war plans, 1914: Seizing an advanced base on a Dutch or German Frisian island, occupying Esbjerg, a destroyer raid on the Elbe or seizing the North Sea end of the Kiel Canal. (Reference 11, p50)

December 1914: Plan to bombard Borkum with Channel Fleet. (Reference 25, Chapter 14 p243)

1915: Plan to take Borkum and Sylt. Sylt has well-defended positions and an armored train. (Reference 48, Chapter 7, p200-201)

January-February 1916: Jellicoe 'at best' supports faints against Borkum and Sylt using dreadnoughts and monitors to draw the High Seas Fleet. (Reference 48, Chapter 7, p213)

British operation planned for June 2 1916. Tempt the High Seas Fleet into the North Sea by sweeping through the Kattegat with 'a couple' of light cruiser squadrons. Behind them a battle squadron would be in the Skagerrak, supported in turn by the BCF and Grand Fleet. (Reference 2, Chapter 2, p45) More details of this operation. (Reference 10, Vol II, Chapter XVII, p444) (Reference 15, Chapter 30, p575)

Grand Fleet destroyer screen: There were occasions when it was considered preferable to leave some of the battleships in harbour, and meet the enemy with less than our full strength, rather than take the fleet to sea inadequately screened. (Reference 9, Chapter II, p37)

July 1917: Plan to use 43 pre-dreadnoughts and 43 cruisers as blockships. US, France and Italy unwilling to provide old warships. (Reference 48, Chapter 7, p216-217)

Late summer 1917: resurrection of plans to capture Heligoland, Borkum or Sylt as a forward base for small craft and aircraft. (Reference 10, Vol IV, Chapter IX, p229)

September 1917: plan to occupy Kristiansand as an advanced base for a Grand Fleet detached squadron. (Reference 10, Vol IV, Chapter IX, p254)

## **Notes on Naval Subjects 1900-1920**

November 1917: Admiralty Plans Division concern about convoy raids by German battlecruisers forcing the Dover Straits. (Reference 45, Chapter 5, p89-90)

### **German Plans**

1914: German suggestion to send two A-H ships Turkey, escorted part way by the battlefleet. (Reference 5, Chapter 3, p30 and Reference 6, Chapter 2, p17)

December 1914: Proposal for German battlecruisers to attack British shipping in the Atlantic. (Reference 25, Chapter 12, p196)

German plans August 1916: clear minefields and enter Kattegat via Little Belt. (Reference 11, p111)

October 1916: Scheer assumed to consider encounter with large parts of the Grand Fleet in the Kattegat. (Reference 11, p161)

### **Russian Plans**

Russian Baltic Fleet 1912 war plan, implemented in 1914. 'Central position' is a dense minefield at the entrance to the Gulf of Finland. Cruiser patrol line to the west, destroyer flotillas on the flanks, fleet concentration to the east. (Reference 8, Chapter 6, p216)

~1912 Russian General Staff "... distinct possibility that the Austrian Navy would be available to bolster the Turkish Fleet in the Black Sea ..." (Reference 55, Chapter 3, p11)

~1914: Black Sea Fleet Chief Staff Officer (Operations) proposes that Baltic battleships Imperator Pavel I and Andrei Pervozvannyi, armoured cruisers Rossiya and Gromoboi from the Mediterranean squadron, with one of the Baltic dreadnoughts when available. (Reference 55, Chapter 3, p12)

~1914? Chief of the Russian Naval General Staff agrees in discussions with the French that the Borodino class battle cruisers will be based at Bizerta when in service (not before 1919) (Reference 55, Chapter 3, p14)

August 1914: Black Sea Fleet Commander proposes to attack Goeben in the Bosphorus at point blank range. (Reference 55, Chapter 4, p20)

### **Austro-Hungarian Plans**

1914: A-H battlefleet began to move south to give cover to Goeben. (Reference 5, Chapter 3, p29, Reference 6, Chapter 2, p17 and Reference 8, Chapter 1, p41)

### **US Plans**

May 1918: US planning section considers the northern route for convoy raids by German battlecruisers more likely than the Dover Straits. Suggests one dreadnought or two pre-dreadnoughts escort each convoy, and that battlecruisers (e.g., a Japanese division) be stationed to intercept raiders. (Reference 45, Chapter 5, p91)

## Notes on Naval Subjects 1900-1920

July 1918: Plan for distribution of US dreadnoughts. (Reference 45, Chapter 5, p92)

