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French Torpedo Development before 1914

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ABSTRACT
France embraced the promise of self-propelled torpedoes in the early decades of development. Proponents of the Jeune École put it at the centre of naval strategy, tactics, and fleet composition, as a way for a weaker navy to challenge a stronger. Even as the French Navy fell under the influence of Alfred Thayer Mahan and constructed a big gun battlefleet, the advanced torpedo still maintained its prominence. A contemporary publication distributed within the French Navy provides technical details, capabilities, and quality of design for standard French model types before the First World War.

Introduction

The French Navy (*Marine nationale*) was an early adopter of torpedo technology and pursued its development enthusiastically through arrangements with leading innovators, and also with its own refinements. In contrast to the close industrial relations between navies and private concerns in Great Britain and the United States as described by Katherine Epstein, French manufacture and maintenance of torpedoes was largely done in or near state-run arsenals connected to major ports under maritime prefects.[1] Designs were at first foreign in origin and were then adapted to specific requirements for operating on a variety of warships.

France constructed large numbers of torpedo boats organised into flotillas, trialled submarines from experimental novelties to an operational ready force, and incorporated torpedoes into larger ships within squadrons and the battlefleet. As a

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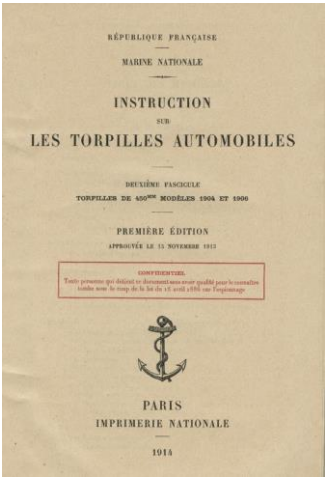
[1]Katherine C. Epstein, *Torpedo: Inventing the Military-Industrial Complex in the United States and Great Britain,* (Cambridge Mass: Harvard University Press, 2014).

preferred weapon of choice, torpedoes and their deployment involved dedicated infrastructure, specialized training, and personnel assignment inside the French Navy.

French torpedoes, like those of other countries, were marvels of engineering and technical complexity designed with one purpose, to deliver an explosive charge against the hull of another ship, in a more-or-less straight line, and at a distance safe enough for those launching to avoid direct fire and countermeasures. The most critical factors were speed, bearing, sea conditions, and reliability. Early torpedoes were notorious for failures and misses until the technology advanced and settled.[2] How good then were French *torpilles*? By the start of the First World War, the French Navy possessed reasonably reliable models that had been thoroughly tested and operationalised and compared favourably with those of other navies. A manual on automotive torpedoes was approved in November 1913 and published in 1914. Meant for internal use, it furnishes an insight into the design and technical aspects of the French Navy's conventional 450-mm torpedoes (Figure 1). At the time, they were state-of-art and admirably reflected the talents of French maritime and engineering industries but the French Navy's subsequent use of torpedoes in the war at sea was very limited.


RÉPUBLIQUE FRANÇAISE

MARINE NATIONALE

INSTRUCTION

SUR

LES TORPILLES AUTOMOBILES

DEUXIÈME FASCICULE

TORPILLES DE 450mm MODÈLES 1904 ET 1906

PREMIÈRE ÉDITION

APPROUVÉE LE 15 NOVEMBRE 1913

CONFIDENTIEL

PARIS

IMPRIMERIE NATIONALE

1914

Figure 1: Front cover of the *Instruction sur Les Torpilles Automobiles*.[3]

[2]Edwyn Gray, *19th Century Torpedoes and Their Inventors,* (Annapolis: Naval Institute Press, 2004).

[3]*Instruction sur les torpilles automobiles,* (Paris: Imprimerie nationale, 1914). All translations from the *Instruction* are by Chris Madsen.

The Democratic weapon of the Republic

The torpedo appealed to France's republican character as a leading continental and maritime nation. Since before and then after the French Revolution, the French Navy had operated under the threat of Great Britain's aggressive and dominant Royal Navy. The French fleet was split between two long coasts, one in the Mediterranean based out of Toulon and Algeria, and the other facing the Atlantic and English Channel. In the event of war, the British intended to keep the Mediterranean component bottled-up and incapable of reinforcing the Atlantic front, where the Royal Navy could descend on French harbours and ports and wreak havoc on commerce. Equally, units of the French Navy would be available to transport land forces from the French Army and its own naval artillery and marines across the short sea distance for raids in force or invasion, either in surprise movements, or once British sea control was contested or ceded.

