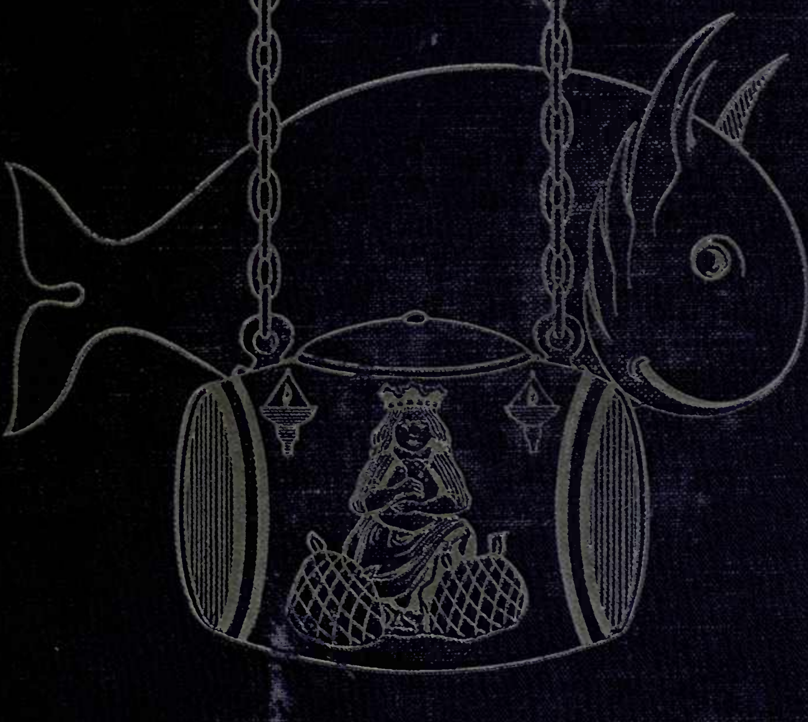
# THE STORY OF THE SUBMARINE

COLONEL C. FIELD



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THE STORY OF THE SUBMARINE

# THE STORY OF THE SUBMARINE

*FROM THE EARLIEST AGES TO THE PRESENT DAY*

BY

LIEUT.-COL. AND BREVET-COL. CYRIL FIELD

*Royal Marine Light Infantry*

WITH UPWARDS OF 100 ILLUSTRATIONS
BY THE AUTHOR



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# PREFACE

The Submarine Torpedo-boat is a new addition to the armaments of the Naval Powers. But its evolution has been the work of centuries. Vague accounts of submersible vessels filter down to us from the Middle Ages, while there are plenty of accounts of divers who, with and without special appliances to enable them to remain under water, were employed in warfare hundreds of years before Christ and for many centuries afterwards.

In the pages of the little volume now before the reader, the author has endeavoured to give an outline of the history of Submarine Warfare and Navigation from the Earliest Ages to the Present Day. He has studied to avoid technicalities and diagrams, which, valuable and useful as they are in more ambitious works, are, in his opinion, out of place in a book which is intended merely to satisfy the curiosity of the "man in the street," and for the amusement of the casual reader, without aiming at being a work of reference. Finally, the author has to acknowledge the valuable assistance he has received in his compilation from the works of N. Pesce, Alan H. Burgoyne, and Maurice Delpeuch, which are each and all of them most comprehensive books of reference on Submarine Navigation. He is especially indebted to Mr. Burgoyne for his kind permission to make use of the numerous diagrams and drawings in his "Submarine Navigation" in the preparation of the illustrations.

C. F.

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# CHAPTER I

## B.C. 415–A.D. 1559

# CHAPTER I

## B.C. 415–A.D. 1559

The Divers and Diving Apparatus of Antiquity and the Middle Ages—Mediæval references to Submarine Navigation.

Contrary to the generally conceived idea that submarine warfare is one of the latest phases of Naval Science, under-water attack is one of the most ancient modes of assailing an enemy's ship. To arrive at the beginning of "war under water" we must go back many centuries and poke about for information in the mists of antiquity and the monkish legends of the Middle Ages.

Alexander the Great, who died B.C. 324, is said to have had divers in his employ who made use of apparatus enabling them to remain under water for a considerable time, and there are pictures in old manuscripts which represent that monarch himself exploring the wonders of the deep in a glass barrel let down by chains from a ship at the surface. But this barrel story must be received with the utmost reserve, for in the Middle Ages, Alexander the Great occupied the place now reserved for Baron Munchausen and De Rougemont. His remarkable adventures formed the theme of many a story both in prose and in verse, and were, in point of fact, fairy tales pure and simple. Even now the exploits of the "Two-horned Alexander"[1] form the staple of many of the tales related by the story-tellers of the Indian Peninsula.

But it is very certain that he knew what there was to kno w

[1] It is interesting to note that Alexander's horse in the above MS. is depicted with a pair of horns.

about submarine attack in his day, and had experienced its formidable nature himself; for at the siege of Tyre, B.C. 332, the cables of his ships were cut by his enemy's divers, while the huge breakwater with which he tried to "bottle up" their harbour was also destroyed by their efforts.

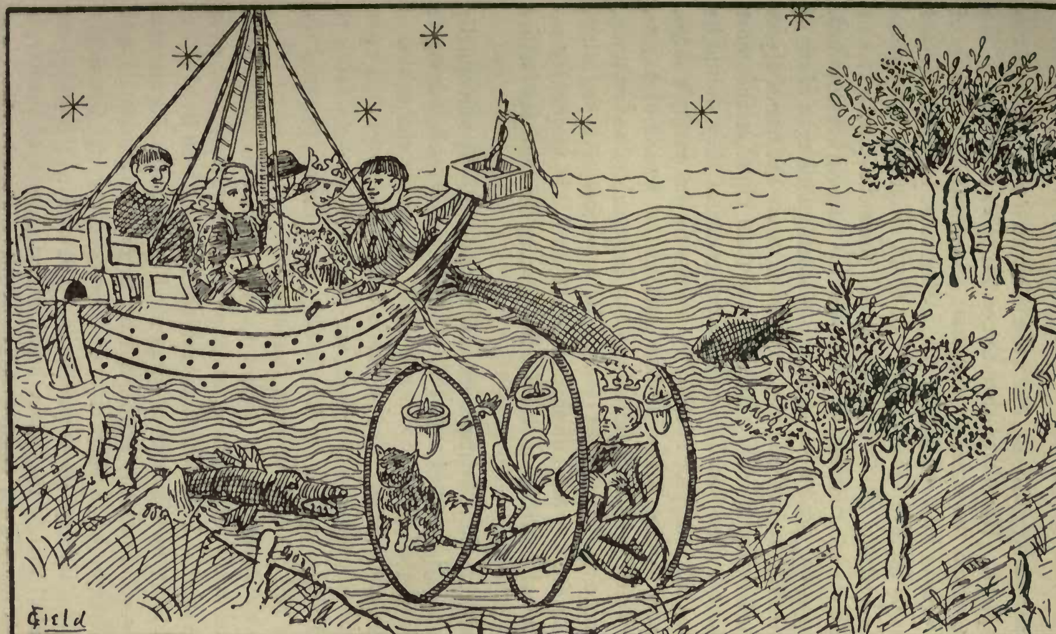
Whether these divers had any special apparatus to enable them to work under water is unknown, but Aristotle distinctly states that there was in his day an instrument to supply them with air when below water, "like the trunk of an elephant"—a tube, in fact, such as is used at the present time; and he refers also to the use of a diving-bell in this very siege.

