



# *Torpedo:* *A Historical Review*



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*Historicon 2000*

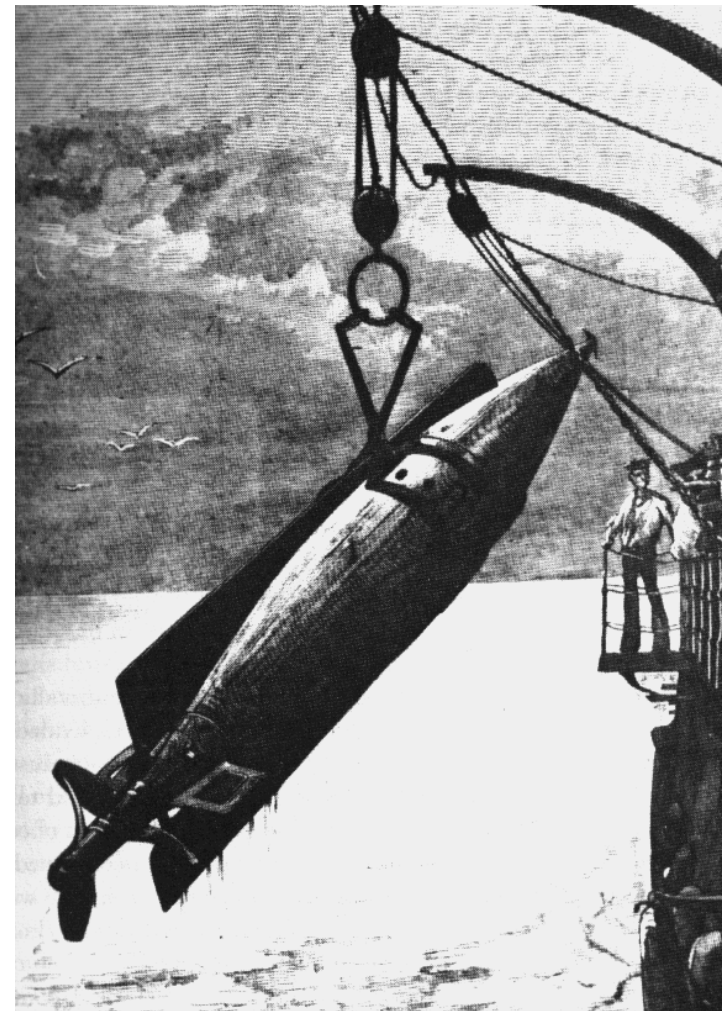
*Admiralty Trilogy Seminar*



# 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**

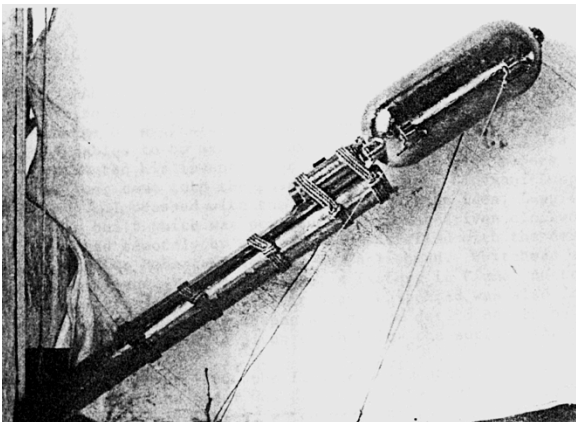




# Definition

## *Torpedoes*

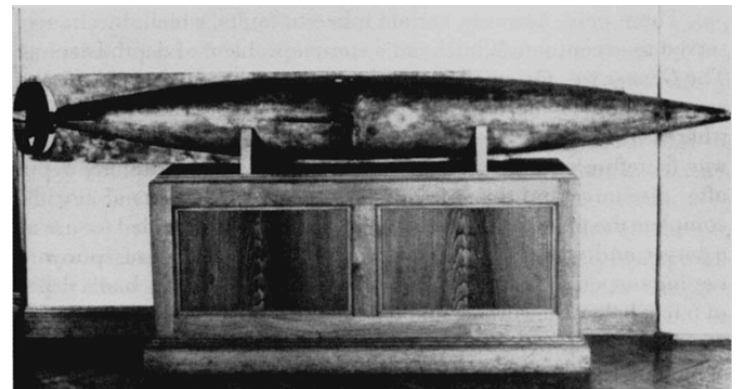
- ◆ **Torpedo**: Generic term used to cover *all* forms of underwater weapons and explosives
- ◆ Name derived from the Cramp, or torpedo, fish which stuns its intended victim with an electric shock



