Torpedo:
A Historical Review

Admiralty Trilogy Seminar

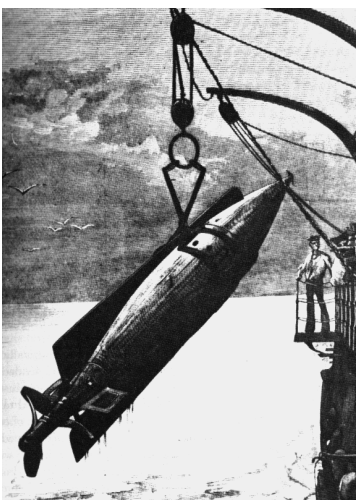
Presented by:

Clash of Arms Games

Introduction

Torpedoes

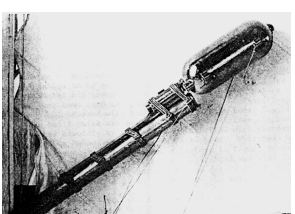
- Definition
- Whitehead's Devils Device
- How a torpedo kills a ship
- Early torpedoes
- WWI - The ship killer
- WWII - Torpedo revolution
- Modern torpedoes
- Conclusions



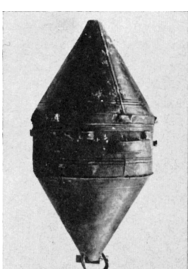
Definition

Torpedoes

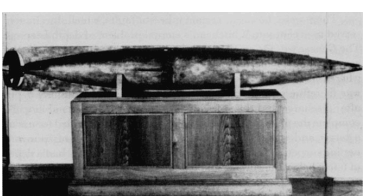
- Torpedo: Generic term used to cover *all* forms of underwater weapons and explosives
- Name derived from the Cramp, or torpedo, fish which stuns its intended victim with an electric shock



Spar torpedo



Civil War mine

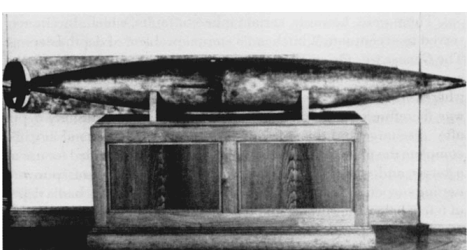


Fish torpedo

Whitehead's Devils Device

Torpedoes

- 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

Torpedoes

- 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:**

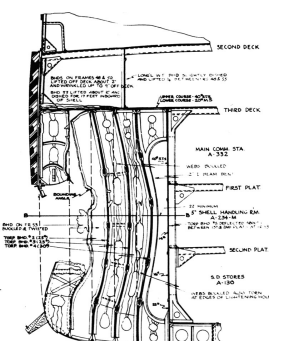
Put a hole in a ship, let the water in and Mother Nature will do the rest!

