Torpedo: A Historical Review

Admiralty Trilogy Seminar
Presented by: Clash of Arms Games
Introduction

- Definition
- Whitehead’s Devils Device
- How a torpedo kills a ship
- Early torpedoes
- WWI - The ship killer
- WWII - Torpedo revolution
- Modern torpedoes
- Conclusions
**Torpedoes**

- **Torpedo**: Generic term used to cover *all* forms of underwater weapons and explosives
- Name derived from the Cramp, or torpedo, fish which stuns its intended victim with an electric shock

Spar torpedo  
Civil War mine  
Fish torpedo
Whitehead’s Devils Device

• Original torpedo idea not Whitehead’s
  – Robert Fulton, 1813: Underwater cannon
  – CDR Giovanni de Luppis, 1860: Small self-propelled boat with explosives, Der Küstenbrander (coastal fireship)

• Whitehead’s first “Fish” torpedo - October 1866
  – Length: 11 feet 7 inches
  – Diameter: 14 inches
  – Range: 200 yards
  – Speed: 6.5 knots
  – Warhead: 40 lbs gun cotton
  – Cost: $600
How a Torpedo Kills a Ship

- Damage effects depend on where the warhead is detonated in relation to the target, or fuzing
- Two fuze types: Contact and Influence
  - Contact: When the torpedo hits the target
  - Influence: When a physical signature exceeds a pre-selected strength which closes the firing circuit

- Bottom line:

  Put a hole in a ship, let the water in and Mother Nature will do the rest!
Contact Detonation

- Explosive charge creates severe pressure (shock) wave
  - Shock wave overwhelms the ship’s structure
  - Fragments are propelled at high-speed into the ship
  - Typical blast and fragmentation damage

SMS Seydlitz

USS California
Influence Detonation

Torpedoes

• Potentially far more destructive than contact
  – Shock damage
  – Hull Whipping
  – Bubble Pulse/Bubble Collapse

• 50% of the energy in an explosion is available to do damage (25% - shock, 25% - bubble)
Influence Detonation

Torpedoes
Early Torpedoes

• Major development, but with a “few” shortcomings
• Propulsion Plant was compressed, unheated air
  – Very short range and slow speeds
    ◆ Approximately 800 yards at 27 knots
• Small and weak warhead
  – 115 - 130 lbs wet gun cotton (≈58 - 65 lbs TNT)
• Poor accuracy and depth keeping
  – Ship had to point the target
  – Gyros introduced in 1895
  – Depth keeping problems fixed by 1870 (The Secret)
The First Torpedo Kill

• First successful torpedo attack claimed by the Russians in the Russo-Turkish War
  – Turkish steamer *Intikbah*, 25 January 1878
  – Claim a matter of serious controversy amongst historians

• First verified sinking occurred during the Chilean Civil War of 1891
  – Chilean Navy ironclad *Blanco Encalada*, 23 April 1891
  – Clearly demonstrated the potential lethality of a torpedo if the accuracy problems could be solved
By the beginning of World War I, many of the torpedo’s early shortcomings had been addressed:

- Heated propulsion plants (1904) produced an order of magnitude increase in range
- Speed had increased by almost a factor of two
- Larger diameter torpedoes (17.7 in to 21.0 in)
- Wet gun cotton was replaced by TNT (≈1910)
  - 200 lbs of wet gun cotton replaced by 400 lbs of TNT = 4 times more deadly

By the end of World War I, German U-boats sank:

- 11,018,865 tons of merchant shipping, 95% - torpedo attacks
- The torpedo had supplanted the gun as killer of ships
WWII - The Torpedo Revolution

Torpedoes

• Earlier advancements concentrated on propulsion and stability

• WWII improvements concentrated more on the improving accuracy and lethality

• Major improvements
  – Electric propulsion matures (1939 - G7e)
    ◆ Both the US and Germany had working prototypes in WWI
  – Influence (magnetic) fuze perfected
    ◆ Both US and Germany experienced reliability problems early in the war
  – New explosive “Torpex” - about 1.5 times as powerful as TNT
The Smart Torpedo

- Acoustic homing introduced by the Germans in 1943, followed soon thereafter by the US
  - T-V GNAT (25 kHz passive homer)
  - LERCHE (wire-guided passive acoustic homing)
  - Geier (80 kHz) active homing torpedo

![GNAT acoustic seeker](image1)

![Lerche wire-guided torpedo concept](image2)
Modern heavyweight torpedo performance was heavily influenced by the advances of German torpedoes developed during WWII

- All European torpedo designs use the Lerche concept (counter-measure resistance) for wire guidance (SUT, SST-4, F-17, A-184)
- Russian and European acoustic homing seekers largely based on Lerche and Geier designs
- Russian wake homing torpedoes evolved directly from the German IBIS torpedo
- Advanced thermal propulsion based on German work with HTP
- Russian rocket-propelled torpedoes benefited from the German G5 ur liquid rocket torpedo
• Wake homing weapons are easier to use and there is, at present, no effective countermeasure
Rocket Propulsion

Torpedoes

German G5 ur

Russian APR-3E

-Russian M-5 Shkval

High speed (195 kts), long-range (10 km) due to novel drag reduction system used in the Shkval
Modern Torpedoes

Mk 48 Mod 5 ADCAP (US)

Tp62/Torpedo 2000 (Sweden)
Modern Torpedoes

DM2-A3 Seahake (Germany)

UGST (Russia)
Modern Torpedoes

Mk 50 Barracuda (US)

MU-90 IMPACT (France/Italy)

APR-3E (Russia)
Conclusions

- Torpedoes have come a long way since Whitehead’s first trials in 1866 - orders of magnitude in performance
- Torpedoes are the ship killer heavy weight champion, even in today’s anti-ship cruise missile environment