Spar torpedo



Civil War mine



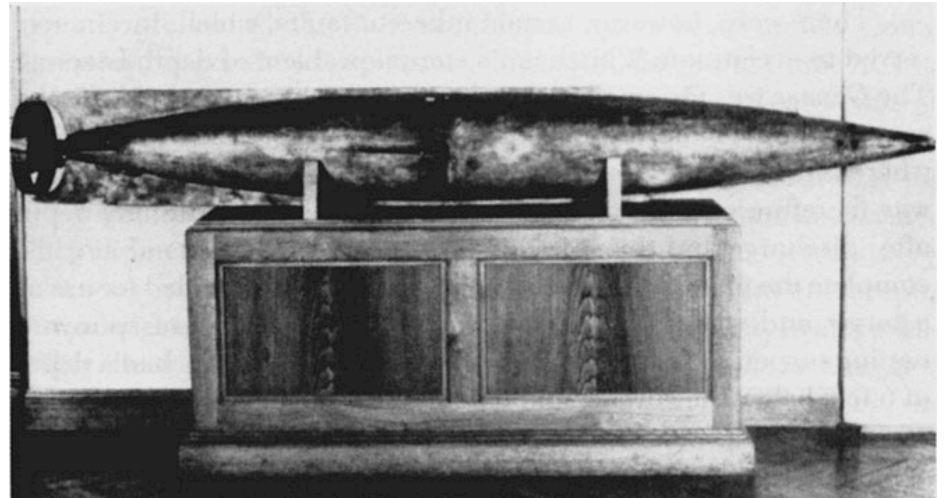
Fish torpedo



# 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!***





# Influence Detonation

## *Torpedoes*

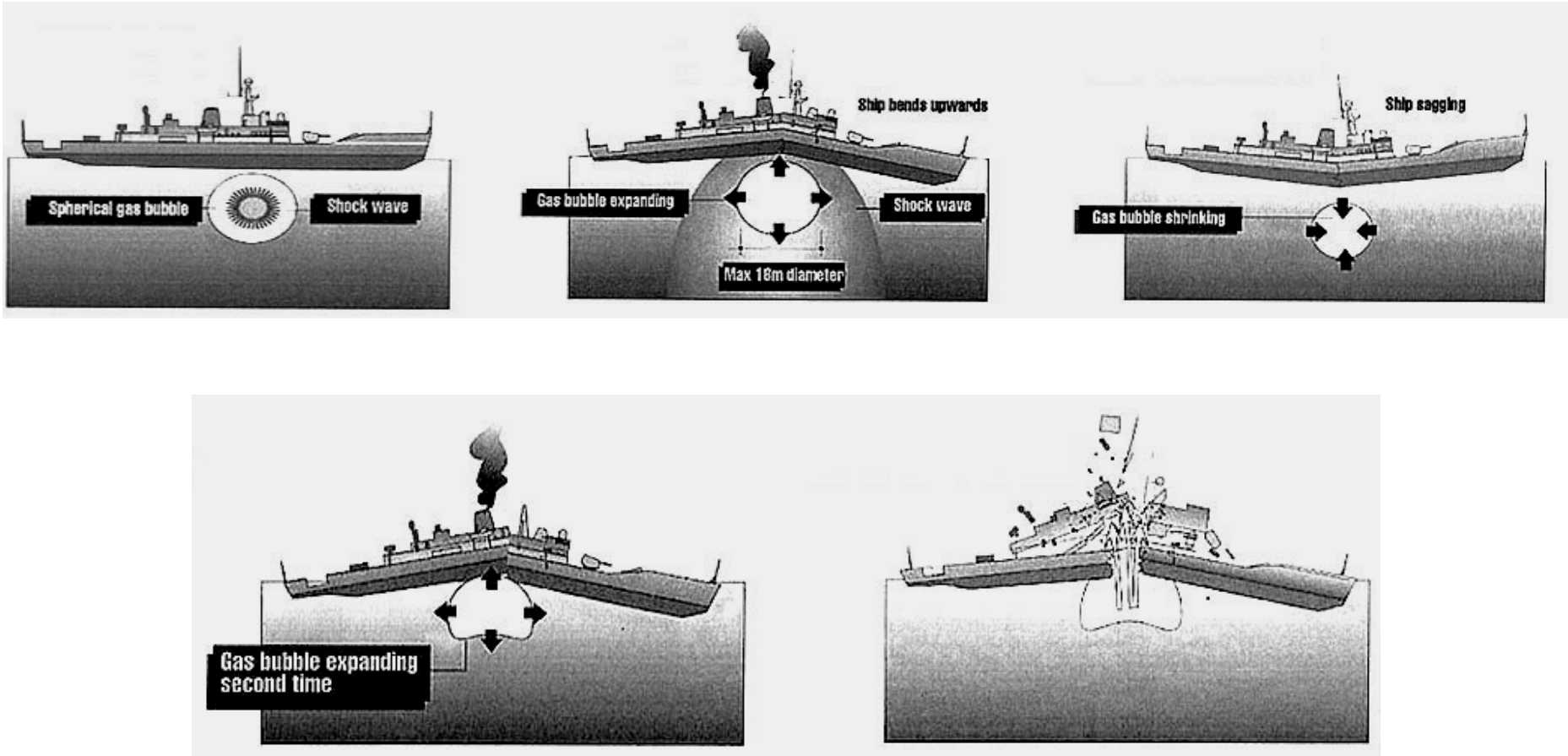
- ◆ **Potentially far more destructive than contact**
  - Shock Damage
  - Hull Whipping
  - Bubble Pulse/Bubble Collapse
- ◆ **50% of the energy in an explosion is available to do damage (25% - shock, 25% - bubble)**





# 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 (≈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*

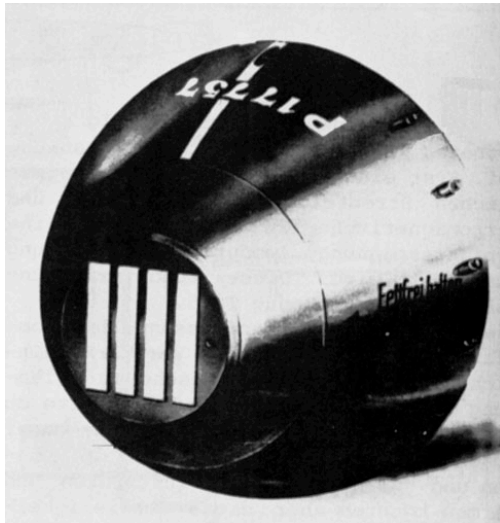
- ◆ **Earlier advancements concentrated on propulsion and stability**
- ◆ **WWII improvements concentrated more on the improving accuracy and lethality**
- ◆ **Major improvements**
  - **Electric propulsion matures (1939 - G7e)**
    - **Both the US and Germany had working prototypes in WWI**
  - **Influence (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