Pliny, too, has some story about a diving apparatus; Calluricus is said to have invented a submarine gun, or instrument for the propulsion of Greek fire; while Lucullus is reported to have sent a messenger from a besieged port in a distended goatskin, in which he passed unharmed through the enemy's fleet, being mistaken for a fish. Here, apparently, was something very like a submarine boat.

But there were plenty of expert divers in ancient times who were capable of swimming under water and remaining a wonderfully long time below the surface without the aid of any apparatus at all, and such men were not infrequently employed for the purposes of naval warfare.

One of the most renowned of these amphibians was Scyllis of Scyone, who, according to Herodotus, was employed by Xerxes in his expedition against Greece. This gentleman, for some reason or another, deserted to the Greeks, and brought about the loss of several Persian vessels which were at anchor. It was heavy weather and blowing hard, but, taking with him his daughter Cyane, who was as good a diver as her father, he went down, and, cutting their cables, let them drive to destruction. According to Pausanias this famous diver could swim as much as eighty stadia under water. We may believe as much of this as we please.

Thucydides also has stories to tell of divers in warfare so




QUEER SHIPMATES. ANOTHER VERSION OF ALEXANDER THE GREAT'S SUBMARINE ADVENTURE.

From British Museum, Royal MS. 20, B xx.

far back as B.C. 415–13, when the celebrated siege of Syracuse took place. He relates that the entrance to a portion of the harbour was defended by a species of submarine stockade of piles driven into the mud. The Athenians, he says, utilised divers to remove these. They cut them off under water close to the bottom, after which a specially protected raft was sent in with working parties, who removed the floating obstructions. Another old writer on military matters, Philon, a Jew of Alexandria, born about B.C. 20, also discusses the use of divers in warlike operations. He suggests that night is the most favourable time for their enterprises, and that they should be utilised not only for cutting the cables of the enemy's ships, but also to bore holes in their bottoms by means of augers. This would appear a difficult, if not impossible, undertaking, but, apparently, it could be done by some means or the other, for the employment of this mode of attack is frequently referred to by writers of the Middle Ages, as we shall see farther on.

Early in the Christian era, at the siege of Byzantium by Septimus Severus in A.D. 196, we find the divers belonging to the besieged again at the old game of cutting the cables of the enemy's ships. But on this occasion they improved upon former practitioners of their art, by attaching long ropes to the Roman galleys, by which they were drawn towards the town and away from their consorts.

Early in the Middle Ages we again come across vague and fragmentary information as to submarine warfare, and even navigation. Bohaddin, an Arabian historian who lived about A.D. 1150, mentions that some kind of submarine apparatus was used in order to enable a diver to get into Ptolemais with a message, when that city was besieged by the Crusaders. Again, a German poem written in 1190, entitled "Salman and Morolf," makes the latter build a diving-boat of leather, in which he escapes from a dozen of his enemies' galleys and hides at the bottom of the sea for no less than fourteen days, during which time he supplies himself with air through a long tube. It is said that there was once a drawing of this submarine in the manuscript, but that it was stolen—more's the pity.[1] It would have been very interesting to see the mediæval idea of a submarine.

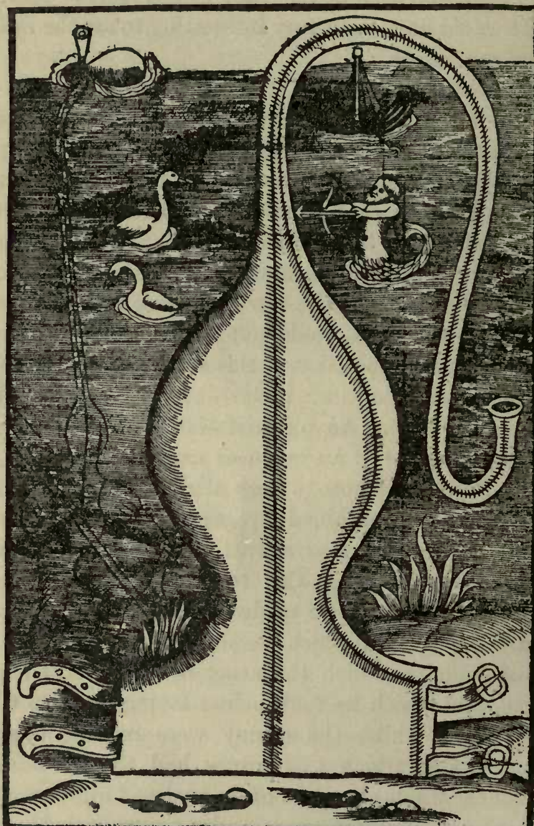
Eighty years later we find the famous Friar Bacon—long thought to be a wizard by his countrymen, but now recognised to have great claims to be considered a scientist—writing about the possibilities opened out to divers by the employment of air-tubes. He says that apparatus could be made to enable people to walk about below water, and that " such instruments were made in ancient days, and also in our own times."

It is well known that the terrible Greek fire, so much employed in the Crusades, could not be extinguished by water, and it was some composition of this sort that Philip Augustus employed to burn down an under-water stockade at the Isle of Andelys in 1203. An old historian narrates the circumstances as follows :[2] " An engineer named Gaubert, a native of Mantes, found out how to keep alight, even under water, a kind of firework contained in earthen pots without any covering ; and as he also shared, with certain divers, the accomplishment of being able to cross a fairly wide river swimming under water, he made use of this secret to set on fire the big stockade which defended the approach to the Island of Andelys, which the army of Philip Augustus was attacking, and which he took before laying siege to Château Gaillard. For, whilst the enemy were making an assault upon the bridge which this prince had thrown across the Seine, and the whole attention of the besieged was concentrated upon this spot, Gaubert swam under water with his earthen pots full of fireworks, and, having reached the stockade, he set it instantly in a blaze. As the boats were all in readiness

[1] According to a writer in the "Scientific American."

[2] Père Daniel, after Roger de Hovenden (as quoted by Pesce in " La Navigation Sous-marine ").

to transport the soldiers to the island, it was surprised on this side, and the garrison of the castle was obliged to surrender."



DIVER'S HELMET.

There is no doubt whatever that about this time the under-water attack of ships in warfare was considered a perfectly practicable means of damaging an enemy. There were ten rules or maxims for the carrying on of a sea-fight, which were universally accepted by the sea-commanders of those days, and the tenth and last ran: "Let your divers, with augers, pierce the ship's sides; in order to hasten her destruction, you must hurl great stones at the spot where the water is coming in." Valturius, writing in 1402, recommended the same thing. And it is related by an old writer that a Swedish fleet in particular gained a signal victory over a squadron commanded by Oddo, a Danish pirate, which they caught at anchor and whose sides had been bored through by their divers the night before the battle took place.

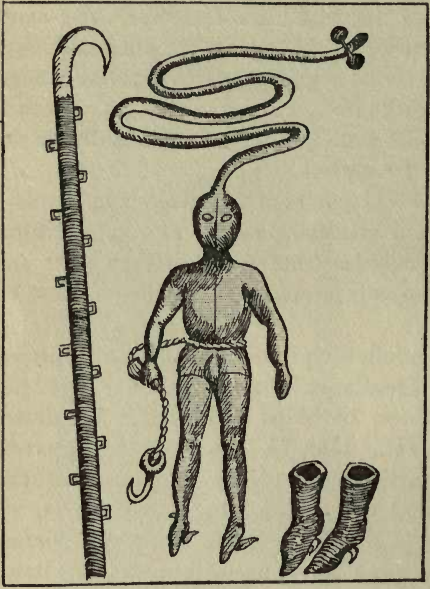
That the divers employed upon such hazardous enterprises were often provided with helmets, possibly of a special form to protect them from missiles from the ship they were endeavouring to sink, is so very probable that it may almost be taken for granted.