Naval operations during the wars against the Russians in the Crimea in 1854-56 and the Prussians in the Baltic in 1870 highlighted the limitations of close blockade, the difficulties behind planning and conduct of combined amphibious landings, and the dangers of mines, obstructions, and fixed artillery in coastal fortifications. In the second half of the nineteenth century the British and the French traded qualitative advantage back and forth in building first ironclads and then the newer battleships incorporating the latest advances in naval architecture and armaments. However, strained French finances and constant organizational churn due to political instability from the frequent turnover of the Third Republic's governments and navy ministers meant the French Navy experienced difficulty staying ahead.[4] How to overcome the basic strategic dilemma of divided fleets, address material inferiority as ships aged and present a cohesive doctrine for their employment preoccupied opinion-makers and tacticians within the French Navy. The arrival of the self-propelled torpedo offered new defensive and offensive opportunities to those thinkers.

French enthusiasm for the new innovation bordered on infatuation and fed into a classic underdog narrative that inspired new thinking inside and outside the French Navy. Although spar and towed torpedoes had existed for some time, the challenge of making an autonomous device, launched under its own power that could then travel to an intended target, was not solved until a working prototype was made by a British engineer, Robert Whitehead, who was managing the Fiume works in the Austro-

[4]Hugues Canuel, 'From a Prestige Fleet to the Jeune Ecole: French Naval Policy and Strategy under the Second Empire and the Early Third Republic (1852-1914)', *Naval War College Review*, 71, 1, (Winter 2018), p. 103.

Hungarian Empire.[5] Whitehead's torpedo ran on compressed air, and was capable of reaching an advertised effective range of about 400 meters in good conditions. Other engineering features of the automotive torpedo were considered trade secrets, so the French government negotiated rights to the plans and started manufacture in 1873.[6]

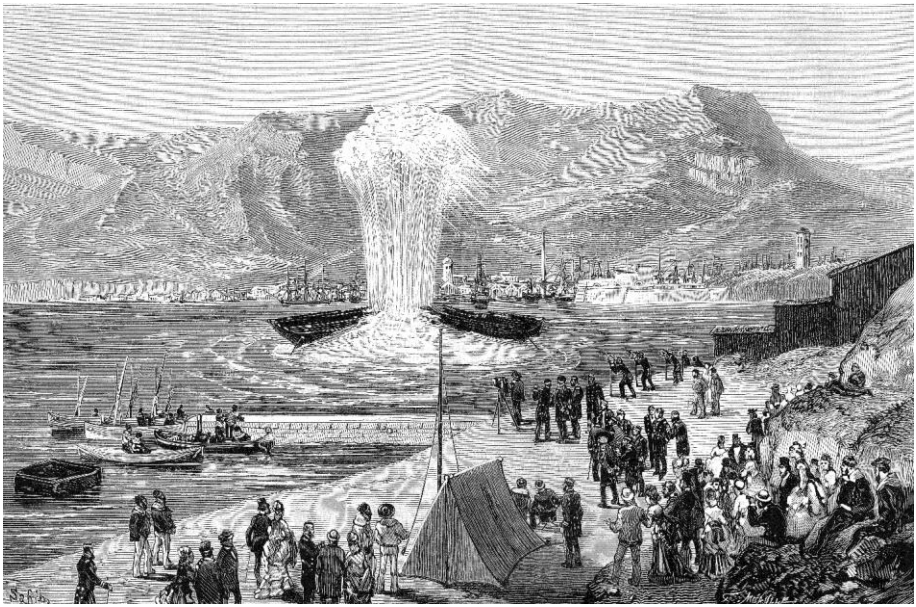


Figure 2: Torpedo trials on an old warship in Toulon attracted large crowds of spectators.[7]

Vice-Admiral Siméon Bourgois, the celebrated inventor of a steam propeller whose technical and operational knowledge was extensive, proved instrumental in the early French adoption of the torpedo. The torpedo training establishment (*école des défenses*