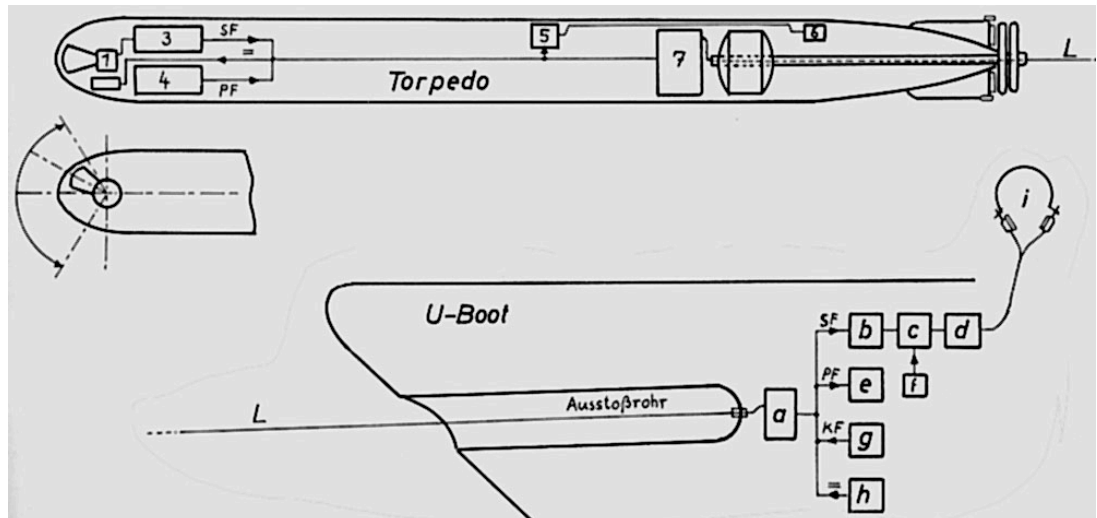


## Torpedoes

- ◆ 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

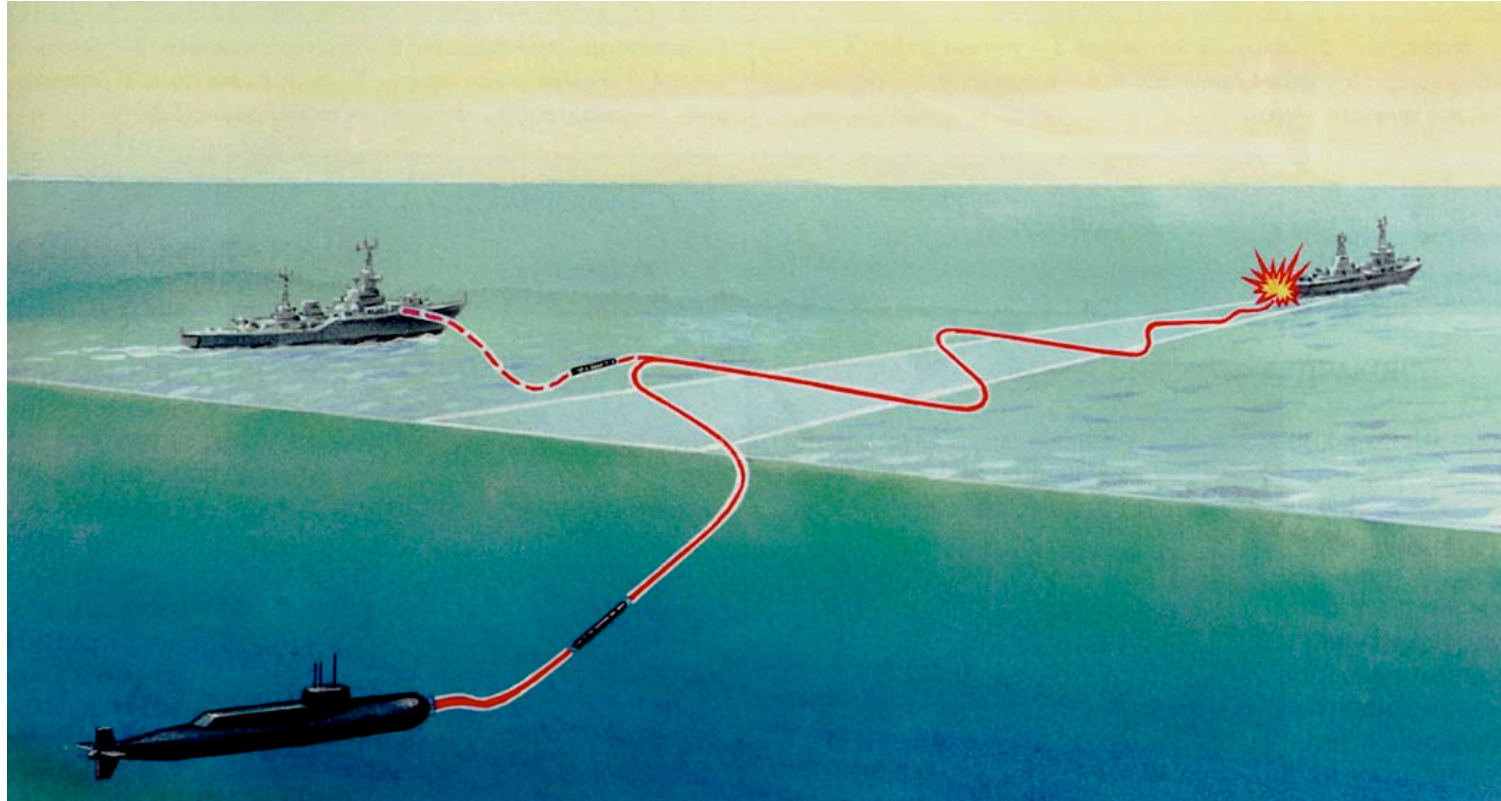
## *Torpedoes*

- ◆ **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*

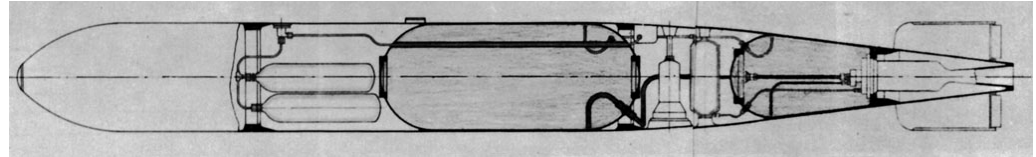


- ◆ **Wake homing weapons are easier to use and there is, at present, no effective countermeasure**

