



# Torpedo: A Historical Review



*Christopher Carlson  
Historicon 2000*

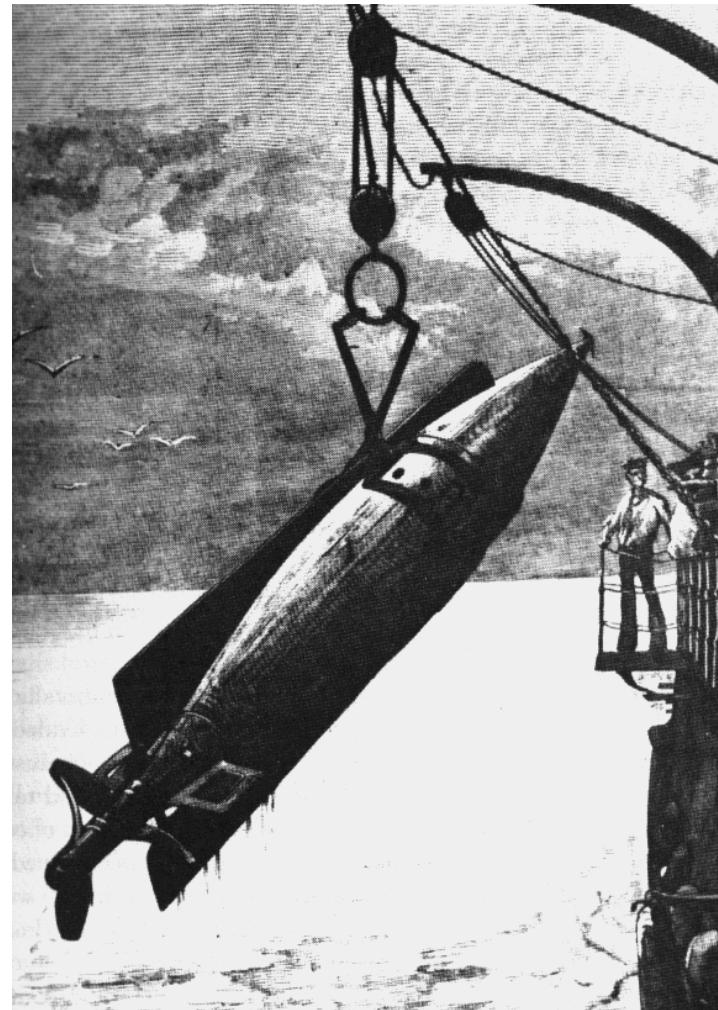
*Admiralty Trilogy Seminar*



# Introduction

## *Torpedoes*

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

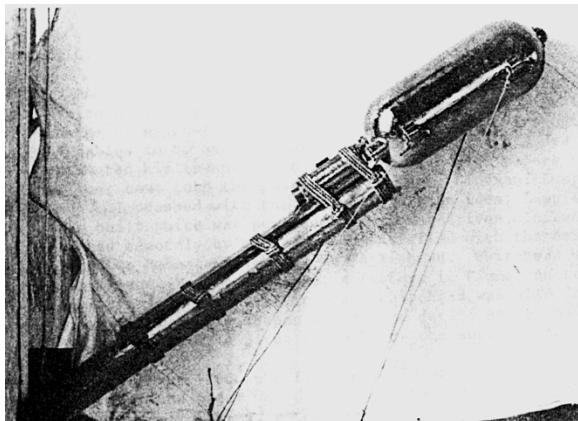




# Definition

## Torpedoes

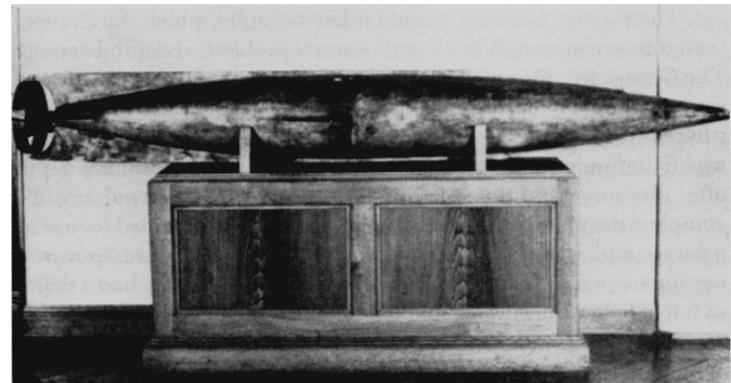
- ◆ **Torpedo:** Generic term used to cover *all* forms of underwater weapons and explosives
- ◆ Name derived from the Cramp, or torpedo, fish which stuns its intended victim with an electric shock