[5]Edwyn Gray, *The Devil's Device: Robert Whitehead and the History of the Torpedo,* (Annapolis: Naval Institute Press, 1991). Alan Wolstencroft, 'The Whitehead Story', *Mariner's Mirror*, 59, 3 (1973), p. 345. Paul Halpern, 'The French Navy, 1880-1914', in Phillips Payson O'Brien (ed.), *Technology and Naval Combat in the Twentieth Century and Beyond,* (London & New York: Routledge, 2001), p. 38.
[6]Theodore Ropp, Stephen S. Roberts (ed.), *The Development of a Modern Navy: French Naval Policy 1871-1904,* (Annapolis: Naval Institute Press, 1987), pp. 112-113.
[7]Lithograph print in author's possession.

sous-marines) at Boyardville on the Isle of Oléron, was headed by the up-and-coming Captain (*Capitaine de vaisseau*) Amédée Courbet who, under the maritime prefect of Rochefort, reorganised it in 1876 to carry out advanced studies and provide opportunities for experimentation. Trials of French-procured Whitehead torpedoes invited considerable public interest and spectacle as can be seen in Figure 2. To the public and advocates of the new weapon, here finally was a truly revolutionary and democratic weapon that could challenge British superiority and tyranny (and incidentally aristocratic elements in the French Navy).[8] That the Royal Navy also had its own Whitehead torpedoes and was vigorously pursuing the procurement of torpedo boats and eventually torpedo boat destroyers (larger counter-torpedo boats) was merely inconvenient.[9]

Wild claims about the effectiveness of torpedoes and torpedo boats gave rise in part to the *Jeune École*, the 'young school', that found virtue in the small and the many. Its main champion was Vice-Admiral Théophile Aube who argued that any naval war against Great Britain could be best waged by attacks on commerce by cruisers while flotillas of torpedo boats provided for coastal defence and, when opportune, offensive operations.[10] Journalist Gabriel Charmes, an Aube confidant, went one step further and argued that boats carrying torpedoes could operate independently to strike opposing naval forces and mercantile trade. Although Bourgois pointed out the evident technical and legal impediments, the *Jeune École*'s allure rose when Aube became Navy Minister in 1886. Thereafter support peaked periodically whenever ministers and admirals of similar views came into positions of influence and decision making, in particular under the reformers Édouard Lockroy and Vice-Admiral Ernest Fournier.

Great Britain's determination to build up to a two-power standard was formalised by the Naval Defence Act of 1889.[11] This determination meant that French shipbuilding capacity was unable to compete in the construction of larger warships to add to the battlefleet. This situation solidified the French Navy's already inferior position, so that only a wholly different strategy could hope to defend against and to challenge a clearly

[8]Gabriel Sauvé, 'La pensée navale et le débat sur la torpille en Angleterre au cours de la décennie 1880', MSc History (Montreal: Université de Montréal, 2010), p. 32.
[9]Mark Briggs, 'Innovation and the Mid-Victorian Royal Navy: The Case of the Whitehead Torpedo', *Mariner's Mirror*, 88, 4 (2002), p. 453. Joseph Zeller, 'Redefining the Naval Seascape: The Emergence of the Torpedo Boat', MSS, (Calgary: University of Calgary, 2009), pp. 29-30.
[10]Arne Røksund, *The Jeune Ėcole: The Strategy of the Weak,* (Leiden & Boston: Brill, 2007), p. 18.
[11]The two-power standard required Britain to maintain a fleet at least equal to the naval strength any two other countries, in this period, effectively France and the next largest European navy.

superior Royal Navy. The emergence of the torpedo presented a seductive justification for the *Jeune École*'s advocacy of a form of naval warfare that addressed France's strategic position.

Incremental advances in torpedo technology and establishment reorganizations gradually caught up with the initial hype surrounding the weapon and its possibilities. French engineers improved the original models through a system of trial-and-error, and Whitehead adopted a small gyroscope invented by Ludwig Obry to increase stability and depth-keeping.[12] The 1892 model installed on French warships could run beyond 1,100 metres in a straight line. The main consideration was the supply of compressed air for propulsion, as this affected both speed and range.