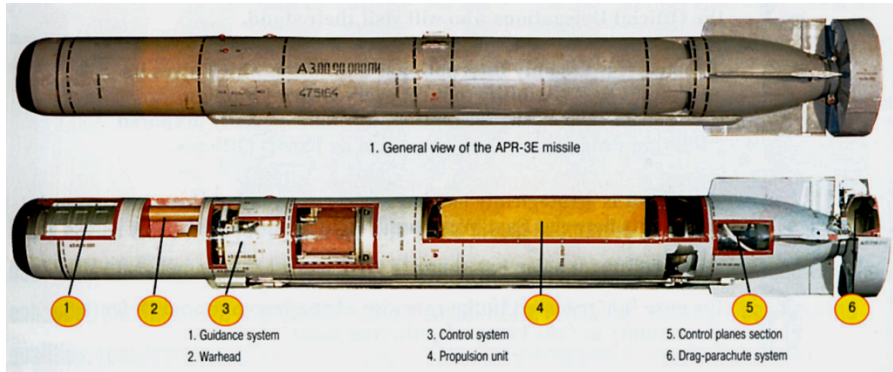
# Rocket Propulsion



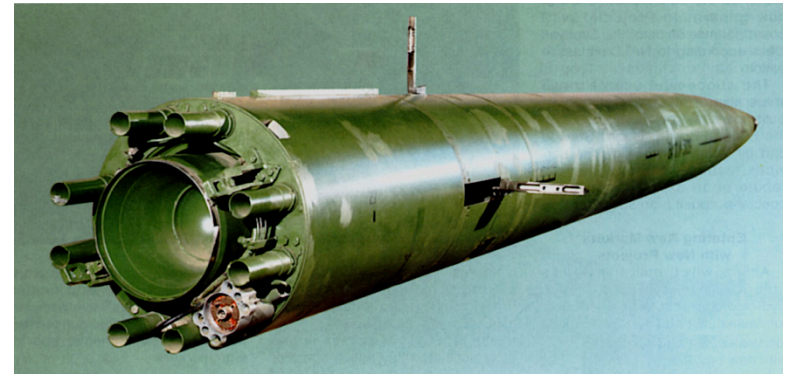
## Torpedoes



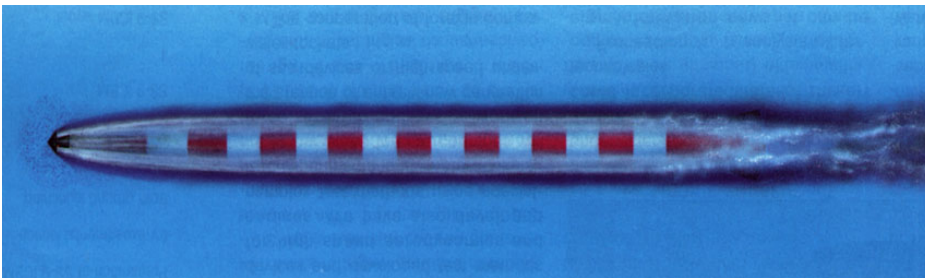
German G5 ur



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*

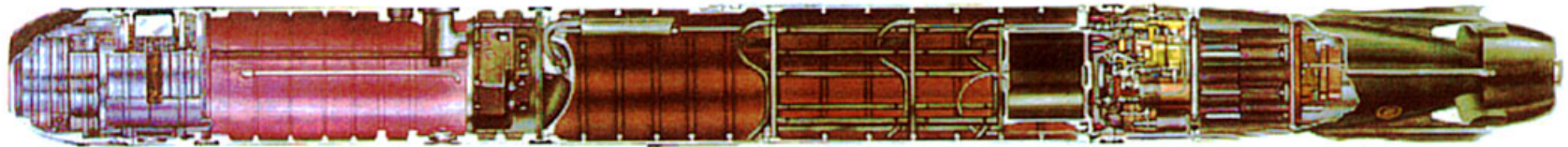




# Modern Torpedoes

## Torpedoes

Mk 48 Mod 5 ADCAP (US)



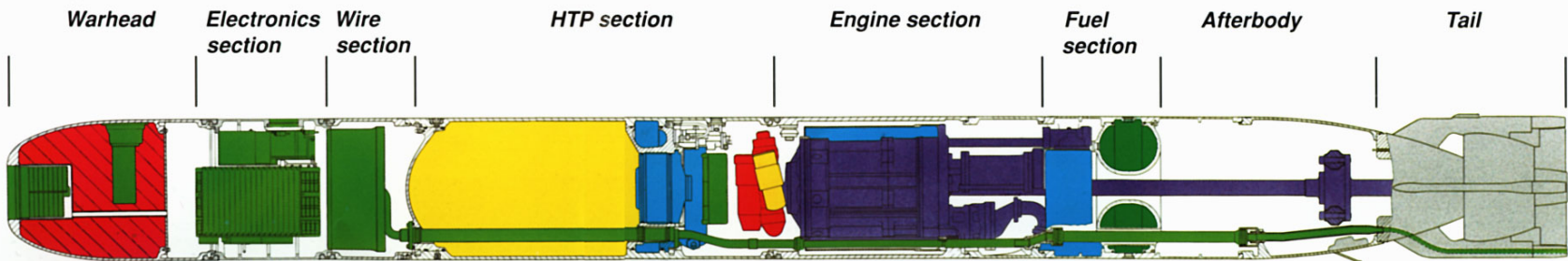
**Sonar,  
Guidance  
& Control**

**Warhead**

**Fuel Tank**

**Propulsion**

Tp62/Torpedo 2000 (Sweden)