Spar torpedo



Civil War mine



Fish torpedo



# Whitehead's Devils Device

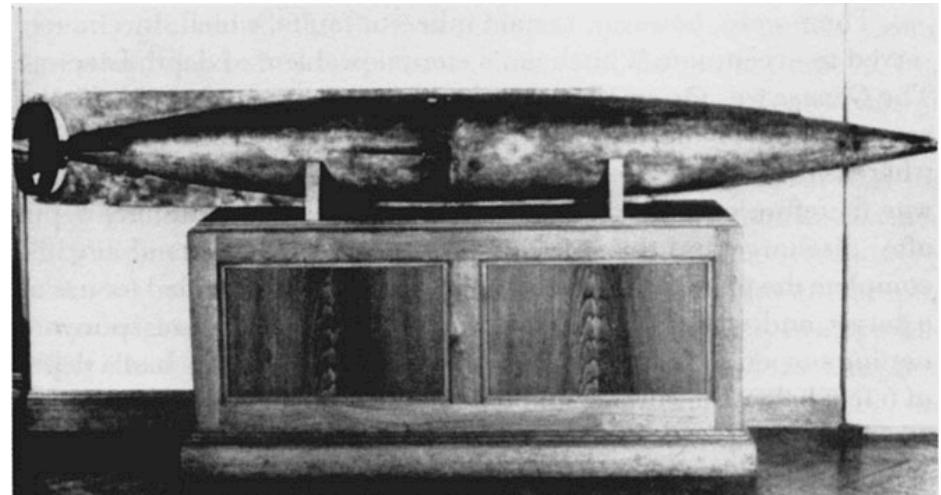
## Torpedoes

### ◆ 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 fusing
- ◆ 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:

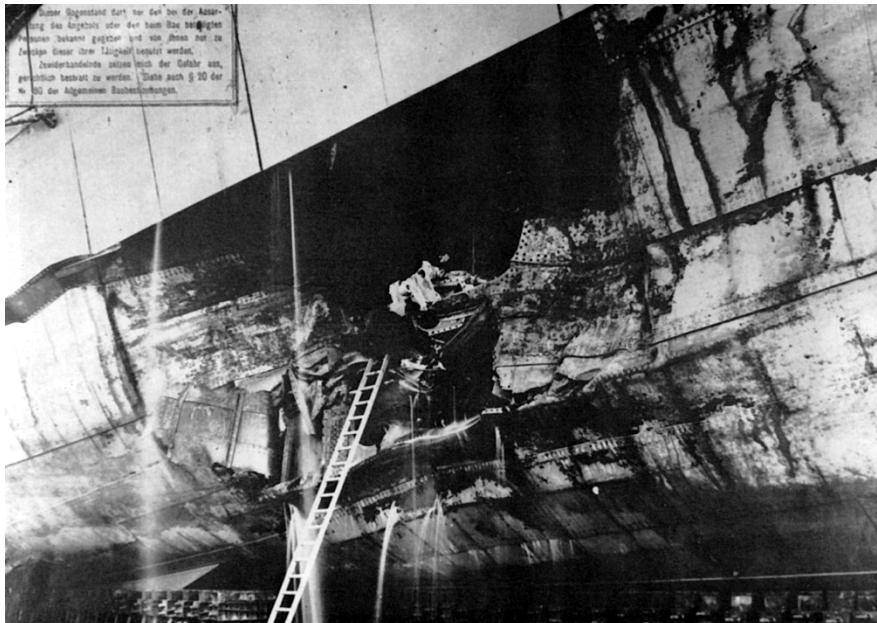
*Put a hole in a ship, let the water in and  
Mother Nature will do the rest!*