August 1918: Prediction of movements of German battlecruiser raider, including range estimate for Derfflinger. (Reference 45, Chapter 5, p93-95)

October 1918: Plans for use of pre-dreadnoughts and armored cruisers for convoy escorts. (Reference 45, Chapter 5, p98)

### 11 Protection

British battlecruiser 4 inch guns unarmoured (weather and blast protection only) except Queen Mary forward battery. (Reference 54, p98)

August 1916: Addition of armour to Grand Fleet ships, in some cases while they remained operational. (Reference 21, Chapter XVIII, p189-191)

In German tests, US pattern lattice masts damaged by medium caliber shells. Tripod masts present 'eminent' target area. Therefore German vessels use slim tubular masts. (Reference 46, p211)

Repulse and Renown "... protection was if anything slightly inferior to that of the Invincibles..." (Reference 54, p104)

British turret design weaknesses. (Reference 54, p104)

### 12 Refits

Jutland: Derfflinger had only four 8.8-cm flak guns. The others had been given to minesweepers and merchant ships in the Baltic. (Reference 3, Chapter II, p46)

France: Elevations not increased until 1916. (Reference 8, Chapter 2, p71) Navweaps.com says this increase was only for one turret each on Lorraine and Provence.

Majority of German destroyers had 4.1in guns by 1916. (Reference 14, Chapter 8, p111)

### 13 Seastate

US battleship secondary batteries rarely operable in North Sea conditions. (Reference 45, Chapter 4, p82)

### 14 Ships

Jeanne d'Arc ammo passages connect all magazines. Any gun can be supplied from any magazine. (Reference 51, p73)

Tiger oil and coal: Emergency stowage 3480 tons oil/3320 tons coal. Normal maximum 2450/2450. WW1 maximum actually carried 800/3240. (Reference 54, p38)

## Notes on Naval Subjects 1900-1920

Tiger efficiency: Nov 10, 1914 "... absolutely unfit to fight ..." Nov 12, 1914 "All dynamos defective except one and not much done in the way of practices." (Reference 35, Part II, No. 54 and 56, p80 and p82)

Tiger efficiency: Dec 3, 1914 "...in a very bad condition..." (Reference 34, Part III, No. 98, p172)

Prinzregent Luitpold crew discipline problems similar to Tiger. (Reference 46, p243)

French seaplane carriers: Foudre August 1914, Campinas 1916-1919, Nord, Pas de Calais and Rouen 1916, Dorade and Normandie 1917. (Reference 8, Chapter 2, p82)

German seaplane tenders: Answald, Santa Elena mid-1915, Oswald 1918. (Reference 8, Chapter 3, p118)

Italian seaplane tenders: Elba June 1914 to September 1915, Europa May 1915. (Reference 8, Chapter 5, p294)

Russia: All dreadnoughts shared a dangerously weak underwater protection scheme. Gun ranges/elevations Table 6.10. Cruiser gun refits Table 6.9. Destroyer refits before the war replaced 75mm guns with 4 inch. (Reference 8, Chapter 6, p233-6)

January 1915: First opportunity for training of Konig class ships when Battle Squadron III transfers to Baltic. (Reference 25, Chapter 15 p256)

Jutland ship recognition: German ships painted the back side of after funnels red. (Reference 28, Chapter 6, p197). Moltke second funnel bright red; easy to distinguish from others. (Reference 19, Chapter II, p34) Three lead German battlecruisers have red paint on after funnels. (Reference 19, Chapter VI, p108)

Jutland, Castor narrative: "... apparently unable to see our destroyers, which were painted black." (11<sup>th</sup> Flotilla) (Reference 19, Chapter XVII, p351)

Jutland, Lion narrative: All four turrets can just bear on Red 32. (Reference 19, Chapter VI, p110)

Jellicoe on British protection, 9 June 1916: "The earlier ships are particularly bad and I fear will suffer heavily once hitting begins." (Reference 35, Part IV, Section C, No. xvii, p276)

Commissioning dates of US armored cruisers. (Reference 53, p190)

### 15 Shore Batteries

August 28, 1914: Heligoland shore batteries consist of 8-inch guns. (Reference 15, Chapter 6, p103)

### 16 Signaling

W/T standard on all British ships larger than destroyers by 1905 (Reference 52, p152)

Tsushima: Japanese destroyers equipped with radios. (Reference 80, p43)