In this connection the following item from an old roll, giving a list of "Streamers, Standards, Armour and Artillery, delivered to various Masters of Ships and Barges for divers Voyages, 43–9 Edw. III., 1369–75," may be of interest. Among the various articles of armour supplied to the *Christopher of the Tower*,[1] one of the King's finest ships, we find, "Ten Ketelhattes." Sir Harris Nicholas, the voluminous historian of the early British Navy, specially notes this item, but does not attempt to explain it. May we hazard a guess that these "Kettle Hats" were neither more nor less than special helmets for those employed in submarine attack. In support of this assumption, it may be noted that the earliest diving-bells were generally referred to as "kettles." May they not have been so termed from having been an amplification of the "Ketelhattes" used by seamen in warfare of this kind? Thus, in describing an experiment which took place at Toledo in 1538, an old writer[2] says: "Were the ignorant vulgar told

[1] "Of the Tower" means merely that it was a King's ship, just as we write H.M.S. nowadays.

[2] Taisnier.

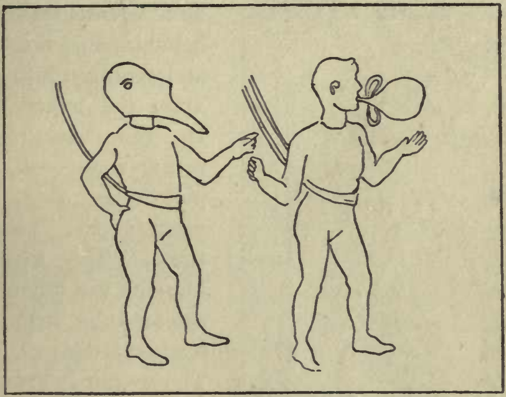
that one could descend to the bottom of the Rhine, in the midst of the water, without wetting one's clothes or any part of one's body, and even carry a lighted candle to the bottom of the water, they would consider it altogether ridiculous and impossible. This, however, I saw done, at Toledo, in Spain, in the year 1538, before the Emperor Charles V. and almost 10,000 spectators. The experiment was made by two Greeks, who, taking a very large *kettle*, suspended by ropes, with the face downwards, fixed beams and planks in the middle of its concavity, upon which they placed themselves, together with a candle." At what time kettles, as we generally know them, with spouts, were first made, cannot be said, but if they should have been sometimes so made in the Middle Ages, it seems possible that "Ketelhattes" may have been so called from having been made—like them—with a spout or tube, which would enable a diver to keep out of harm's way just below the surface while he laboriously bored through the bottom of an enemy's ship. Against this theory it is only fair to state that



DIVER'S EQUIPMENT, A.D. 1500.
From an old work by Ludwig von Eybe zum Hartenstein.
By favour of the "Scientific American."

"Kesselhaube," *i.e.* "Kettle cap," is the name applied in German to several varieties of heavy and more or less spherical helmets in use in the Middle Ages.

A modern French writer [1] on the naval affairs of this period refers to under-water attack as follows: "The warriors of the sea were always distinguished for their intrepidity and boldness, and it is easy to believe that from them emanated the system of submarine warfare that in the fifteenth century



MEDIÆVAL DIVERS.

From a Fifteenth Century MS. in the Ambras Collection.

From "Arms and Armour," by Auguste Demmin.

gave birth to a series of extraordinary inventions in nautical weapons."

The writer probably refers to the quaint diving-dresses and apparatus which are pictured in a number of drawings and engravings that appeared in the next century. In a work written by a German knight [2] early in that century, there is an excellent representation of a diving-dress all complete with

[1] Paul de la Croix.

[2] Ludwig von Eybe zum Hartenstein.

helmet, buoyed air-tube, ladder, heavy boots and hook-rope. In early editions of Vegetius, published in 1511 and 1532, there are quaint engravings of diving-helmets—or may we say "Ketelhattes"? One of these is of an oval shape, the other apparently composed of two rectangular or cylindrical portions, one above the other, though it seems just possible that the latter may be intended to be a representation of the helmet before it is fastened and strapped into position upon the wearer's head. In the background—or rather water—of the first picture is seen a man wearing the whole costume. The method of buoying the upper end of the air-tube with a large bladder is distinctly shown. The wearer is armed with a sword and battleaxe, and has been clever enough to catch a fish in his hand. Other representations of divers are to be seen in the Ambras Collection, where they are coloured black all over, the idea probably being to represent a leather covering. One figure has a most peculiarly shaped head-piece, while the other does not look as if he had on a helmet at all, but is supplying himself with air from a gourd or bladder. Other under-water warriors are pictured in the works of Vegetius, to which reference has already been made. Of these, one is apparently *in puris naturalibus*, and, like the diver men-

DIVER WITH GOURD OF AIR.
From Vegetius, British Museum, 534, M 2.

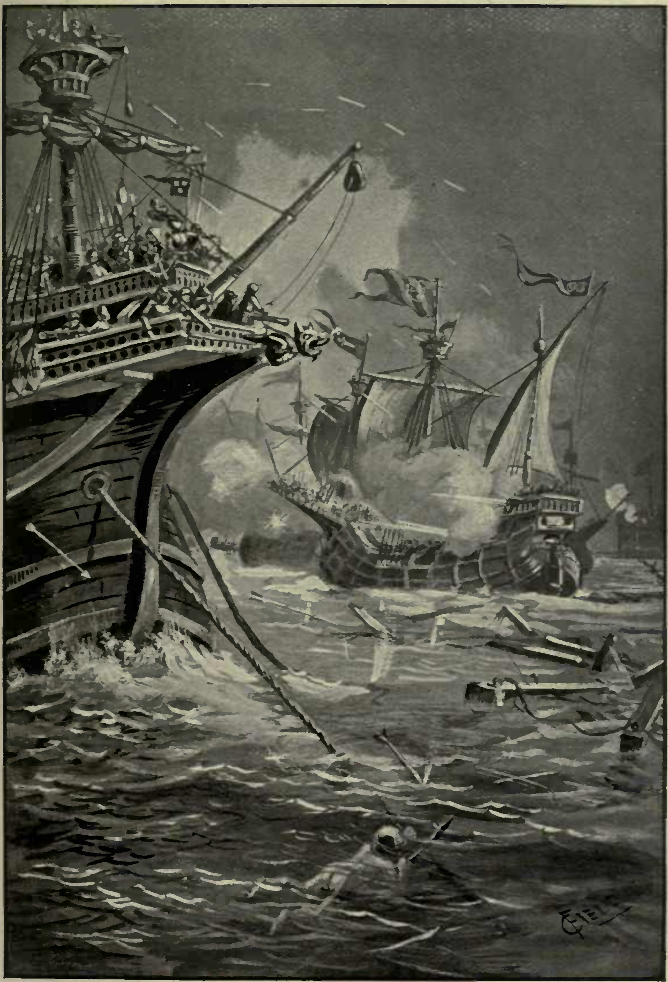
tioned above, is breathing from a gourd or bag of air. There are two curly somethings attached to the neck of the bag, which may be either strings used to tie it up or tubes for inhaling and exhaling. That the end of one is above and that of the other below water may perhaps lend a certain amount of plausibility to the latter idea. The other warrior is equipped with what looks like a tilting helmet, a shield, and a mace. He seems to be engaged in battle with a diminutive merman with two tails who is at the surface brandishing a sword and buckler.