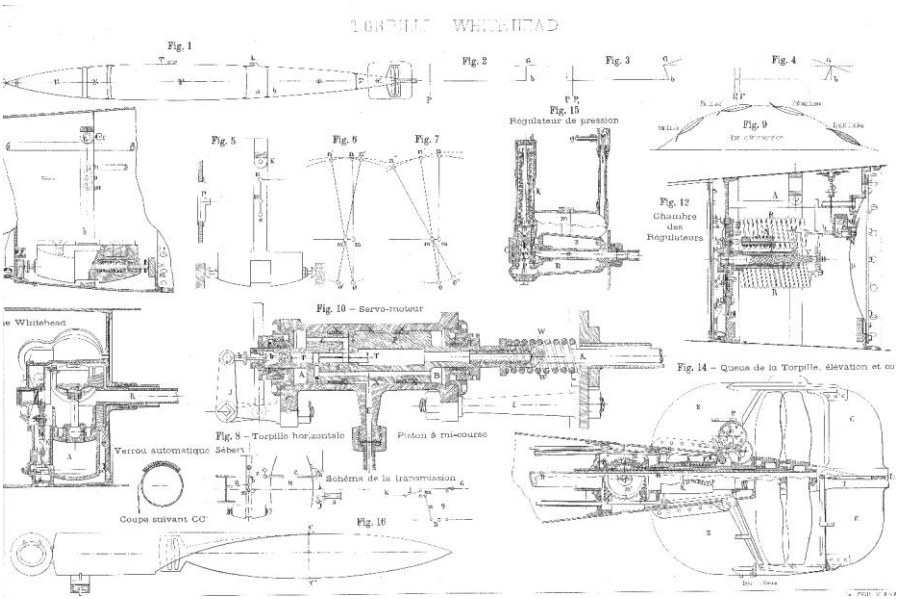


Figure 3: Schematic for the Whitehead torpedo, its internal mechanisms and launch tube.[13]

[12]Roger Branfill-Cook, *Torpedo: The Complete History of the World's Most Revolutionary Naval Weapon,* (Barnsley: Seaforth Publishing, 2014), p. 40.
[13]Graphic in author's possession.

Regular inspections of torpedo boats and crews distributed in *défense mobile* flotillas around the coasts identified glaring technical, material and training deficiencies. These forces relied upon stocks of torpedoes held in local arsenals, where most first-line and second-line maintenance occurred. The older torpedoes often presented hazards to the personnel handling them, and specialised training was required to develop a minimum of familiarity with these weapons. The older armed steamer *Algésiras* served as a torpedo school ship for many years, and a torpedo school (*école des torpilles*) was established ashore, under the Director of Underwater Defences at Toulon, which trained an allotted number of lieutenants every year. Torpedo advisors were attached to commands, squadrons, flotillas, and even larger ships to provide expertise and ensure standards in training. The Whitehead torpedo (Figure 3), much improved by the French, was still the mainstay of the French Navy.

Echoes of the *Jeune École* in a Mahanian fleet

After the discomfiture that resulted from the stand-off with Great Britain over Fashoda in 1898, the *Marine nationale* underwent a major reorganisation and transformation. In 1900, Navy Minister Jean-Marie de Lanessan secured political and financial commitments for a comprehensive plan to build a balanced fleet with new capital ships for the battlefleet, additional torpedo boats for the flotillas and longer-range submarines of new types.[14] From 1904 the subsequent diplomatic rapprochement with Great Britain, following with their mutual recognition of Imperial Germany as a threat, resulted in the Royal Navy becoming a friend and ally rather than the likely enemy. Even the drama associated with Camille Pelletan's tenure as the last of the *Jeune École* navy ministers from 1902 to 1905 barely marked a significant departure from the French quest for a battlefleet sufficient to defend France proper, secure the colonies, and deter the Triple Alliance, even though the Italian Navy (*Regina Marina*) was waning in power and was less critical in French calculations.[15] French naval officers were now reading Alfred Thayer Mahan, whose major historical and theoretical work had been translated into French by *Capitaine de vaisseau* Émile Boisse in 1899.