## Notes on Naval Subjects 1900-1920

British: Simple maneuvering signals took about 20 minutes (bridge to bridge) in 1914 and 3 minutes in 1916. (Reference 14, Chapter 1, p16)

British: “At the beginning of the war ten minutes to a quarter of an hour would elapse before I could be sure that all ships had received a maneuvering wireless signal ... In 1916 the time rarely exceeded two or three minutes.” (Reference 16, Chapter 5, p44)

### 17 Smoke

Jutland, run to the south: Warspite sights possible smoke box dropped by German CL. (Reference 2, Chapter 3, p93)

Jutland, run to the south, Galatea narrative: “... floating brass cylinders [German] ... the contents of which give out a thick, impenetrable smoke when in contact with water.” (Reference 19, Chapter I, p24)

Smoke floats were in use as early as the Battle of Jutland by the Imperial German Navy – long cylinders that were tossed over the side, floated like buoys and produced volumes of smoke by chemical means for approximately 20 minutes. The Royal Navy also developed and employed chemical smoke generators fitted to small ships (DDs for example) and coastal craft. It was very dangerous stuff for the operating personnel, but it was nevertheless in widespread use. See the operations of the Dover Patrol and the great Zeebrugge raid for more detail. For WW2, the Battle of Sirte offers an excellent example and the IJN commonly made use of smoke in the night battles of the Solomons when they sought to disengage. Screening by funnel smoke was performed by oil-fired warships (usually destroyers, but any oil-fired ship could produce a screen of sorts. It was accomplished by richening the fuel/air mixture to produce large amounts of oily smoke. A division of destroyers (3-4 ships operating in unison) was required to lay a really persistent smokescreen. The laying of such a screen required suitable weather and proper technique. (TMP post by Bultarski)

Jutland High Seas Fleet: ... fog and smoke from small cruisers and torpedo boats... (Reference 28, Chapter 6, p212)

Jutland High Seas Fleet: “Artificial fog or smoke .... supplied to all the lighter forces to enable them to withdraw from the fire of superior forces.” (Reference 41, Chapter X, Note 6, p215)

November 22, 1916: Grand Fleet smoke shell experiment. Mention of smoke cloud apparatus of the destroyers. (Reference 21, Chapter XXI, p228)

January 1918, Dover: Experiments to make smoke as efficient as the Germans used at Jutland. (Reference 27, Chapter XIII, p154 and p212)

## Notes on Naval Subjects 1900-1920

“The US Naval War College's Maneuver Rules stated that 100 tons of oil was equal to 150 tons of coal for determining fuel expenditure and for purposes of visibility coal-fired ships were considered to make smoke at all speeds, while oil-burning ships were considered to emit gas but not funnel smoke at all speeds 2 or more knots below maximum. Even at those lower speeds, however, the stack gases of groups of 8 or more oil-burning ships proceeding together were considered just as visible as the smoke of a group of 3 or fewer coal-burners. At speeds within 2 knots of maximum, oil-burners made the same smoke as coal-burners, but vessels with internal combustion engines were considered not to make gas or smoke at all.” (Reference 32)

### 18 Speed

Russo-Japanese War, Japanese fleet: “...Welsh coal is now reserved for steaming....best kind of Japanese coal is said to have an efficiency of 75 percent as compared with the best Welsh...” (Reference 57, p115)

Mediterranean Fleet 1899-1902: “Fisher ... convinced his fleet engineers to provide him with reliable high speed, ... in an era of reciprocating engines which ... shook themselves to pieces at speed.” (Reference 18, Chapter 5, p113)

The 24<sup>th</sup> of January [1915, Dogger Bank] has ... shown: English ships, especially cruisers, maintain speeds [of] trial runs, while [German] speeds lag several [knots] behind those specified because the coal cannot be brought to the fires [quickly enough]. (Reference 17, Appendix A, p136)

Jutland, run to the north: British 5<sup>th</sup> BS overtaken by Konig class. (Reference 2, Chapter 4, p154)

Jutland, prior to 5:30, Neptune narrative: “... some of the older ships of the 1st Battle Squadron were finding it difficult to keep up with their younger sisters in the other squadrons.” (Reference 19, Chapter IX, p192)

Jutland, Warrior narrative: “... the sea was flat calm and the ship's bottom clean ... meant that she was making a clear 22 knots through the water, though her normal full speed was 21.” (Reference 19, Part IV, p406)

German coal “... not up to the task. ... arguable that no German heavy unit ever achieved more than twenty-four knots during war operations.” (Reference 25, Chapter 5, p54) Contradicted by the 26 knot speed given for Hindenburg on 17 Nov 1917 (Reference 26, Chapter 7, p294), the 26 knots speed of von der Tann at Jutland (Reference 26, Chapter 1, p47) and ‘Hipper ... steamed at 26kts for a time’ in the run to the north at Jutland (Reference 63, Chapter 6, p97).