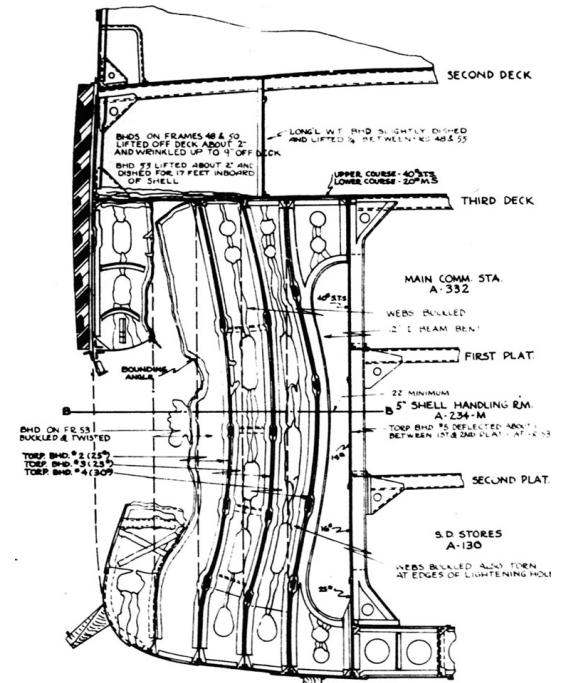
# Contact Detonation

## 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

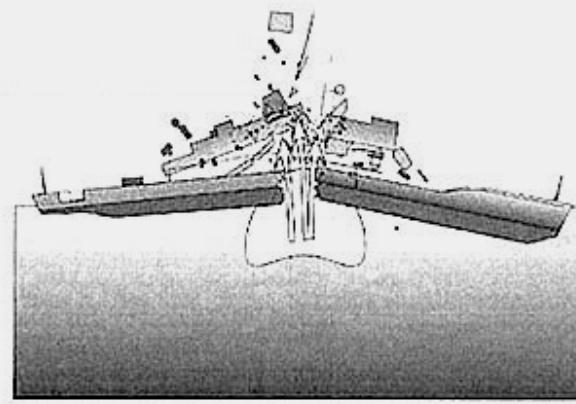
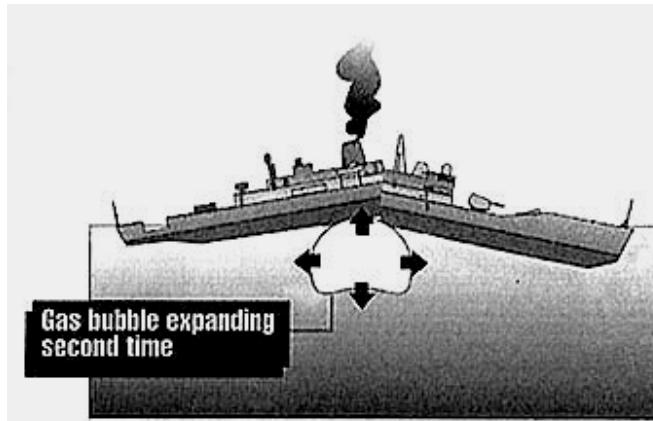
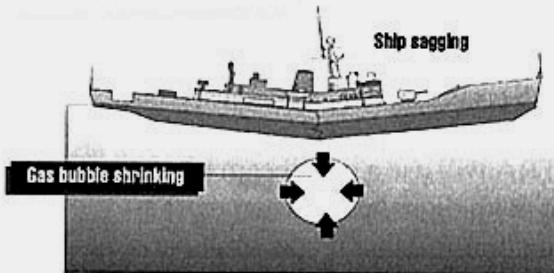
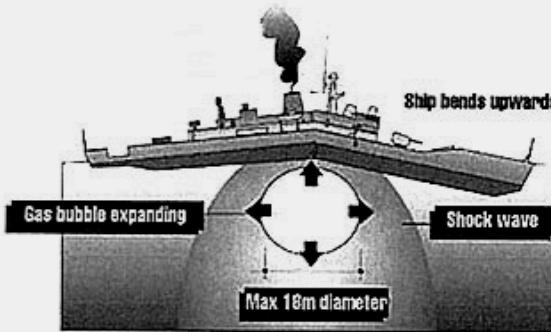
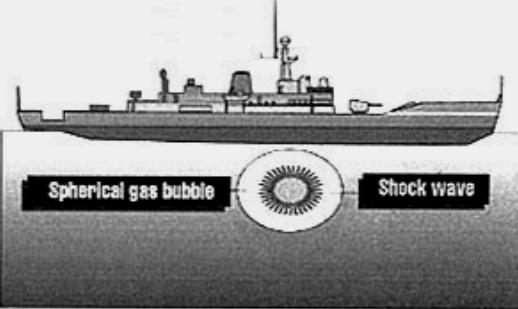
◆ 50% of the energy in an explosion is available to do damage (25% - shock, 25% - bubble)





