Comment coordonner laboratoires et essais en mer ? Détecteurs à ultrasons et formes d'innovation dans les marines françaises et anglaises

How to coordinate labs and open sea experiments ? Forms of innovation in the French and English navies

Benoit Lelong

p. 85-95
https://doi.org/10.4000/dht.1729

[…]

Scientific mobilization, 1915-1918

[…]

At the end of 1914, a Russian engineer, Constantin Chilowski, suggested using ultrasound to detect submarines. His idea was to use radio transmitters for this purpose, as their frequencies were close to those of ultrasound. Painlevé was interested and, in 1915, he asked Langevin to collaborate with Chilowski. At the same time, both men also contributed to ballistics work on the optimization of shells and nozzles.13 The two men set to work at the École de physique et de chimie with two alumni of this school, Marcel Tournier and Fernand Holweck. In March, a first transmitter was developed, consisting of a mica blade capacitor. The receiver is a carbon microphone. The whole system was tested in the Seine, and gave satisfaction. In May 1916, a patent was registered in the name of Langevin and Chilowski. At the end of the year, Langevin decided to use piezoelectricity to detect ultrasound. A first quartz receiver was built in March and tested in April in Toulon to replace the microphone. Encouraged by this success, Langevin decided to use piezoelectricity also to emit ultrasound. In April 1917, the quartz transmitter worked, but the signals emitted were too weak. Langevin decided to amplify them by using resonance, by making the quartz blade vibrate according to its own frequency. As this natural frequency is too high, and produces ultrasounds very quickly absorbed, Langevin modifies it by inserting the quartz blade between two steel blades. The device thus constituted, a quartz-steel triplet, functions at the same time as transmitter and as receiver: the two functionalities are now joined together in only one and same artifact. The new devices were built at the end of 1917, tested in the Seine in February 1918, and in Toulon in April 1918. In parallel, the Navy established in Toulon a Laboratory of Underwater Warfare, directed by Captain Émile Moysan, with a tank to test the device on site and a ship for sea trials. In June 1918, the device was considered to be definitively perfected, and presented as such in several reports sent to the Navy[14].

[…]

The post-war period in France: the sounders

After the end of the conflict, the forms of coordination between the laboratory and the sea will evolve considerably. These transformations are partly due to the new technologies invested by the innovators. In Toulon, Langevin met Pierre Marti, from the hydrographic service of the Navy, and Florisson, an engineer from the Centre d'études. Together, they decided to improve the sounding technique, central to hydrographic surveys. Their work began in 1919 and led to the installation in February 1922 of a prototype on the aviso Ville d'Ys, which left for a hydrographic mission between Newfoundland and Iceland. The ultrasonic sounder was finally patented by Langevin and Florisson in December 1923 and put into service by the Navy in May 1924 [18].

This is in stark contrast to the submarine detectors, which in 1915 were unprecedented technical objects. Developing acoustic sounding - that is, using sound rather than lead and steel wire - was neither a new idea nor a specifically French initiative in 1919. Several patents for sounders based on the echo obtained by underwater explosions had been filed in the 1880s in England, Germany

and France. Since the 19th century, in most of the major industrialized nations, determining the depth of the sea floor has been essential for several activities - notably the establishment of nautical charts by the military hydrographic services and the laying of underwater cables by telegraph companies[19]. In 1912, the sinking of the Titanic by an iceberg stimulated studies on the detection of submerged bodies and prompted a new round of patents - in the same year by the English meteorologist Lewis Fry Richardson and the German physicist Alexander Behm, and in 1914 by the American engineer Reginald Aubrey Fessenden. All these devices were only local initiatives without any real industrial and commercial extension. After 1918, the expertise in underwater detection acquired during the war was exploited by most national navies to develop sounding. In the United States, prototypes were built by a group of scientists led by Harvey C. Hayes at the Naval Engineering Experimental Station in Annapolis. In Germany, Behm created a company in 1920 in Kiel to produce and market his invention, the Behm Echolot Gesellschaft[20].

[…]

The specificity of sounders does not only concern the material form of the artefacts, their uses, their recipients and their modes of use. It also refers to networks and particular forms of cooperation between physicists and the military, as illustrated by the development of depth sounders for great depths. In 1923, after returning from a hydrographic mission in Algeria, Marti informed Langevin that ultrasonic sounders were inoperative at great depths, and that he had to resort to acoustic sounding by detonation beyond 200 meters. In his Parisian laboratory, Langevin continued the study of the power of ultrasound emission. In March 1924, a new sounder was operational, capable of sounding between 200 and several thousand meters. The commander of the Toulon center then asked the Maritime Prefect to entrust the device to the Algerian Hydrographic Service in exchange for an accounting operation[27].

[…]