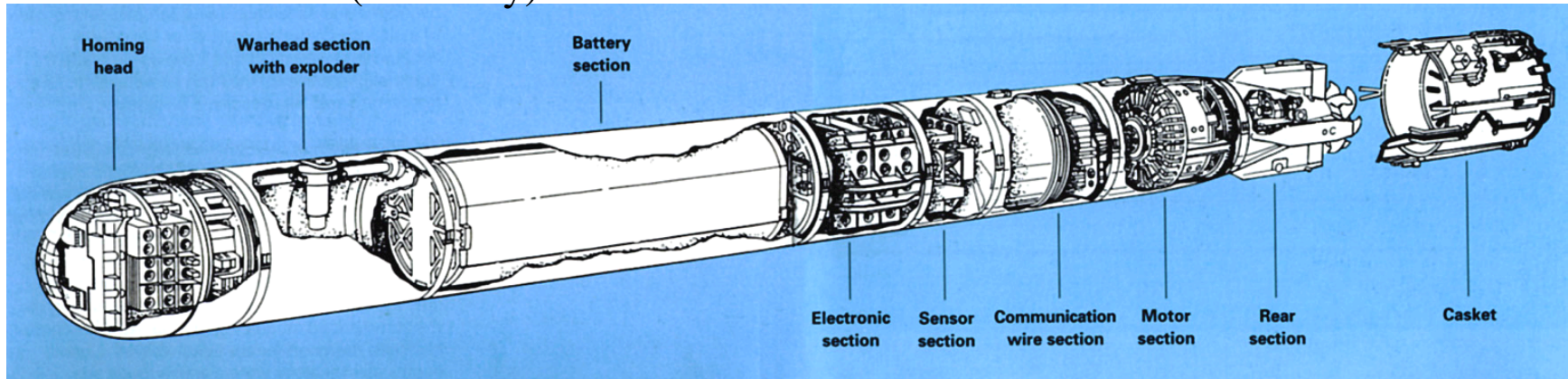




# Modern Torpedoes

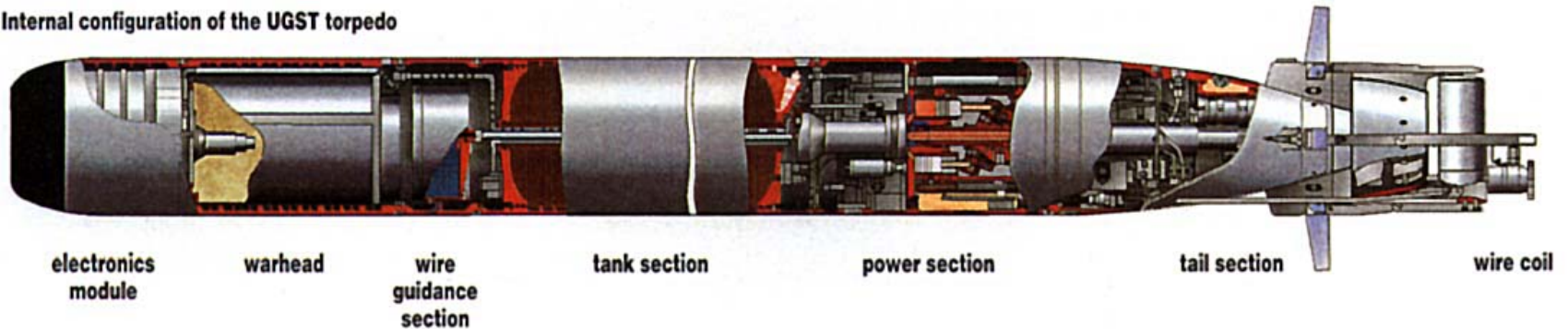
## Torpedoes

### DM2-A3 Seahake (Germany)



### UGST (Russia)

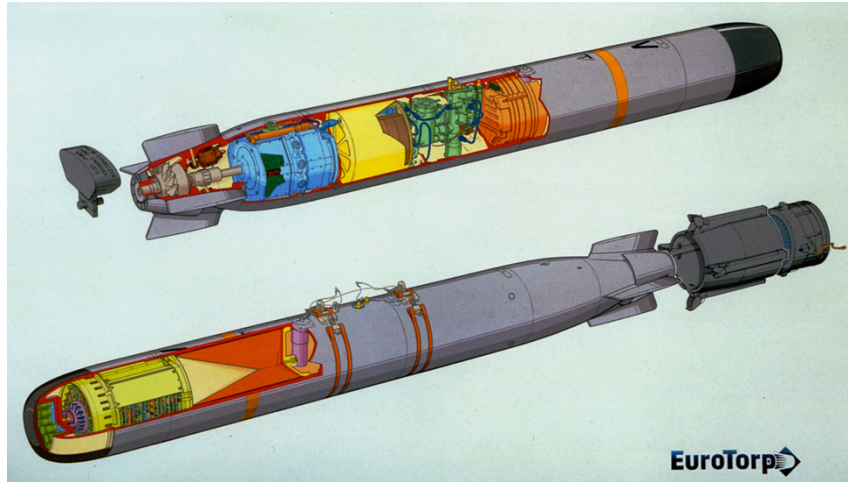