Contact Detonation

Torpedoes

- 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

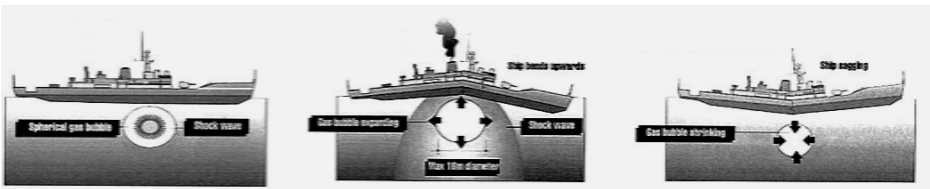
Influence Detonation

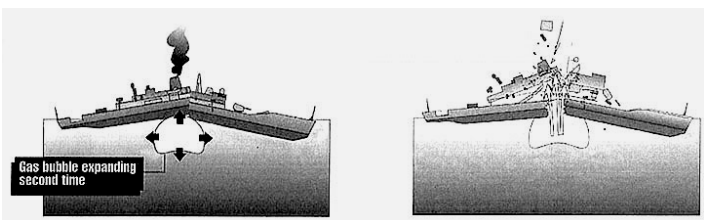
Torpedoes

- 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

Torpedoes

- 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

WWI - The Ship Killer

Torpedoes

- 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

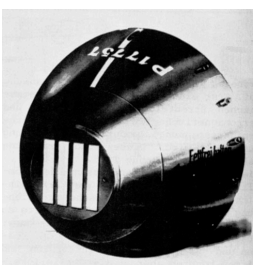
Torpedoes

- 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

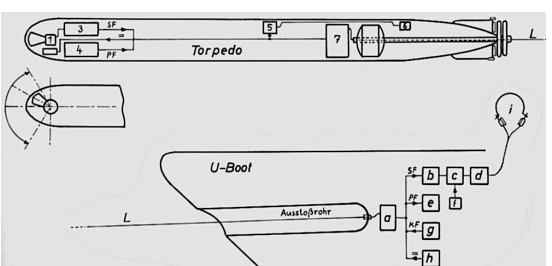
The Smart Torpedo

Torpedoes

- 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



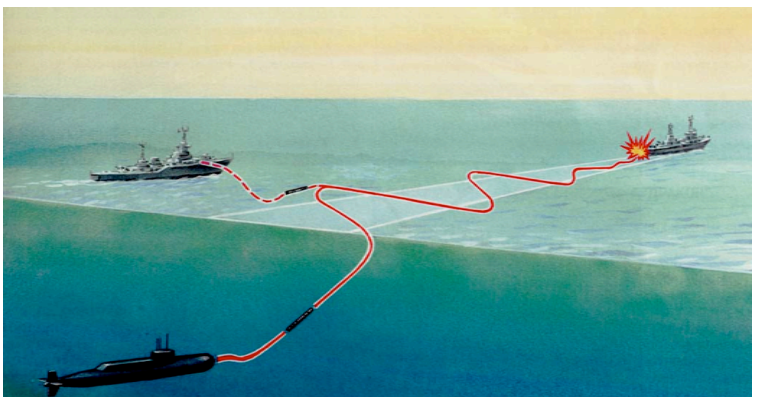
Lerche wire-guided torpedo concept

Influence on Modern Torpedoes

- 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

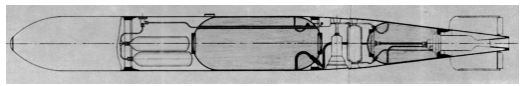
Torpedoes



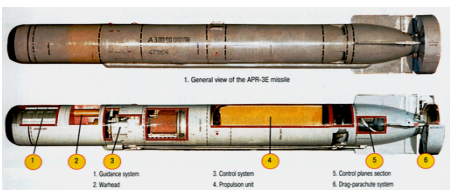
- Wake homing weapons are easier to use and there is, at present, no effective countermeasure

Rocket Propulsion

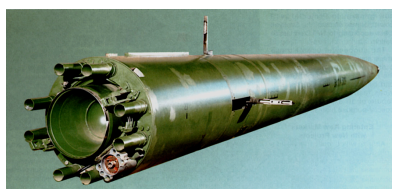
Torpedoes



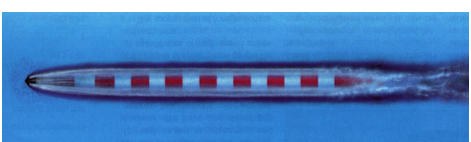
German G5 ur



Russian APR-3E



Russian M-5 Shkval

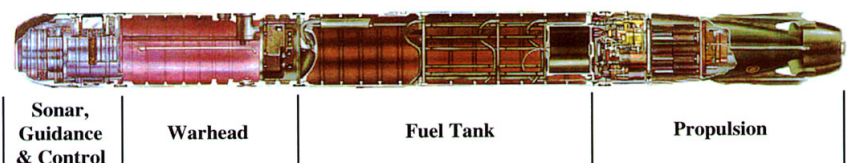


High speed (195 kts), long-range (10 km) due to novel drag reduction system used in the Shkval

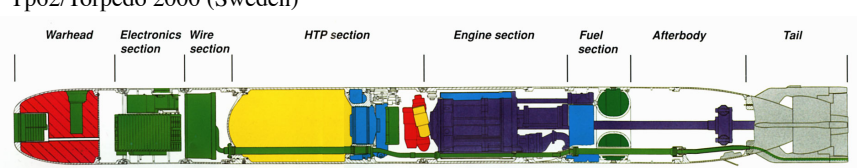
Modern Torpedoes

Torpedoes

Mk 48 Mod 5 ADCAP (US)



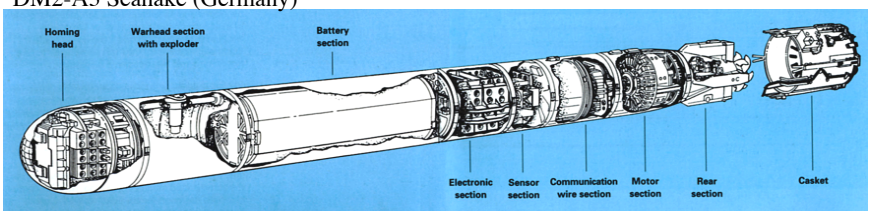
Tp62/Torpedo 2000 (Sweden)



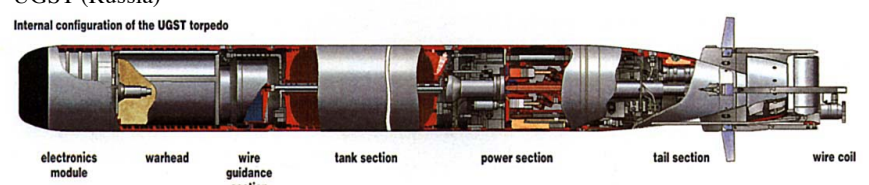
Modern Torpedoes

Torpedoes

DM2-A3 Seahake (Germany)

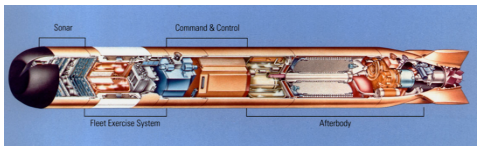


UGST (Russia)

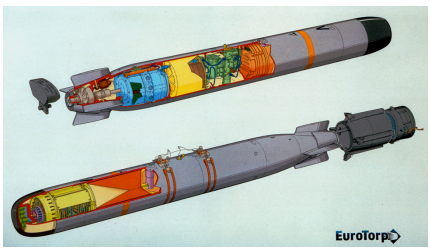


Modern Torpedoes

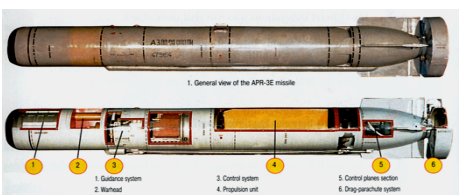
Torpedoes



Mk 50 Barracuda (US)



MU-90 IMPACT (France/Italy)



APR-3E (Russia)

Conclusions

Torpedoes

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