Observations from naval actions during the Russo-Japanese War seemingly reinforced Mahan and the importance of command of the sea and the concentration of force in numbers. In this quest for the biggest and the best, the gun competed with the torpedo as the preferred weapon. Torpedoes were typically associated with smaller and faster warships, able to close rapidly with the enemy rather than taking and inflicting a pounding from behind the protective armour of larger battleships and cruisers. The

[14]Ray Walser, *France's Search for a Battle Fleet: Naval Policy and Naval Power, 1898-1914,* (New York & London: Garland Publishing, 1992), pp. 88-89.

[15]Jean de Préneuf, 'Du rival méprisé à l'adversaire préféré: L'Italie dans la stratégie navale française de 1870 à 1899', *Revue historique des armées*, 250, (2008), pp. 45-46.

transition to Mahanian thinking was, however, never wholesale in the French Navy, which still subscribed to lingering elements of the *Jeune École*.[16] The torpedo remained the primary weapon of the torpedo boat and destroyer flotillas, and the new submarine service (Figure 4).

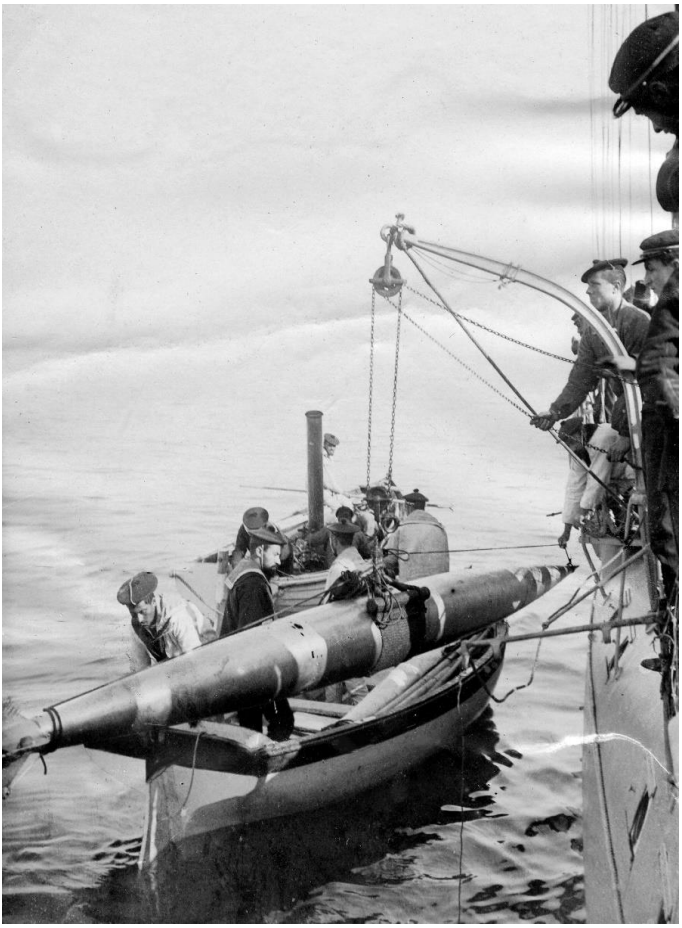


Figure 4: Practice torpedo being hoisted onto a torpedo boat.[17]

[16]Martin Motte, *Une education géostratégique: la pensée navale française de la Jeune École à 1914,* (Paris: Economica, 2004), p. 573.
[17]Photograph in author's possession.

France's platforms carrying torpedoes certainly multiplied in these years. Designers and constructors of larger warships felt obliged to add the capability, if only because ample room was available as warships in general grew larger and larger. Deck-mounted tubes gradually supplanted submerged tubes for launching torpedoes.[18] These tubes drew upon the ship's steam power supply or pneumatic resources to boost the exit velocity on launching. The launch tube was also redesigned to have a downward curve to better direct the torpedo into the water and prevent fish-tailing. These deck mounted tubes on larger vessels were vulnerable to exploding shells as were the personnel serving them and holding a torpedo in a tube represented some risk of explosion or serious damage during combat. Torpedo boats and destroyers, on the other hand, relied upon speed and manoeuvrability, and submarines submerged stealth, to get in range and optimal firing position to launch torpedoes and most importantly retire after the deed was done. Nevertheless, they too were susceptible to gunfire in close-quarter naval combat.