Russian coal inferior. South Wales ‘Admiralty’ coal imported via Archangel. (Reference 56, Chapter 3, p41)

Fuel oil supplementary firing in Seydlitz. (Reference 28, Chapter 6, p236) Fails in von der Tann at Jutland. (Reference 26, Chapter 1, p47)



## Notes on Naval Subjects 1900-1920

Loss of speed in turns – as much as  $\frac{1}{2}$  after 4 points. (Reference 39, p226) “The actual rate of loss of speed is greatest between  $20^\circ$  and  $90^\circ$ , but the speed continues to fall until the ship has turned through about  $180^\circ$ .” (Reference 67, Chapter I, page 2, and Table 1 for examples of specific ships)

“.. 20 knots, the maximum speed at which the [British] battle fleet could keep station.” (Reference 37, p19) Also see Reference 61, Chapter 8, page 168 and Reference 63, Chapter 4, p58.

1917 lack of overhauls and engine maintenance: “Many capital ships of the Grand Fleet could no longer make their contracted speed, and several could achieve only eighteen knots.” (Reference 45, Chapter 2, p28, also Reference 56, Chapter 3, p39-40)

US Naval War College Maneuver Rules: Cruiser acceleration 14 to 25 knots in 8 minutes (Reference 50, p35)

### 19 Strategy

North Sea fleet battle: “We [the Germans] could not have won anything, but we could have lost everything.” (Reference 17, Chapter 3, p55)

### 20 Tactics

#### British Tactics

Divisional tactics, pre-WW1 theory and exercises, Jutland analysis. (Reference 78, p113)

Reversing course of British line of battle practiced before and after Jutland. Turn made by subdivisions in rapid succession from the rear. (Reference 1, Chapter 12, Postscript 11, p183)

Jutland: ... Sturdee ... expected that either the 1<sup>st</sup> or 2<sup>nd</sup> Battle Squadron, at the rear and van of the line, respectively, would have on its own initiative attempted to close the enemy... (Reference 10, Vol III, Chapter III, p126)

August 1916: Grand fleet tactics unchanged after Jutland. “... to approach the enemy as closely as possible in parallel lines ahead and develop at the last minute a battle line whose length and awkwardness made envelopment or pursuit of the enemy difficult!” (Reference 21, Chapter XVIII, p193-194)

August 1916: Jellicoe argues that light cruisers should not be used to screen capital ships without, in turn, being screened by destroyers. (Reference 22, Chapter 7, p231)

February 1917: Admiral Sturdee's tactical ideas. (Reference 21, Chapter XXIV, p258)

## Notes on Naval Subjects 1900-1920

### German Tactics

Flotillas “.. were expected to attack at short ranges.. ..were not to evade or abort just because they were spotted.. .. must attack regardless of the consequences to the boats.” (Reference 80, p55)

Doctrine focused on reserving torpedoes for use against enemy capital ships. (Reference 80, p60)

Dogger Bank: 'Storm' of 8.2 and 5.9 inch shells from Blucher at 7000 yards force British destroyers to retreat without hits. (Reference 15, Chapter 21, p386)

“...continued to explore daytime long-range torpedo firing during the war, concluding that fire at individual targets beyond three thousand meters was futile (a conclusion that the British had reached before the war) and experimenting with long-range coordinated fire against enemy formations. (Reference 80, p76)

### Others Tactics

Russia 1898: Gives preference to turning away from a torpedo attack if able to maintain a fair speed. (Reference 82, p264)

A-H torpedo flotillas were to intervene in a daylight battle only if their battleships were damaged or to attack damaged enemy battleships. (Reference 8, Chapter 1, p24)

Russia: Divisional tactics with individual brigades maneuvering independently. (Reference 8, Chapter 6, p232)