AN UNDER-WATER MAN-AT-ARMS.
From Vegetius, British Museum, 534, M 2.

Before leaving the subject of divers and going on to submarine boats proper, it may be interesting to glance at an account which is given by Burchett of the exploit of a helmeted diver at the siege of Bonifacio in 1420. Having related how John Baptiste Frégose was sent with a squadron of seven great ships to the relief of that city when it was beleaguered by Alphonsus, King of Aragon, he goes on to say: "King Alphonsus, to prevent the city's receiving any relief by sea, shut up the entrance of the harbour with a floating boom, consisting of great planks chained together, which was defended within by five large ships ranged in a line, from the two outermost whereof were stages laid across to the shore, as there were also from one ship to another, and on each side of the harbour's mouth were raised batteries of cannon. On the arrival of Frégose off Bonifacio, the garrison sent him advice, by a dexterous swimmer, of the state of their affairs ; by whom he signified his directions to them to keep a good look-out on their walls, and when they should observe he was attacking the boom and ships, to sally out with a body of stout fellows, each with an axe in his hand, and cut the cables by which the ships were held. The first ship that began the attack was one of considerable force, commanded by James Benicia, which, going afore the wind with a brisk gale, forced her way through the boom, and opened a passage to the enemy's five ships; being immediately followed by others, there being a warm dispute, which was maintained for a long time, with considerable loss on both sides. At length a skilful diver, armed with a helmet on his head and a scimitar hung to his side, threw himself into the sea, and, swimming under water to the enemy's ships, cut their cables ; which, being thus loosed, soon fell foul of one another with great destruction." This was, surely, no inconsiderable feat for a man to perform, weighted as he was with sword and helmet. Perhaps the latter was a specially constructed "kettle hat," enabling him to breathe while swimming just below the surface. If not, it was probably the lightest of steel caps which could be dignified by the name of helmet.

Writing in 1629, Furtenbach, in his "History of Naval Architecture," states that the Barbary pirates were past masters of submarine attack. "The Corsairs," he says, "indeed, are very wily in attack and defence, acquainted with many sorts of projectiles, even submarine *torpedoes*, which a diver will attach to the enemy's keel." It would be very interesting to know what exactly he meant by the word "torpedoes"—possibly some of the pots of Greek fire which we have seen used by Philip Augustus.

By the beginning of the sixteenth century we begin to hear



A DIVER CUTS THE ENEMY'S CABLES AT BONIFACIO.

p. 14]

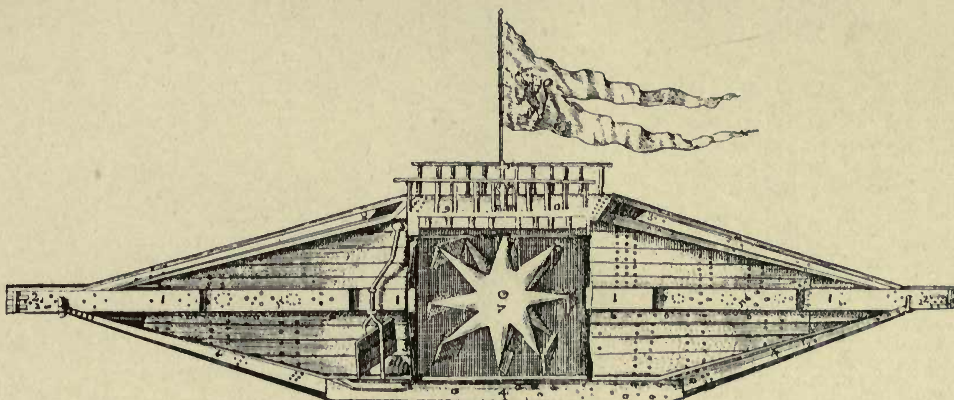
of submarine navigation in some kind of boats or vessels. Such a contrivance had, as we have already mentioned, been conceived by a German poet as far back as the twelfth century, but now we come to a man who states that he has actually seen a submarine vessel with his own eyes. This is Olaus Magnus, Bishop of Upsala. In his account of Scandinavia, written about 1555, he says: "There are pirates in Gruntland [? Greenland] who make use of skiffs and vessels constructed

PIRATES OF "GRUNTLAND."
Facsimile of a woodcut in "Olaus Magnus."

of leather, for the purpose of going wherever they wish, either above or *below water*, and by their means they pierce and make great holes in passing merchant vessels. In the year 1505 I saw two of these leathern boats or skiffs in the Cathedral Church of Asloe, in the western porch. They were dedicated to St. Haluard, and placed there on exhibition, and are said to have been taken by King Hakon while passing with his warships along the coast of Gruntland, when the pirates by their wickedness tried to sink his vessels."

Unless the boats that were seen by the bishop were in reality nothing more than Esquimaux kyaks, which are canoes covered with skins, all but a small opening which fits closely round the occupant's waist, a supposition that it is extremely probable is a correct one—this statement is very interesting. He says, further, that augers were employed to bore holes in the ships' bottoms, but, as we have already noted, this was a recognised device in mediæval naval warfare. But some kind of submarine vessel may have been known at this period, for in the account which Sir Francis Bacon gives of experiments with a diving "kettle," he concludes by saying: "We have heard it said that they have invented another machine, like a *little ship*, by the aid of which men can travel below water for a considerable distance." Possibly this, or a similar affair, was the so-called submarine boat by the aid of which the Venetians, in 1559, contrived to raise a galleon which had been sunk in the Roads of Malamocco.

NOTE.—Valturius ("De Re Militari"), circ. 1472, gives a picture of a cigar-shaped boat which he says is for crossing rivers and can be propelled at great speed. Pesce, in his "Navigation Sous-marine," claims these as ancestors of our modern submarines, but this seems hardly warranted, as the cranks for propelling them are drawn *outside* the queer-looking affairs.



DE SON'S BOAT: INTERIOR (1653).

From an old print.