Standardisation of torpedo types greatly eased manufacturing, maintenance and repair, although French production of this very specialised armament was done on a virtually craft-like basis, requiring skilled craftsmen and precision machining. After Whitehead's death in November 1905, the *Marine nationale* augmented state manufacturing facilities in Toulon with a privately-run adjustment workshop at Saint-Tropez, and a torpedo factory at La Londe-les-Maures built by armaments firm Schneider in 1912.[19] Since the quantities required were modest, mass production or line assembly methods were never really tried in peacetime.

Even though most French naval officers acquired a modicum of knowledge about torpedoes at various points in their careers, technical complexity favoured specialists and those more familiar with the workings and refinements of successive torpedoes (even the standard 450-mm *torpille* came in multiple types). In 1909, the torpedo schools fell under a division based in Toulon, with Rear-Admiral Alphonse Guillou as commandant on the armoured cruiser *Brennus*. Whereas the Royal Navy drew a

[18]Gabriel Darrieus, *La guerre sur mer: stratégie et tactique,* (Paris: Augustin Challamel, 1907), p. 422.

[19]Nabil Erouihane, 'Un enjeu géostratégique: l'implantation des industries d'armement sur la côte méditerranéenne français de 1871 à 1940', *Cahiers balkaniques*, 45 (2018), pp. 6-7, doi.org/10.4000/ceb.10740. During the First World War, 330 women were employed in the La Londe factory, and 140 at Saint-Tropez, to replace male workers conscripted into the army and navy. Schneider had constructed a fixed platform torpedo testing station constituting the offshore *Batterie des Maures* there in 1908-09. Schneider and Co., *Les établissements Schneider: matériels d'artillerie et bateaux de guerre,* (Paris: Imprimerie de Lahure, 1914), pp. 54-60. Claude Beaud, 'Les Schneider marchands de canons (1870-1914)', *Histoire, économie et société*, 14, 1 (1995), p. 120.

distinction between gunnery and torpedoes, the French Navy's training was much more integrated in nature, even as France's Mahanian battlefleet took shape.

Mechanical fish with many complicated parts

The five-part *Manual on Automotive Torpedoes* was basically an authoritative technical guide for the use and maintenance of the newest types of French torpedo.

An opening section described the improvements:

> FIRST ARTICLE. PROGRESS SINCE THE 92 MODEL
>
> The 1904 model torpedo is distinguished from earlier models at first glance by its much more pronounced ends.
>
> These forms make it possible to concentrate the charge forward and place the centre of gravity of the charge closer to the point of action; the shattering power of the explosive mass is multiplied.
>
> The machine's power has been increased due to the fact that its dimensions are larger and the motor consists of four cylinders.
>
> Finally, an increase in the resistance of the metal in the air reservoir, obtained by use of nickel steel, made it possible to increase the air pressure to 150 kilograms per square centimetre, and consequently, to get: either 36 knots from 5 to 600 metres, or 24 knots from 5 to 2,000 metres.[20]

Reshaping the front point of the torpedo accommodated the cone, which came either as a combat cone made of bronze phosphorous or a practice cone made of steel. The newer combat cone dispensed with a cartridge and anchored the cotton powder directly into the bronze phosphorous, the charge consisting of seven rings of 81 millimetres in thickness and an eighth ring of 21 millimetres, as well as a priming channel 52 millimetres in diameter and 443 millimetres in length. (Figure 5).

[20] *Instruction*, p. 1.

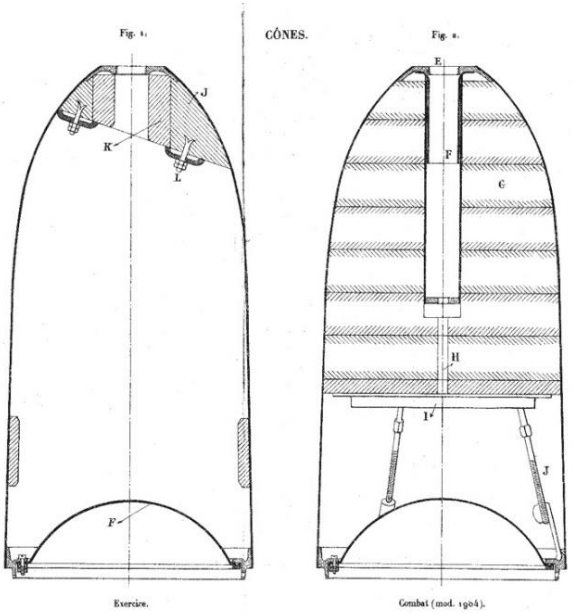


Figure 5: Practice and combat cone cutaways.[21]