# Influence Detonation

## Torpedoes





# Early Torpedoes

## 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 ( $\approx$ 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 ( $\approx$ 1910)
  - 200 lbs of wet gun cotton replaced by 400 lbs of TNT = 2 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

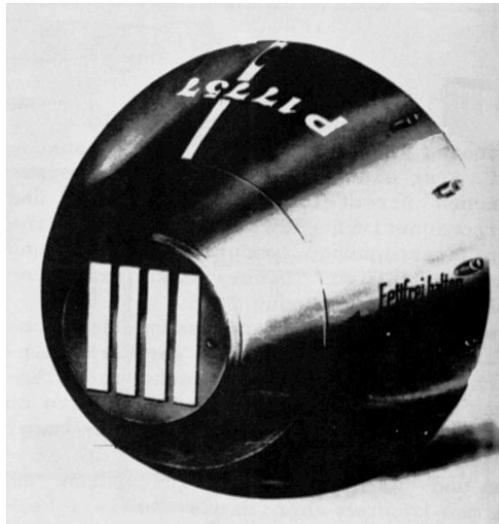
- ◆ Earlier advancements concentrated on propulsion and stability
- ◆ WWII improvements concentrated more on the improving accuracy and lethality
- ◆ Major improvements
  - Electric propulsion matures (1939 - G7e)
    - Both the US and Germany had working prototypes in WWI
  - Influence (magnetic) fuze perfected
    - Both US and Germany experienced reliability problems early in the war
  - New explosive “Torpex” - about 1.5 times as powerful as TNT