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## CHAPTER II

1578–1634

## CHAPTER II

### 1578-1634

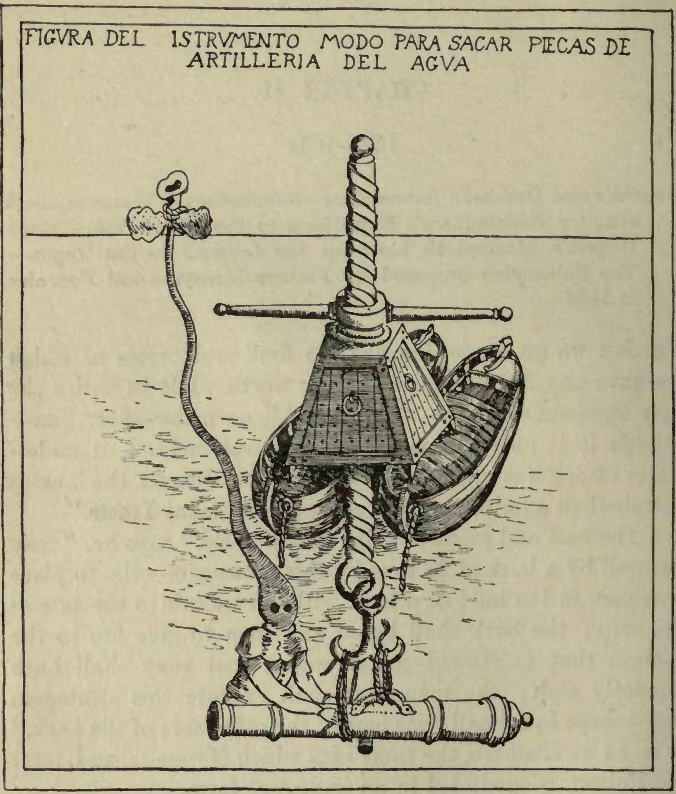
**Bourne's and Drebbel's Submarines—Submarines, "Water-mines," etc., for Buckingham's Expedition to the Isle of Rhé—Prince Rupert's attempt to blow up the *Leopard* in the Tagus—The Submarine proposed by Fathers Mersenne and Fournier in 1634.**

BEFORE we go on to describe the first submarines of which we have any definite account, it is worth while to notice the first appearance of the "Colombiad," or under-water gun—though it is only on paper. This novel method of under-water attack was suggested by Sir William Monson, the famous Elizabethan admiral, in his well-known "Naval Tracts."

"The best and greatest ships in the world," says he, "may be sunk by a bark of 20 tons by this stratagem—viz. to place a cannon in the hold of a bark with her mouth to the side of the ship; the bark shall board and then to give fire to the cannon that is stowed under water, and they shall both instantly sink; the man that shall execute this stratagem may escape in a small boat hauled the other side of the bark." It is, as we shall see, the same idea which Mersenne, and, later on, Fulton, propounded in an improved form.

To an Englishman, William Bourne, who had served as a gunner under Sir William Monson, belongs the credit of having worked out and published the first known detailed description of a submarine boat. It is not probable that his design was ever carried out, but it is very possible that Van Drebbel got the idea of his own under-water boat from Bourne's proposals.

He made them in a little book that he published in 1578, entitled "INUENTIONS OR DEUISES—Very necessary for all Generalles and Captaines, or Leaders of Men as wel by sea as

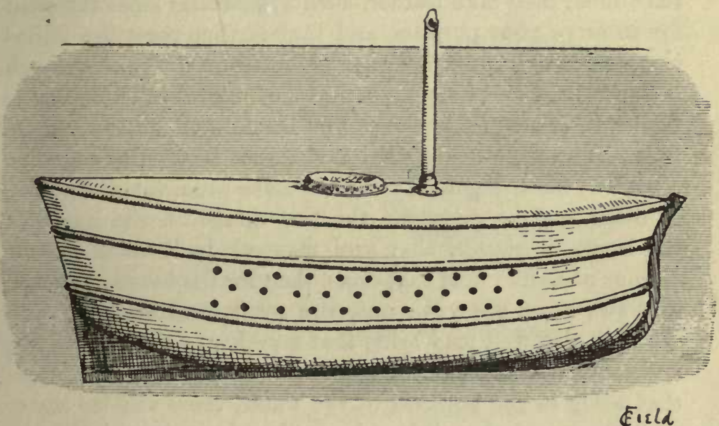



DIVER SALVING A GUN.

From "Diego Ufano," 1613.

by land." His explanation of his design is rather long, but still worth transcribing in full.

"It is possible," says this old seaman, "to make a shippe or boate that may goe vnder the water vnto the bottome, and so to come vp againe at your pleasure. Any magnitude of body that is in the water, if that the quantity in biggnesse, having alwaies but one weight, may be made bigger or lesser, then it shall swimme when you would, and sinke when you list: and for to make anything doe so, then the iointes or places that doo make the thing bigger or lesser, must bee of leather; and in the inside to have skrewes to winde it in and



THE AUTHOR'S IDEA OF THE PROBABLE APPEARANCE OF WILLIAM BOURNE'S PROPOSED SUBMARINE, 1578.

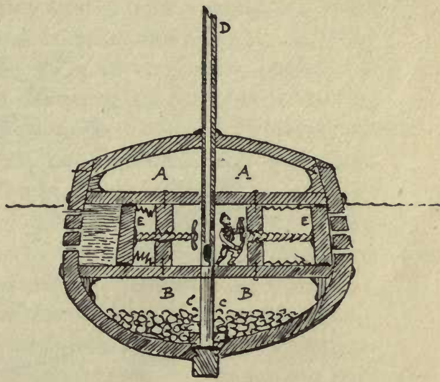
also out againe: and for to have it sinke, they must winde it in to make the thing lesse, and then it sinketh vnto the bottome: and to have it swimme, then to winde the sides out againe, to make the thing bigger, and it will swimme according vnto the body of the thing in the water.

"And to make a small shippe or barke, or boate, do this, the barke being made of purpose, let there be good store of balast in the bottome of hir, and ouer the balast, as lowe as may be, let there be a close orloppe,[1] such a one as no water

[1] From the Swedish "ôfverlopp," a deck.

may come into it, and then in like manner, at a sufficient height, to have another close orloppe, that no water may come through it; and that being done, then bore both sides full of holes between the two close orloppes; and that being done, then make a thing like the side of the barke or shippe, that may go vnto the side of the shippe, the one for the one side and the other for the other side, and that must be made so close and tight, that no water may come through it: and that done, then take leather, such a quantitie as is sufficient for to serve your purpose, and that leather must bee nailed close, with such prousion that no water may soake through it, and to be of that largenesse, that the thing may goe close vnto the barke or shippe side when you would and come in againe, to let sufficient water in, that it shall not be able to swimme. And now, this being done you must make prouision of skrewes, or other engines, to winde the two things on the inside of the barke or shippe, that you may winde them in or out at your pleasure: and that done, then for the hatch or skotel, that you must goe in or out, you must have leather round about it, that you may bring that together as a purse mouth, and so with a small skrewe, you may wind it so close together, that being in the bottome of the water, there shal no water come in: and that being done, then you must have one mast, that must bee of sufficient biggnesse, that it must have hole bored through the one end vnto the other, as a pompe hath: and that done, then when that you list to sinke, then you must sound the deepness of the water, and foresee that the water will not rise higher than the top of the mast, for the hole that goeth through the mast must give you ayre, as men cannot live without it: And when you would sinke, then with your skrewes winde the two sides inwardes, and water will come into the holes, and so the ship or barke will sink vnto the bottome, and there it may rest at your pleasure: and when you would have it swimme, then with the skrewes winde out the things on both the sides, and that will thrust the water out againe at the holes, and so it will rise and come vp above the water and swimme as it did before."

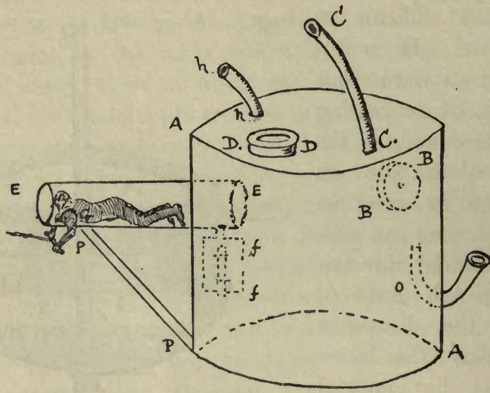
This description of his "18th Deuise," as Bourne calls it, is by no means succinct, but for all that, when we realise that "orloppe" is merely the old English word for "deck," it is not difficult to understand. It is interesting to note that the plan of increasing and decreasing the volume of the boat in the water in order to make her rise or sink was that adopted in the Campbell-Ash boat of 1885, the difference being that the latter sank at her normal form and only rose by pushing out a row of big cylinders on either side.