## 21 Torpedoes

### British Torpedoes

Heligoland Bight 28 August 1914: “Soon after the battle the Admiralty was forced to issue an order reminding all concerned that the stock of these expensive weapons [torpedoes] was not inexhaustible, and that too lavish an expenditure might endanger the future supply.” (Reference 79, p38)

Jutland, run to the north: 13<sup>th</sup> Flotilla attack on German Battlecruisers. “It wasn't the fashion in those days to let off all one's fish at once, so we only fired two and then streaked for home.” (Reference 2, Chapter 4, p152)

Jutland, Jellicoe : Officer assigned and instrument provided to determine change of course required to avoid torpedo attack. (Reference 2, Chapter 5, p263)

Jutland, HMS Garland: Fired and turned away to reload. Single tube ships with spare torpedoes on either side deck. (Reference 2, Chapter 6, p311)

Jutland, HMS Ambuscade: Loading of spare torpedo in record time. (Reference 2, Chapter 6, p321)

## Notes on Naval Subjects 1900-1920

Jutland, run to the south, HMS Petard, 13<sup>th</sup> Flotilla attack: Fired one torpedo set to high speed at a group of destroyers, followed almost immediately by one at the battlecruisers range 9000 yards. Then 'steamed ahead a little' and fired the remaining two torpedoes. (Reference 19, Chapter III, p58)

Jutland run to the north, Malaya torpedo tube bar jams and will not run out. Speed was probably about 23 knots. (Reference 19, Chapter V, p101)

Jutland, Chester narrative: Two attempts to fire torpedoes fail. [Possibly due to speed while working up to 28 knots?] (Reference 19, Chapter XI, p232)

Jutland: British destroyer orders were that each ship and each tube fire independently (as opposed to salvos). Salvos adopted in the Russian fleet "many years" before the war. "Apparatus for concentrated torpedo fire had only just begun to be constructed in England." (Reference 21, Chapter XXI, p235-236)

Jutland, Garland: Necessary to remove torpedo from tube to change depth setting [K class]. (Reference 19, Chapter XV, p316)

Jutland, Spitfire: Intention to reload tube using spare torpedo. One spare on a boat with two tubes [K class]. (Reference 19, Chapter XV, p321)

After Jutland, torpedoes supplied to the Grand Fleet with larger air chambers to increase range to 19,000 yards. (Reference 21, Chapter XIX, p210)

Post Jutland: September 1916 GFBO 'seizing every possible opportunity for firing torpedoes from our own ships (battleships to light-cruisers inclusive)' (Reference 10, Vol III, Chapter VII, p274) January 1918 GFBO 'maximum rate of fire ... by all vessels.' (Reference 10, Vol IV, Chapter II, p35)

Glorious: Speed for firing submerged torpedo 23 knots, limited by damage to guidebar. (Reference 12, p40)

February 1917: Grand Fleet torpedo exercises by division. 55% hits (5/9) at 9000 yards in heavy sea when tracks could not be seen. 30% in calm sea. (Reference 21, Chapter XXIII, p254)

"Reliable broadside sub-merged firing has not been accomplished as yet for speeds much over 20 knots. Breakage of torpedoes is frequent at the higher speeds and excessive afterbody pressures are necessary. The British torpedoes are much stronger than those of the United States, which accounts in a measure for their being able now and then to get a satisfactory run fired from a ship going 28 knots. A fault which the British are unable to explain develops in their torpedoes when fired at over 20 knots ship speed, in that they take a course abaft the direction in which they were pointed." (Reference 30, February, p79)

"Again, the unreliability of British torpedoes was to blame [for running too deep]." (Reference 38, p234, but without a source)

".. the maximum number of torpedoes should be fired in attack, providing conditions are favorable," (Reference 36, p95, from GFBO)

No way to coordinate capital ship torpedo launches. (Reference 39, p509)

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### Others Torpedoes

Fuji class battleships of 1894: torpedoes could not be fired above 14 knots. (Reference 43, p16)

RJW torpedo data, explosives, gyros. (Reference 80, p16)

RJW Japanese torpedoes set to short range/high speed for Tsushima. (Reference 80, p37)

RJW small torpedo warheads 'rarely caused damage that was immediately fatal.' (Reference 80, p43)

US: 'Curved fire' from 1910, allowing entire torpedo battery to be fired ahead at the same time. End on approach until after launch was 'stealthier'. (Reference 8, Chapter 7, p287)

Adjustable gyroscopes for capital ship torpedoes: British 1912, German Winter of 1913-14. (Reference 23, p89)