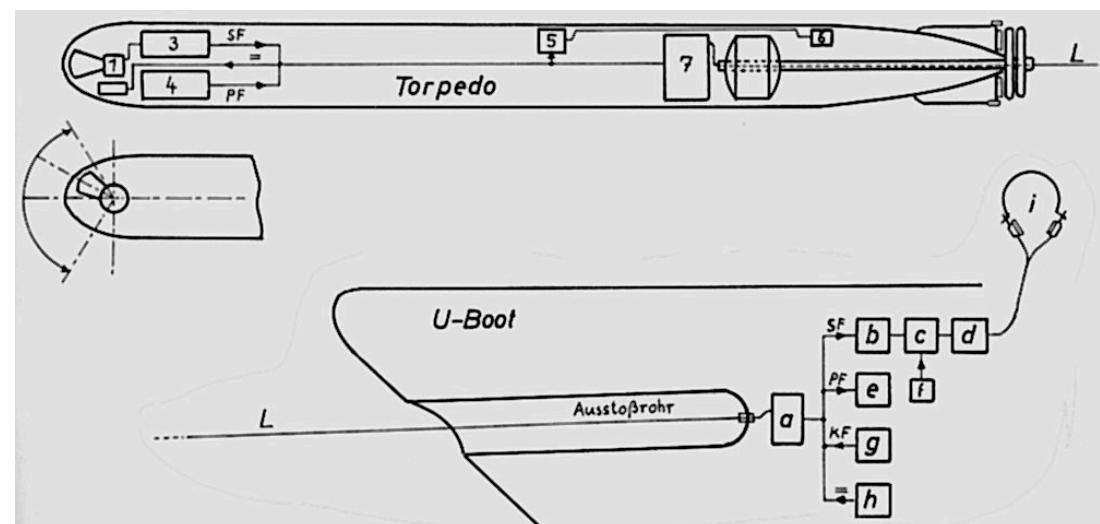
# The Smart Torpedo

## 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

## Torpedoes

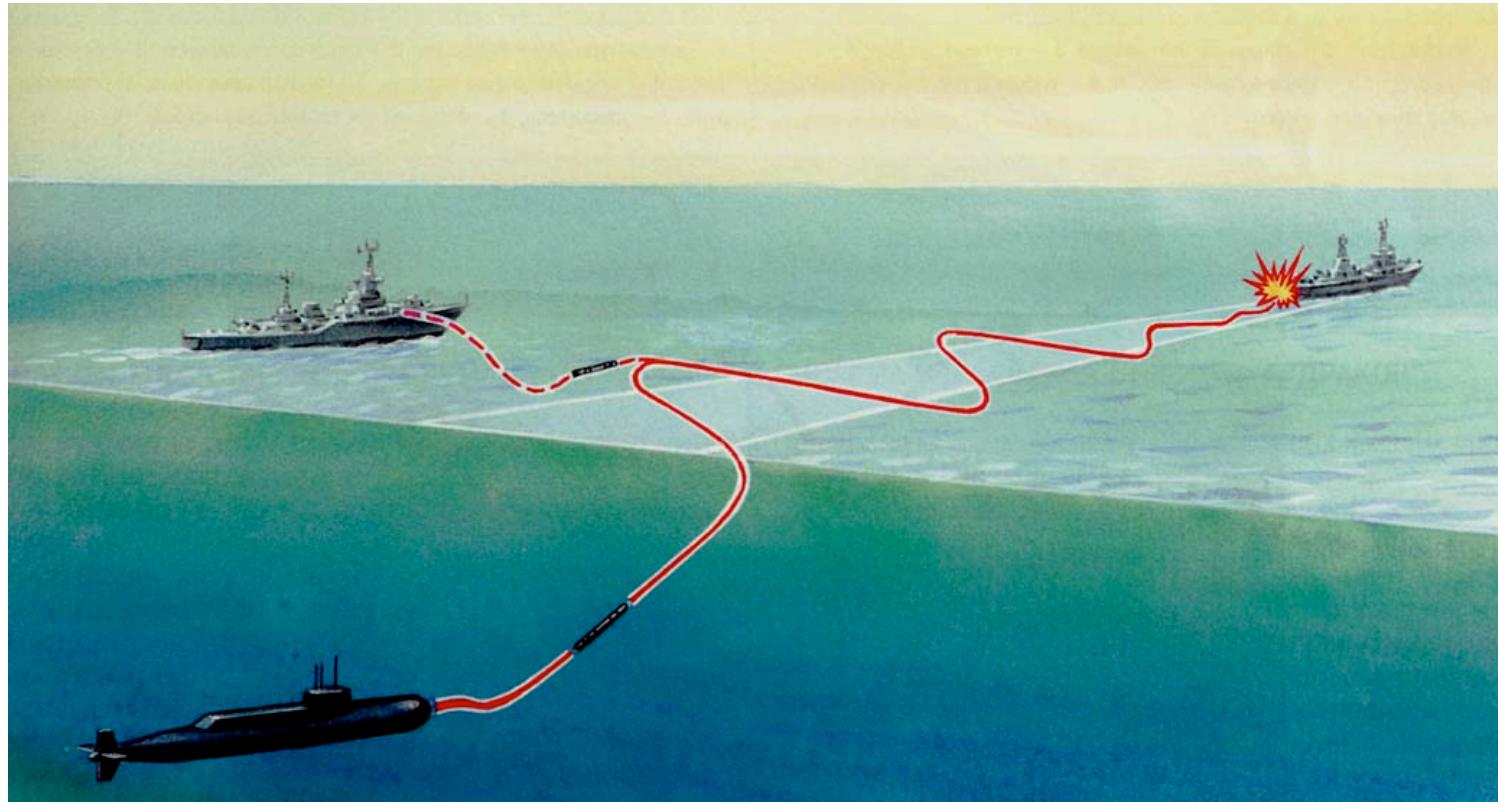
◆ Modern heavyweight torpedo performance was heavily influenced by the advances of German torpedoes developed during WWII

- 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

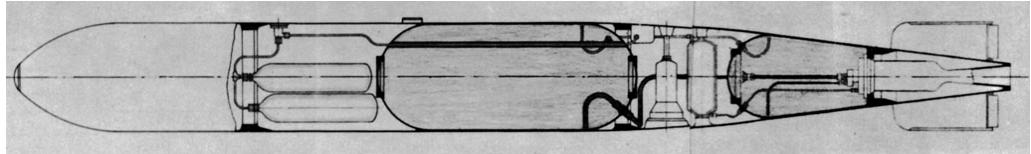


- ◆ Wake homing weapons are easier to use and there is, at present, no effective countermeasure