ATHWARTSHIPS SECTION TO SHOW THE AUTHOR'S CONCEPTION OF THE PRINCIPLE OF BOURNE'S PROPOSED SUBMARINE.

A, A. Upper "Close Orloppe."
B, B. Lower "Close Orloppe."
C, C. Ballast.
D. Hollow Mast for Air Supply.
E, E. "A thing like the side of the Barke," with leather attached. Shown on the right screwed close against the side of the boat to exclude the water, and on the left withdrawn to admit water.

Before the sixteenth century was out, a Scotsman, Napier of Merchiston, announced that he had invented a submarine. According to his own account he had made four "Secret Inventions"—"besides devices of *sailing under water* with divers other devices and stratagems for burning of the enemies, by the Grace of God, and work of expert craftsmen, I hope to perform." Magnus Pegelius seems actually to have constructed something of the sort in 1605, but details are not procurable. In a Venetian work on Fortification published in 1609[1] there is a description of an iron-bound box with windows which seems to have been intended for use under water as a diving bell or boat, while in 1617 Kessler published an account of his design for "Water-Armour" for divers.




PAPIN'S SUBMARINE, 1692.

Said (probably erroneously) to have been a copy of Drebbel's boat.

From *Gentleman's Magazine*, December 1747.

A, A. The "boat" itself.
B, B. A "Hessian rotary sucker, drawing in air" through pipe C, C.
D, D. The hatchway.
E, E. Copper tube, 6 ft. by 1½ ft., to hold a man, who endeavours to injure an enemy's ship by passing his arms out of the hole at G. The water is excluded from the tube (which is closed behind the man) by the pressure of air forced into it by the pump F, F.
*h*, *h*. Valve for letting out air.
O, O. A species of barometer to register the depth of descent.
P, P. Supporting bracket for the copper cylinder E, E.

N.B.—The figure of the man is added by the author (who assumes there is a hole on either side at G) to show the probable mode of attacking the bottom of an enemy's ship with an auger.

This brings us to a really famous inventor, Cornelius Van Drebbel of Alkmaar, who invented a considerable number of different kinds of apparatus of a scientific nature, and

[1] By Buonaruto Lorini. Possibly this may have been the contrivance referred to at the end of Chapter I.

among them a submarine boat which it seems quite certain was navigated below water in the river Thames. According to a Dutch work of 1645,[1] "he built a ship which one could row and navigate under water from Westminster to Greenwich, the distance of two Dutch miles; even five or six miles, or as far as one pleased. In this boat a person could see under the surface of the water and without candle-light, as much as he needed to read in the Bible or any other book." It is a great pity that no exact details or plans of this interesting vessel have come down to us. The Duke of Hesse, many years later, caused a model of Van Drebbel's boat to be constructed by the celebrated Papin, but it is, from the drawings that have been published of it, an obviously incorrect one, as it would not be possible to move it about under water, as may be seen by its shape and the absence of propelling mechanism, whereas contemporary accounts of Drebbel's submarine say that she carried twelve rowers besides passengers. It is said that she made a journey of several hours in a submerged position at a depth of twelve to fifteen feet, and tradition adds that King James I., who was the personification of caution, had such confidence in the Dutchman's invention that he actually ventured his Royal Person in one of Drebbel's submarine trips. As he was a close friend and patron of the ingenious inventor, there is a certain amount of plausibility about this story.

Possibly the apparatus that Papin made was a copy of some other invention of Drebbel's more in the nature of a diving-bell. The celebrated Boyle[2] refers to this early submarine as follows:—"A Conceit of that deservedly Famous Mechanician and Chymist, Cornelius Drebbel, who among other strange things that he performed, is affirmed (by more than a few credible persons) to have contrived for

[1] "Chronicle of Alkmaar."—C. van der Wonde (1645).

[2] "New Experiments Physico-mechanical touching the Spring of the Air and its Effects."—Honble. Robert Boyle (1662).

the late learned King James, a vessel to go under water; of which trial was made in the Thames with admirable success, the vessel carrying twelve Rowers besides Passengers; one of which is yet alive, and related to an excellent Mathematician that informed me of it. . . . Drebbel conceived, that 'tis not the whole body of the air but a certain Quintessence (as Chymists speake) or spirituous part of it that makes it fit for respiration, which being spent, the grosser body, or carcase (if I may so call it) of the Air, is unable to cherish the vital flame residing in the heart: so that (for ought I could gather) besides the Mechanicall contrivance of his vessel he had a Chymicall liquor, which he accounted the chief secret of his Submarine Navigation. For when from time to time he perceived that the finer and purer part of the Air was consumed or over-clogged by the respiration and steames of those that went in his ship, he would, by unstopping a vessel full of the liquor, speedily restore to the troubled air such a proportion of vital parts as would make it again for a good while fit for Respiration."

Ben Jonson in his play, or rather comedy, "The Staple of News," has a slight reference to Drebbel's boat, which he terms an "invisible eel":

> THOMAS. They write here one Cornelius' son
> Hath made the Hollanders an invisible eel
> To swim the Haven at Dunkirk and sink all
> The shipping there.
>
> PENNYBOY, JUNIOR. But how is't done?
>
> GRABAL. I'll shew you, sir,
> It is an automata, runs under water
> With a snug nose, and has a nimble tail
> Made like an auger with which tail she wriggles
> Betwixt the costs of a ship and sinks it straight.

Is it possible that the "auger" referred to was some kind of a screw propeller? From its position at the stern one might almost imagine it possible, though of course, as we have seen, the auger was a recognised weapon of under-water attack.

Drebbel had probably something to do with the apparatus referred to in the following warrants, which were orders to provide special equipment for Buckingham's ill-managed attempts on the Isle of Rhé and the relief of La Rochelle. The first, dated January 26, 1626, is from "His Majestie to the Master of the Ordnaunce, thereby signifying His Highnesses pleasure and order given to Sir William Heydon Lieut: of the Ordinance, for the making of dyvers water mines, water petards, fforged cases to be shot with fireworks, and *boates to goe under water*." The second, issued on June 29 in the same year, is a warrant from the Duke of Buckingham for the delivery of "360 fforged iron cases with fireworkes, 50 water mynes, 290 water petards, and *two boats to conduct them under water*," for H.M. special service to goe with the fleete." Here we have the whole paraphernalia of submarine warfare—submarine boats, mines, and torpedoes,—for we may consider that the "water petard" was a kind of torpedo for attaching to the enemy's ships or stockades, since the ordinary "petard" was a strong bell-shaped casting of iron packed with explosive which was intended especially for blowing in gates and doors of the massive nature used in fortifications; to which it was placed in close contact before explosion. What a pity it is that no detailed account of these contrivances and their performances in action has been preserved! Delpeuch, in his "Navigation Sous-marine," states that Drebbel was their inventor and that he accompanied Buckingham on his ill-fated expedition, and also that his "engines" were launched against the French fleet but without success. But he does not give any further details or any authority for his statement. It is very probable, in any case, that he is absolutely correct, for we should surely have had some account of any success that Buckingham's unfortunate operations had to show to their credit.