"World War I destroyers of all navies carried one torpedo per tube – there were no spares." (Reference 10, Vol II, Chapter XVII, p440)

German destroyers normally carried only one torpedo per tube ... and one or two spares. (Reference 10, Vol III, Chapter IV, p182)

Whereas the firing of torpedoes by destroyers could usually be seen or surmised from their maneuvers ... submerged torpedo fire of the heavy ships could not be seen by the enemy. (Reference 10, Vol III, Chapter V, p224)

"... German Navy chronically short of mines and torpedoes, with .. consequences for wartime doctrine as to how torpedoes were to be used." (Reference 18, Chapter 1, p24)

Scarborough Raid: "Most of the [German] destroyers would have had to readjust their torpedoes to night range (4400-4900 yds), although some, which could not change settings in the tubes, already had their torpedoes set for this range." (Reference 18, Chapter 7, p146)

US Bureau of Ordnance says in WWI it was impractical to launch underwater torpedoes above 16 knots. (Comment in Warship International Issue No. 3, 2015, p221)

... the time to reload a submerged torpedo tube was only, for an average crew, about three minutes. (Reference 10, Vol III, Chapter V, p224)

## 22 Visibility

1898: Unfavorable in relation to smoke: calm weather, light following wind. If wind is abeam, firing from leeward is better. (Reference 82, p151-153)

"Visibility is much greater in the direction of the clear than of the cloudy horizon. (Reference 82, p212)

1907-1908. Assumption that the favorable position for a fleet is downwind and with the sun behind. (Reference 73, p586-587)

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It is unfavorable if the smoke from one's own guns hangs in front of them ... or drifts toward the enemy's line. It is bad if the enemy has the sun behind him. It is unfavorable if we have to shoot right towards a high rolling sea. (Reference 3, Chapter III, p58)

Dogger Bank: Spray from high speed and leeward position. (Reference 25, Chapter 15 p268-269)

Jutland: "... in this sort of weather the differences in visibility are very great in different directions. A ship clear of the mist is much more clearly visible from a ship actually in the mist than vice versa. ... In misty weather the ships with their shady side towards the enemy are much easier to see than those lit by the sun." (Reference 3, Chapter VII, p102)

Jutland, run to the south, Princess Royal narrative: "The majority of the enemy's shells appeared to fall short throwing up columns of water nearly 100 feet high, but doing no harm, and causing little of the interference that we had at the Dogger Bank action when the splashes coming inboard drenched the turrets and even the bridge, and seriously interfered with the gun-layers, range-takers and spotting officers." (Reference 19, Chapter II, p30)

Jutland, run to the south, Tiger narrative: "It was very hard to judge the inclination of the enemy, except of the leader of the enemy line, who was generally far clearer of smoke than any of the others. (Reference 19, Part IV, p405)

Jutland, Tiger Gunnery Officer narrative: 3:45 pm sighted German battlecruisers. "... the weather was misty in patches, the visibility varying from 12 to 6 miles; wind west, force 3; sea calm." 3:49 pm "The smoke and flashes of the enemy salvoes when coinciding with our fall of shot made spotting difficult." ... "The top reported that the funnel smoke of our battle cruisers ahead made their view very bad, so I did not shift my position to the top." (Reference 19, Part IV, p397)

Jutland 5:40pm: Jellicoe has ranges taken on various bearings to determine the most favorable direction to engage ('light-gage-for-gunnery advantage'). (Reference 2, Chapter 5, p190 and Reference 1, Chapter 11, p145)

Jutland, Warrior narrative, ~6 pm: "... looking back to the northeastward, and seeing how clearly our battleships showed up in that direction against a bright skyline ..." (Reference 19, Chapter VIII, p163) [contradicts most accounts]

Jutland: Hipper had the advantage of the leeward position, in which smoke and fumes from the guns cleared away more rapidly than in the windward position. (Reference 10, Vol III, Chapter II, p81)

Scandinavian convoy attack December 12, 1917: British destroyers in leeward position. The north-west wind swept a blinding storm of spray into the faces of the gunners... (Reference 10, Vol IV, Chapter X, p312)

Jutland: Wind lee position proved favorable... (Reference 28, Chapter 6, p212)

Jutland: ... illumination shells preferred to floodlights in many cases... (Reference 28, Chapter 6, p212-213)