The publication's subsequent sections gave very detailed technical specifications of the internal components of the torpedo and changes made. The torpedo's rear part was devoted to mechanical and hydraulic mechanisms for propulsion and depth-keeping. The nickel steel air reservoir held increased pressures, the regulator fed into bronze tubes, a hydrostatic system with chambers and pistons governed immersion and transmission rotations translated through a differential. A primitive servomotor maintained constant speeds (Figure 6). The parts were delicate, small, and extremely precise. Yet, they had to be rugged enough to be carried on board ship in all weathers and operate flawlessly together in the final run toward a target.

[21] Ibid.

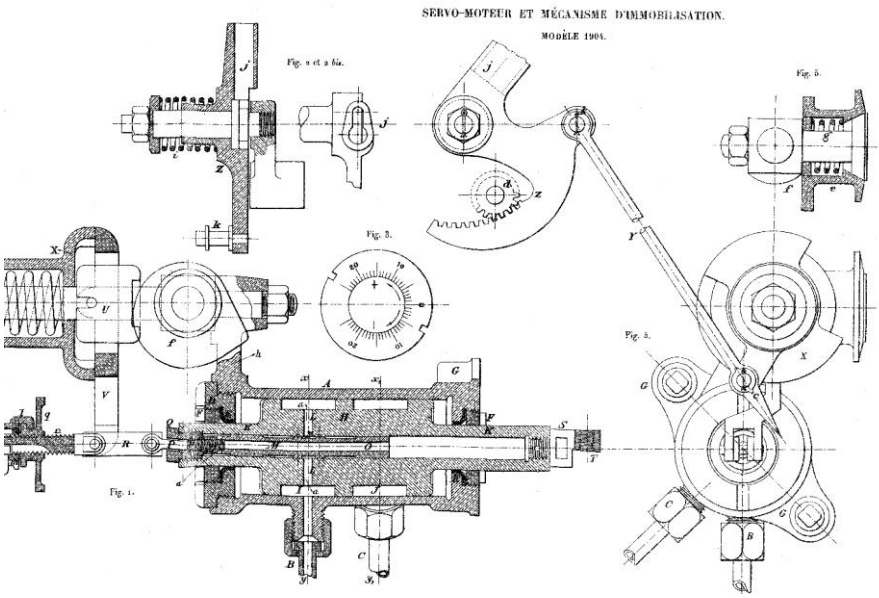


Figure 6. Intricate parts of the servomotor.[22]

The 1906 model torpedo incorporated three cones, adding a practice combat cone made of steel. Changes improved upon the 1904 model with increased air pressures, simplified motor parts and a better balance in the overall torpedo obtained through modification and trial. The 1906 M (for modified) model provided for more improvements and greater numbers. They were produced in Fiume and Toulon in five batches, serial number runs indicated in the brackets:

Manufactured in Fiume:
80 torpedoes from batch F/61 (9532 to 9611)
120 torpedoes from batch F/69 (9709 to 9828)
180 torpedoes from batch F/74 (9829-10,008)

Manufactured in Toulon:
150 torpedoes from batch T/32 (2694 to 2743)
50 torpedoes from batch T/33 (2744 to 2793)

[22]Ibid.

In total 580 torpedoes of the modified 1906 model were manufactured.[23]

These figures demonstrate that upwards of a third of the latest-model torpedoes in the French inventory were manufactured in France in the years leading up to 1914. Besides reducing France's dependence on a foreign source, having its own specialised engineering capacity allowed the French Navy to improve the production lines with greater ease and rapidity. This model of torpedo was also suited for the new larger and more advanced cruising submarines.[24] French 450-mm torpedoes were technically advanced and became more so to the point where they provided a relatively predictable and reliable performance.