Despite their ill-success, however, Drebbel contrived to keep himself in favour with the Admiralty, for in 1628 we discover him as commanding officer of a fireship at £150 a month—very high pay, especially when we consider the value of money at that date. His son-in-law, Dr. Kuffler, had charge of another fireship, but he only got a pound a day. Neither were satisfied. They were "on the make," and demanded more—which, by the way, they didn't get.

Cornelius van Drebbel died in 1634, but Dr. Kuffler was still to the fore after the Restoration. Pepys in his "Diary" relates that on March 14, 1662—"In the afternoon came the German Doctor Kuffler to discourse with us about his engine to blow up ships. We doubted not the matter of fact, *it being tried in Cromwell's time*, but the safety of carrying them in ships; but he do tell us, that when he comes to tell the King his secret (for none but Kings successively and their heirs must know it), it will appear to be of no danger at all. We concluded nothing, but shall converse with the Duke of York about it." What the Duke said is not related, but probably he was averse to the idea, since late in the following year Pepys still refers to the matter as a project only. The entry in the "Diary" runs: "At noon to the coffee-house, where, with Dr. Allen, some good discourse about physick and chymistry. And, among other things, I telling him what Dribble, the German doctor, do offer of an instrument to sink ships." Pepys must be confounding Drebbel, who had been dead nearly thirty years, with his son-in-law Dr. Kuffler, who, so to speak, had inherited the business.

Although it is evident that under-water attack by means of explosives had been under consideration for a number of years, one only instance of their employment can be quoted, and in this case the attack was in reality more like the anarchist attempts of the present day. This was when Prince Rupert tried to blow up or at any rate damage the *Leopard*, Blake's flagship, as she lay in the Tagus in 1650. He concealed an infernal machine in what looked like a barrel of oil, which he placed in a shore boat in charge of a seaman and two negroes, all of whom were disguised in Portuguese costume. They pulled alongside the *Leopard*, probably with the intention of passing the barrel in at one of the lower-deck ports,—for on finding them closed, the sailor made an exclamation in English. This attracted the attention of the watch on board, who hitherto had had no suspicion of what looked much like other shore boats that were in the habit of hanging round the fleet. The boat and her occupants were seized, when it was discovered that a string passed through the bunghole of the barrel to the trigger of a pistol that was arranged to fire the infernal machine. Doubtless the intention had been, after passing in the barrel, to row away to the extreme length of the string and then pull the trigger. Perhaps the most extraordinary point about the story is that Blake allowed the seaman who had been in charge of this detestable contrivance to go scot free.

In the same year that Drebbel died, the subject of submarine navigation was taken up by two priests, Fathers Mersenne and Fournier, of the Order of the Minimes. They wrote a treatise upon the subject and suggested a design for a submarine war-vessel, which, if it could have been carried out, might have proved a formidable engine of attack.

They went into the matter with great attention to detail—among other things urged that such a vessel should be built of metal and be fish-shaped with pointed ends, so she could move ahead or astern equally well. Here we have the idea that is carried out in the lines upon which—with variations—the whole almost of our modern submarines are constructed. Like Simon Lake's successful *Argonauts* and *Protectors*,[1] the proposed boats were to be equipped with wheels for movement upon the sea-floor, but they had to fall back upon oars as a means of propulsion. They were to be fitted

[1] *Vide* Chapters XIV. and XVII.

with air-pumps and ventilators, and provided with phosphorescent apparatus to enable the crew to see what they were about when below water. In order to be in a position to blow a hole through the bottom of an enemy's ship they were to carry a battery of big guns on either side, which—like Fulton's "Colombiads"[1]—could be fired through ports fitted with special valves or stoppers to prevent the ingress of water when the cannon recoiled after discharge. Means of entering and leaving the boat when submerged were also provided for in the shape of leather sacks, the idea being that, the outer end being fastened, a man could get inside and, after the bag had been tightly closed behind him, could undo the exterior fastening and slip out into the water—rather a trying operation for the man, and fraught with considerable danger to the other occupants of the boat.

[1] *Vide* Chapter V.

# CHAPTER III

## 1640-1774

## CHAPTER III

### 1640–1774

Bishop Wilkins' fantastic ideas, 1648—De Son's Rotterdam Ship, 1653—Borelli and Symons' Submarines—Ciminius and Doligny's projects—Dionois' Submarine—Day's Fatal Experiment in Plymouth Sound.

In 1640 the King of France granted a patent for some kind of submarine vessel to John Barrié, together with the monopoly of using it for fishing and salvage purposes for twelve years. Most writers consider this to have been more of a diving-bell than a boat, but the inventor calls his vessel a "patache," the nearest English translation being the word "packet." This sounds rather as if it were intended to be a more mobile vessel than a mere diving apparatus. He is said to have carried out some salvage operations at Dieppe with it which were attended with a good deal of success. Evidently Barrié's boat, whatever it may have been, was a real submarine vessel.

Turning from the real to the ideal, we come to the extraordinary ideas as to submarine navigation and existence put forward by Bishop Wilkins in his "Mathematical Magick," published in 1648. He devotes a whole chapter to "The possibility of Framing an Ark for Submarine Navigation." He refers to Mersenne's book and admits that such a thing is feasible, "because it hath been already experienced here in England by Cornelius Drebbel." He discusses the difficulties attendant on under-water navigation, and among them that of getting in and out of a submarine when below without the admission of water. He proposes to arrange for this in just the same way as did Mersenne and Fournier—by means of leather bags, opened and closed at each end in turn. As for propulsion, he advocates the use of oars with contracting and expanding blades "like the fins of a fish." Later on he expatiates on the manifold uses of such a boat, and among these he mentions that it is "Private, a Man may thus go to any Coast of the World invisibly without being discovered or prevented in his journey": that, "'Tis safe from the Uncertainty of Tides and the Violence of Tempests, which do never move the Sea above Five or Six paces deep," and that "It may be of very great advantage against a Navy of Enemies, who by this means may be undermined in the water and blown up." Again he suggests that "It may be of special use for the Relief of any place that is beseiged by Water to convey to them Invisible Supplies; and so likewise for the Surprizal of any Place that is accessible by Water." But he waxes most enthusiastic over the great advantages that his proposed boat would confer upon Submarine experimenters and explorers, prognosticates great sport in shooting big fish with muskets, and thinks that untold wealth might be realised by the discovery of submarine treasures—pearls, corals, and the cargoes and specie on board wrecked vessels. In the end his imagination runs away with him altogether and he conjectures that with the universal adoption of submarine navigation, some people would live under water altogether and bring up their children as mermans. "All kinds of Arts and Manufactures," he writes, "may be exercised in this Vessel. The Observations made by it might be written and (if need be) Printed here likewise. Several Colonies may here inhabit, having their Children born, and bred up, without the knowledge of land, who could not chuse but be amazed with Strange Conceits upon the Discovery of this Upper World."