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Jutland, Bellerophon narrative: June 1st, 2:30 am "... quite light ... visibility still low... 6,000 to 8,000 yards ..." (Reference 19, Chapter IX, p183)

Jutland, Indomitable narrative: June 1st, 2:30 am "... visibility lessening from 10,000 to 8,000 yards, or less at times." (Reference 19, Chapter XI, p227)

Jutland, Colossus narrative: June 1st, 2:15 am "Visibility 2 miles. Misty, calm." (Reference 19, Chapter IX, p190)

Jutland, Malaya narrative: June 1st, dawn "Visibility 2 miles." (Reference 19, Chapter XVII, p358)

Grand Fleet August 1917: Leading ships of battleship divisions tow kite balloons at 1000 ft with observers in telephone contact with bridge to see behind smoke-screens and control indirect fire. (Reference 27, Chapter VIII, p107)

A wind on the engaged bow would blow gun and funnel smoke to the disengaged side and so give a clear field of view, while the enemy if on a similar course would be hampered by smoke blowing across the range. (Reference 9, Chapter V, p115)

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### 23 References

1. Dreyer, Admiral Sir Frederic, "The Sea Heritage, A Study of Maritime Warfare," 1955.
2. Steel, Nigel and Hart, Peter, "Jutland 1916," 2003.
3. von Hase, Commander Georg, "Kiel & Jutland."
4. Usborne, Vice-Admiral C. V., "'Blast and Counterblast," 1935.
5. Koburger, Charles W., Jr., "The Central Powers in the Adriatic, 1914-1918," 2001.
6. Halpern, Paul G., "The Naval War in the Mediterranean 1914-1918," 1987.
7. Wilson, H. W., "Battleships in Action," ~1926.
8. O'Hara, Vincent P., et.al., "To Crown the Waves," 2013.
9. Creswell, Commander John, "Naval Warfare," 1942.
10. Marder, Arthur J., "From the Dreadnought to Scapa Flow," 1965, 1978.
11. Michael Epkenhans and Gerhard P. Gross, Editors, "The Danish Straits and German Naval Power," 2010.
12. Conway's All the Worlds Fighting Ships 1906-1921.
13. Young, Filson, "With the Battle Cruisers," 1921, 1986.
14. Brown, D. K., "The Grand Fleet – Warship Design and Development 1906-1922," 1999.
15. Massie, Robert K., "Castles of Steel," 2003.
16. Kent, Captain Barrie, "Signal!," 1993.
17. Wegener, VA Wolfgang, "The Naval Strategy of the World War," 1929, 1989.
18. Friedman, Norman, "Fighting the Great War at Sea," 2014.
19. Fawcett and Hooper, editors, "The Fighting at Jutland," USNI edition 1921, 2001.
20. King-Hall, Commander Stephen, "A North Sea Diary 1914-1918."
21. Von Schoultz, Commodore G., "With the British Battle Fleet."
22. Sondhaus, Lawrence, "The Great War at Sea," 2014.
23. Sumida, Jon Tetsuro, "A Matter of Timing: The Royal Navy and the Tactics of Decisive Battle, 1912–1916," 2003.
24. Black, Nicholas, "The British Naval Staff in the First World War," 2009.
25. Goldrick, James, "Before Jutland," 2015.
26. Staff, Gary, "German Battlecruisers of World War One," 2014.
27. Keyes, Roger, "The Naval Memoirs of Admiral of the Fleet Sir Roger Keyes, Scapa Flow to the Dover Straits 1916-1918," 1935.