Internal configuration of the UGST torpedo



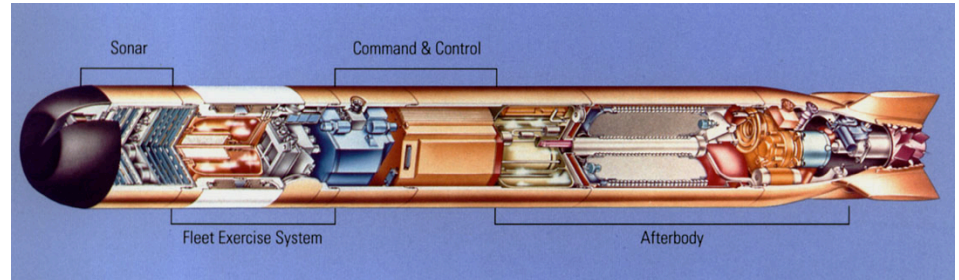
# Modern Torpedoes



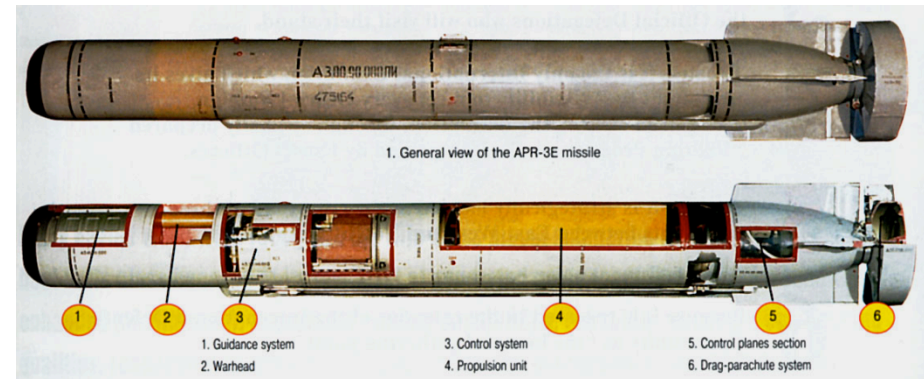
## Torpedoes



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