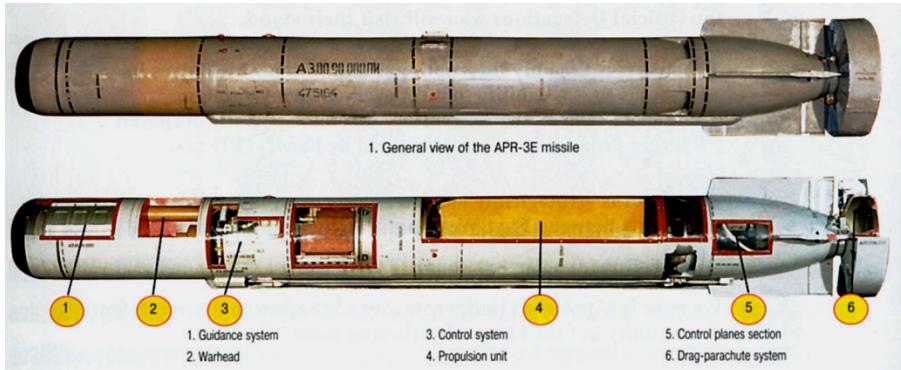


# Rocket Propulsion

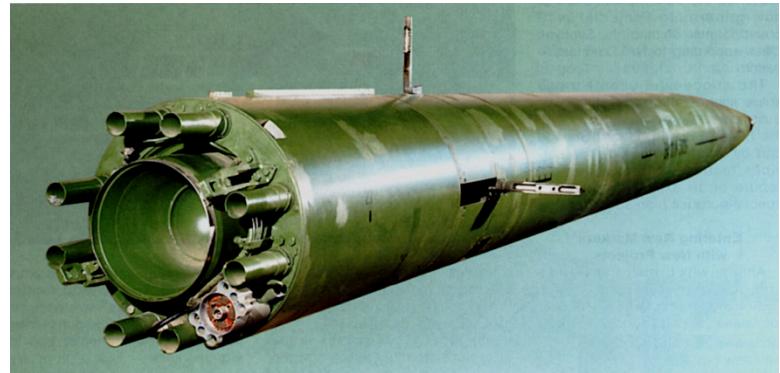
## Torpedoes



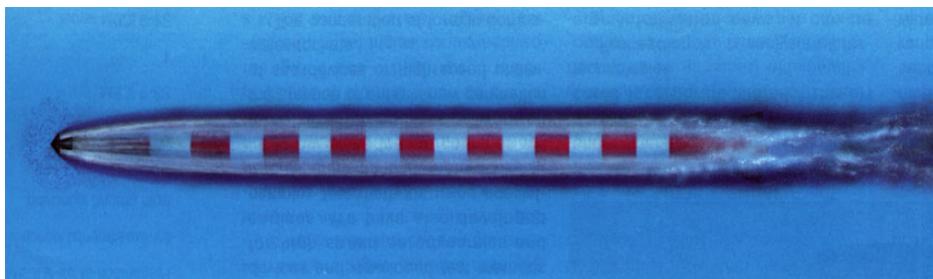
German G5 ur



Russian APR-3E



Russian M-5 Shkval



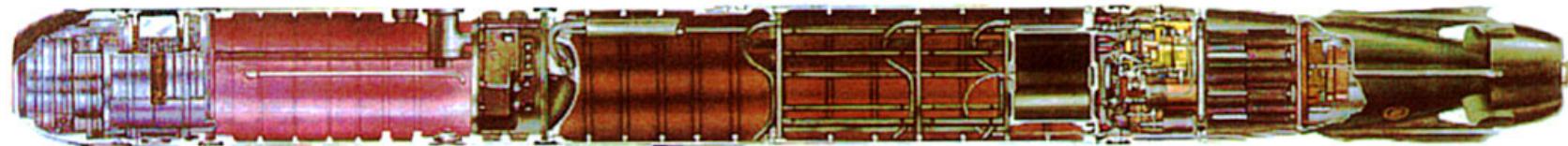
*High speed (195 kts), long-range (10 km) due to novel drag reduction system used in the Shkval*



# Modern Torpedoes

## Torpedoes

Mk 48 Mod 5 ADCAP (US)