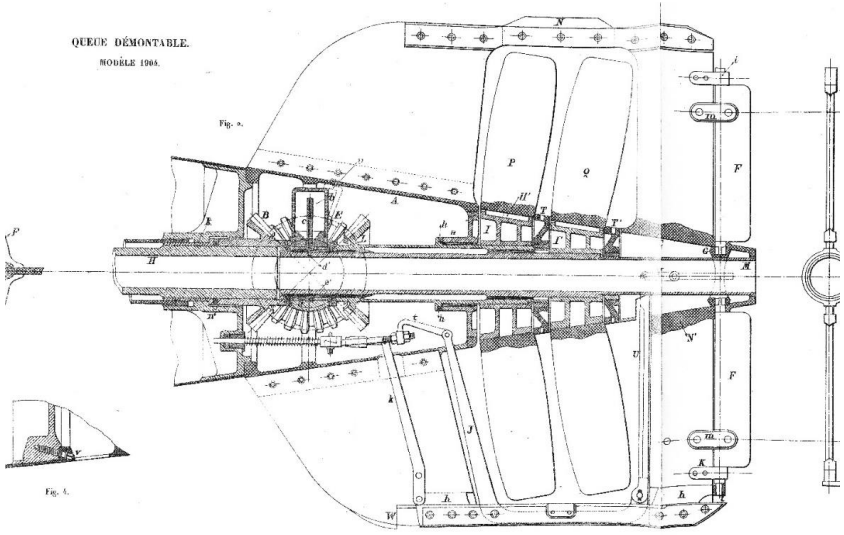


Figure 7: Rear propeller section of a 1904 model torpedo.[25]

Torpedo performance and striking power

By the outbreak of the First World War the French Navy possessed considerable experience with torpedoes. *Torpilles* and torpedo-carrying boats – both surface and submerged – were a centrepiece in French thinking on naval strategy and tactics. The *Jeune École* in particular identified closely with the torpedo and its potential as a ship

[23]Ibid., p.46.
[24]Georges Blanchon, 'Les progress de la torpille et la question des sous-marins', *Revue des deux mondes*, 11, 4, (15 October 1912), pp. 889-890.
[25]*Instruction*.

killer and commerce destroyer. Those attitudes carried over into the later Mahan inspired battlefleet and the coastal defence flotillas that operated during the war. In terms of design quality, technical advancements and manufacturing workmanship, French torpedoes were neither worse nor better than torpedoes in other navies.[26]

Strategy, however, limited the opportunities for their use in naval combat. The Royal Navy, in accordance with pre-war plans, intercepted German shipping and isolated Germany economically through a distant blockade.[27] The German High Seas Fleet for its part declined to leave port save in the most favourable circumstances and Germany resorted to launching a campaign of submarine warfare instead, very much in the spirit of *Jeune École*. In 1915 retired Rear-Admiral Robert Degouy wrote a controversial article in the *La Revue de Paris* criticizing the 'mentality' of the French and British navies for not taking more direct action against the Imperial German Navy in its bases at the start of the war.[28] Even in the Mediterranean, while French soldiers lost their lives by the thousands on the Western Front, the French Navy played junior partner to the Royal Navy and saw little opportunity for offensive action. France's continental and maritime commitments were irreconcilable. French torpedoes were certainly advanced for their time and capable of inflicting great harm in capable hands, but as a result of the way that France chose to fight the war at sea the technology could not reach its full potential during the First World War.

[26]Norman Friedman, *Naval Weapons of World War One,* (Barnsley: Seaforth Publishing, 2011), p. 345.

[27]James Goldrick, *Before Jutland: The Naval War in Northern European Waters, August 1914-February 1915,* (Annapolis: Naval Institute Press, 2015).

[28] *Contre-amiral* Degouy, 'Les Mentalités', *La Revue de Paris*, 22, 4, (July 1915), pp. 329-351. 'Allies' Naval Strategy: French Admiral's Criticism', *Daily Record and Mail* (London), (19 July 1915), p. 1. Robert Degouy, *La guerre navale et l'offensive*, (Paris: R. Chapelot, 1917). Jean-Noël Grandhomme, 'Du pompon à la plume: l'amiral Degouy, commentateur de la guerre et de la "paix d'inquiétude" (1914-1919)', *Guerres mondiales et conflits contemporaine*, 227, 3, (July 2007), p. 47.