## Notes on Naval Subjects 1900-1920

28. Epkenhans, et al, "Jutland – World War I's Greatest Naval Battle," 2015.
29. Friedman, Norman, "Naval Weapons of World War One," 2011.
30. Monthly Information Bulletin - (Office of Naval Intelligence, Navy Department), 1919.
31. Monthly Information Bulletin - (Office of Naval Intelligence, Navy Department), 1923.
32. Friedman, Hal M, US Naval War College Historical Monograph Series No. 21 "Blue versus Orange," 2013.
33. Staff, Gary, "Skagerrak The Battle of Jutland Through German Eyes," 2016.
34. The Beatty Papers, Vol. I 1902-1918.
35. The Jellicoe Papers, Vol. I 1893-1916.
36. Brooks, John, "The Battle of Jutland," 2016.
37. Harper and Bacon, "The Jutland Scandal," 2016.
38. Jellicoe, Nicholas, "Jutland the Unfinished Battle," 2016.
39. Chatfield, "The Navy in Defence," 1942.
40. Dodson, Aiden, "The Kaiser's Battlefleet," 2016.
41. Scheer, Reinhard, "Germany's High Sea Fleet in the World War," 1919/2013.
42. Raven, Alan, and Roberts, John, "British Battleships of World War Two," 1976.
43. Jentschura, Jung, Mickel, "Warships of the Imperial Japanese Navy, 1869-1945," 1977.
44. Jordan, John & Caresse, Philippe, "French Battleships of World War One," 2017.
45. Jones, Jerry W., "U.S. Battleship Operations in World War I," 1998.
46. Nottelman, Dirk, "From Ironclads to Dreadnoughts: The Development of the German Navy 1864-1918, Part VIII," Warship International Vol 54 Issue 3, 2017.
47. Ordovini, Petronio, Jurens and Sullivan, "Capital Ships of the Royal Italian Navy, 1860-1918, Part 4," Warship International Vol 54 Issue 4, 2017.
48. Grimes, Shawn T., "Strategy and War Planning in the British Navy, 1887-1918," 2012.
49. Seligmann, Matthew S., "Spies in Uniform," 2006.
50. Zimm, Alan D., "The Battle of the River Plate: A Tactical Analysis," WARSHIP 2018.
51. Feron, Luc, "The Armoured Cruiser Jeanne d'Arc," WARSHIP 2018.
52. Murfin, David, "Lost in the Fog of War: Royal Navy Cruiser Designs for Trade Protection 1905-1920," WARSHIP 2018.
53. Baker III, A. D., "USS Huntington (ex-West Virginia). WARSHIP 2018.
54. Roberts, John, "British Battlecruisers 1905-1920," revised edition 2016.
55. Nekrasov, George, "North of Gallipoli – Black Sea Fleet at War 1914-1917," 1992.



## Notes on Naval Subjects 1900-1920

56. Goldrick, James, "After Jutland," 2018.
57. "The Russo-Japanese War 1904-1905 British Naval Attache Reports," 2003.
58. Lengerer, Hans & Ahlberg, Lars, "Armourclad Fuso to Kongo Class Battle Cruisers," 2019.
59. Brown, Robert, "Battleship Warspite," 2017.
60. Papastratigakis, Nicholas, "Russian Imperialism and Naval Power," 2011.
61. Roskill, Stephen, "Admiral of the Fleet Earl Beatty," 1981.
62. Padfield, Peter, "Aim Straight," 1966.
63. Campbell, John, "Jutland An Analysis of the Fighting," 1986.
64. Blyth, Lambert, Ruger (editors), "The Dreadnought and the Edwardian Age," 2011.
65. Jane, Fred T., "The Imperial Russian Navy," 1899.
66. Tirpitz, Alfred von, "My Memoirs", 1919.
67. "Remarks on Handling Ships," O.U. 5274, 1934
68. Wright, Matthew, "The Battlecruiser New Zealand," 2021.
69. Brown, David K., "The Russo-Japanese War," WARSHIP 1996.
70. The Jellicoe Papers, Vol. II 1916-1935.
71. Brown, David K. and McCallum, Iain, "Ammunition Explosions in World War I," Warship International Vol 38 Issue 1, 2001.
72. Smith, Vadm Humphrey Hugh, "A Yellow Admiral Remembers," 1932.
73. Bryan, H. F., "The Fight for the Initial Position – A study in Naval Tactics," translated from the Marine-Rundschau July 1907, USNI Proceedings Vol. 34, June 1908.
74. Pye, W. S., "A Few Hints to the Study of Naval Tactics," USNI Proceedings Vol. 34, January 1908.
75. Robison, S. S., "A History of Naval Tactics from 1530 to 1930," 1942.
76. "Naval Ordnance," USN 1917.
77. "The Naval Route to the Abyss, the Anglo-German Naval Race 1895–1914," Naval Records Society 2015.
78. Stephen McLaughlin, "Divide and Conquer?," WARSHIP 2016.
79. Dorling, Captain Taprell (Taffrail), "Endless Story – Destroyer Operations in the Great War," 1931.
80. O'Hara and Hone (editors), "Fighting in the Dark," 2023.
81. "Transactions of The Society of Naval Architects and Marine Engineers Volume X 1902".
82. Makarov, S.O., "Discussion of Questions in Naval Tactics," 1898.