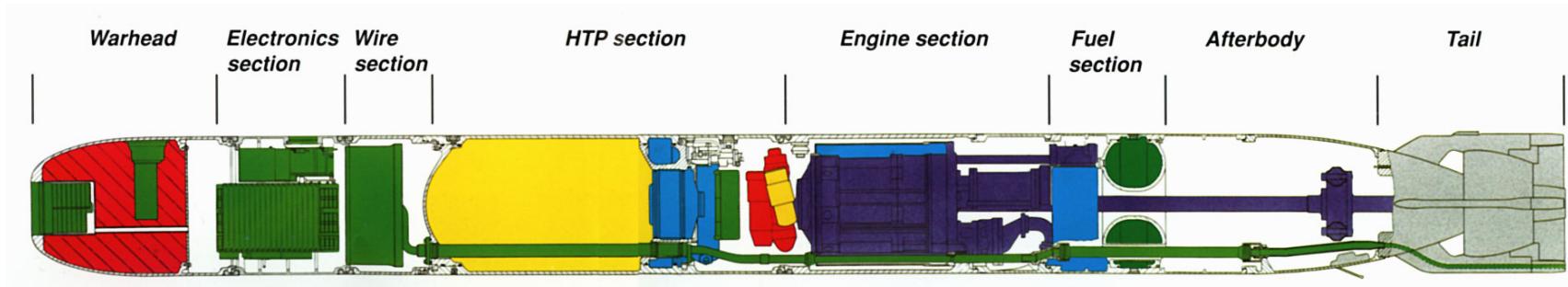
Sonar,  
Guidance  
& Control

Warhead

Fuel Tank

Propulsion

Tp62/Torpedo 2000 (Sweden)

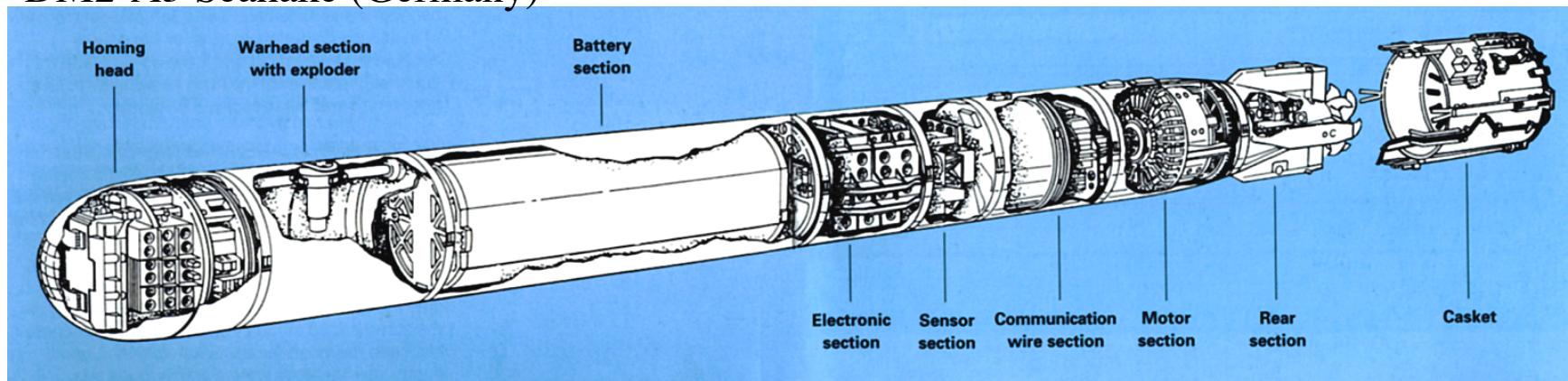




# Modern Torpedoes

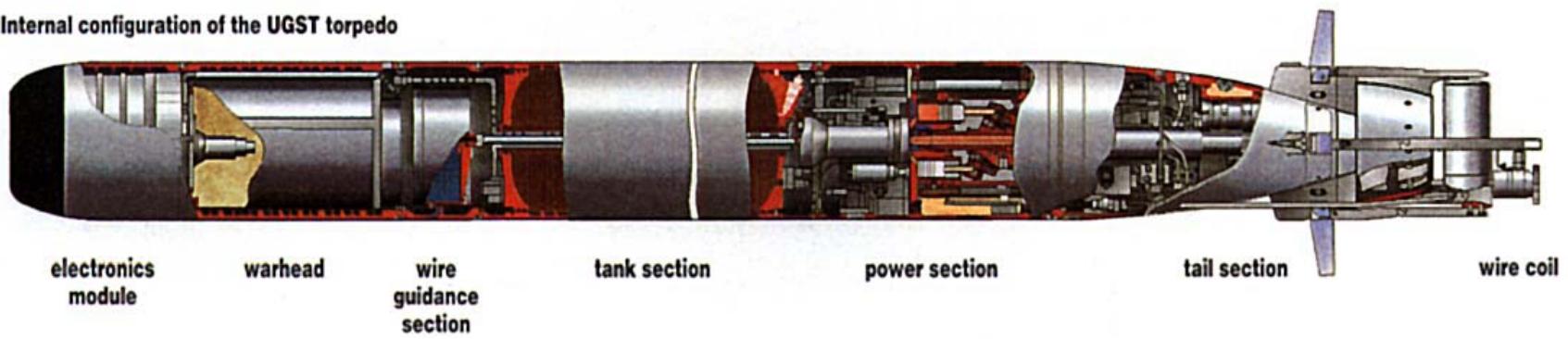
## Torpedoes

DM2-A3 Seahake (Germany)



UGST (Russia)

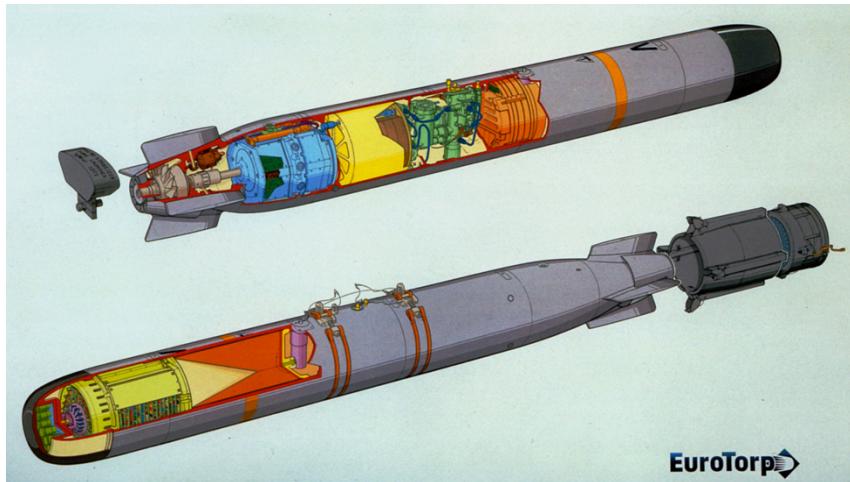
Internal configuration of the UGST torpedo



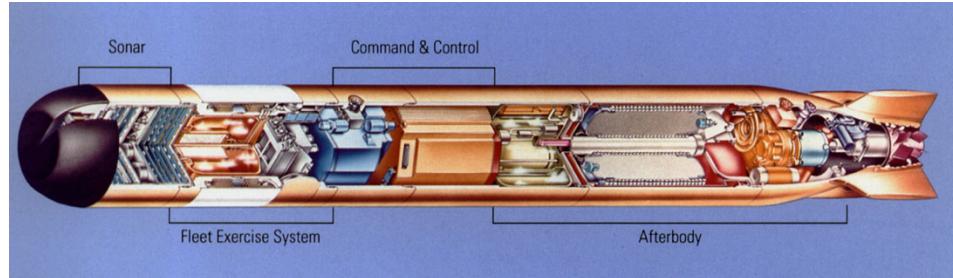


# Modern Torpedoes

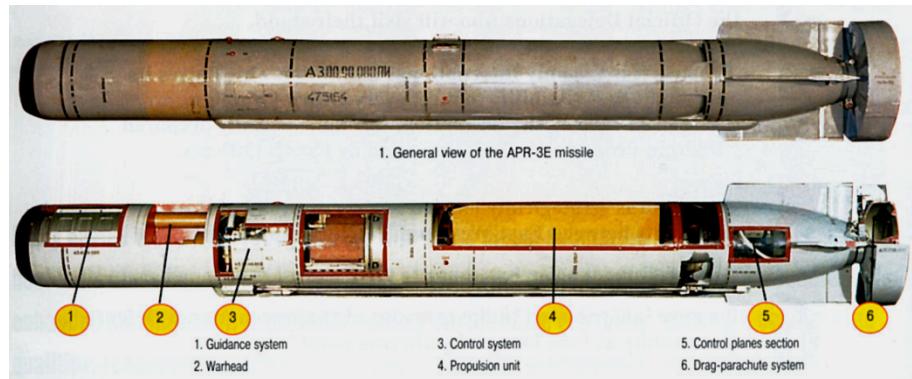
## Torpedoes



MU-90 IMPACT (France/Italy)



Mk 50 Barracuda (US)



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