Six years after the publication of this rhapsody on submarine navigation, a boat was built at Rotterdam which is generally assumed to have been intended for submarine purposes, though it is possible that it may merely have been intended to navigate in an "awash" position. Its designer was a Frenchman of the name of De Son. His boat attracted considerable attention at the time, and is supposed to be the one referred to by Foulis in his "Plots of our Pretended Saints," when he speaks of "the Rotterdam ship that would kill the English under water." There is a drawing to be seen of it in the National Library at Paris, on which appears the following description of the vessel:

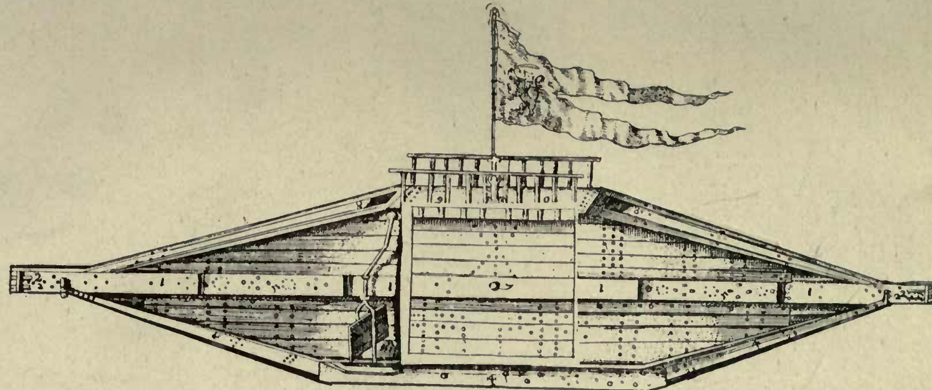
"The true and perfect forme of the Strange Ship built at Rotterdam A' 1653. The inuentor of it doeth undertake in one day to destroy a honderd Ships: can goe from Rotterdam to London and back againe in one day, and in 6 Weekes to goe to the East Indiens, and to run as Swift as a bird can flye: no fire, nor Storme, or Bullets, can hinder her, unlesse it please God. Although the Ships meane to bee safe in their hauens. It is in vaine, for shee shall come to them in any place. It is impossible for her to bee taken, unlesse by treacherie, and then can not bee governed by any but himselfe. The length is 72, the height 12 foote, the breadth 8 foote."

Speaking generally, the shape of this remarkable vessel was that of a nearly cubical box prolonged, fore and aft, by long rectangular pyramids. She was lengthened longitudinally by a massive girdle of timber faced with iron, and was propelled by a species of paddle-wheel with feathering blades that worked in a well in the centre of the vessel. She was the same shape both at bow and stern, her rudders being arranged nearly amidships at the corners of the cubical portion of her hull. It is noticeable that in the description which accompanies the drawing of the vessel, which has been quoted above, no claim is made as to her capabilities for under-water work; and when we consider her form and construction and the high speed she is pretended to have, there is good reason to assume that the rôle really intended for her was that of a ram running in an awash position like our own *Polyphemus* and the American *Kathadin*.[1]

The Marquis of Worcester, who was a scientific dabbler, published a work in 1655 which he called "Scantlings of Inventions." There were in this book about a hundred more or less impossible ideas for novel apparatus of one kind and another which he declares were "by me already practised," a statement which hardly bears the stamp of veracity. Many of these were contrivances for naval and military purposes, and among these there is one that is in the nature of a torpedo, though, strictly speaking, it ought rather to be classed as an infernal machine of the kind favoured by Fenians and Anarchists. He calls it "A Ship-destroying Engine," which, he says, "is portable in one's pocket, which may be carried and fastened to the inside of the greatest ship *tamquam aliud agens*. And at an appointed minute, though a week after, either day or night, it shall infallibly sink that ship." He then sets out to explain his "second idea," which is that it may be used as a torpedo as well. He heads it, "How to be fastened from aloof and under water," and goes on to describe it more particularly as "A way from a mile off to dive and fasten a like engine to any ship, so as it may punctually work the same effect, either for time or execution."

The Abbé Borelli was another publisher of a list of "Devices" about 1679 or 1680; and, after speaking of his observations on the movements of fishes, he tells us his ideas on the subject of submarine-boat construction. His proposed under-water vessel was to be like an ordinary boat with a domed roof fitted over it much like another boat bottom up. It was to be propelled by oars the blades of which were to be made to open and shut like a fish's fin, so that when thrown back they would close up and pass easily through the water, but would open to their full extent as soon as the rower began his stroke, and so hold the water and propel the boat forward.

[1] *Vide* Chapter XVI.



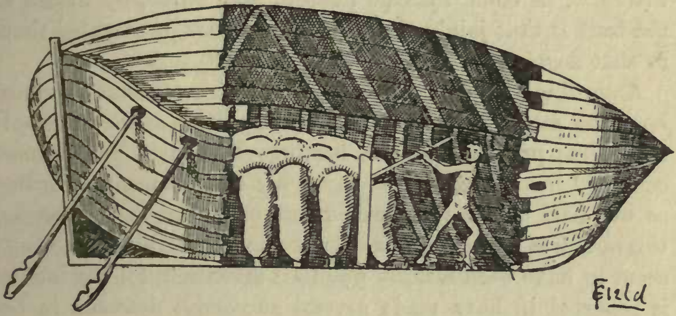
The true & perfect forme of the Strange Ship built at Rotterdam A° 1653, the inuentor of it, doeth undertake in one day to destroy a honderd Ships, can goe from Rotterdam to London and backagaine in one day, & in 6 Weekes to goe to the East Indiens, and to run as Swift as a bird can flye no fire, nor Storme, or Bullets, can hinder her, unlesse it please God, Although the Ships meane to bee safe in their hauens, it is in vaine, for shee shall come to them in any place, it is impossible for her to bee taken, unlesse by treacherie, and then can not bee governed by any but himselfe, the length is 72, the height 12 foote, the breadth 8 foote, 1. The middle beame, 2. the two ends with Iron barrs, wherein the Strength of the Ship lieth on both ends alike. 3. the rudder of y^e Ship. 4. the kiele, 5. Iron boults with scriues, 6. the depth to the middle beame, 7 the wheele that goeth round by which it hath its motion, 8. the Shuttles where they goe in, 9 the Gallery there they walke

DE SON'S BOAT (1653)

From an old print.

He had an ingenious idea for altering the displacement of his vessel and so causing her to sink or float. He would have a large number of big leather bottles whose necks were to be fastened to holes in the bottom of the boat. When the water rose and filled these receptacles the boat would sink, but when, by means of a sort of lever and press, the water was squashed out again, the boat would rise to the surface.

This boat was never built, but a picture of it appeared in *The Gentleman's Magazine* in 1749, which was accompanied




DRAWING OF A SUBMARINE BOAT IN *The Gentleman's Magazine* FOR JUNE 1749.

Sometimes said to be N. Symons' boat, but almost certainly the one designed by the Abbé Borelli in 1680.

by a letter from a contributor signing himself "M. T.," in which he seems to claim the invention as his own. This boat is generally assumed to be the one built by Nathaniel Symons, a carpenter of Harbeston in Devonshire, in the year 1729, of which a correspondent who had seen the above-mentioned picture sent a description to *The Gentleman's Magazine* a month or two later. He writes: "In your Mag: for June, p. 249, you have given us a description of a Diving Ship, etc., which, according to my notion of it, is far inferior to one *made* some years since by one Nathaniel Symons of the Parish of Harbeston, near Totness, Devon, a common house carpenter.

He made his boat in two parts, and joined them in the middle very tight, with leather, that no water could get in; he made a false door in the side, which, when he was in, shut very tight; and tho' his going in admitted a small quantity of water, it was no inconvenience; after this outer door was shut, he opened the inner one to get into his boat. There was more than four-score weight of lead to the bottom of his boat, but this I presume must be according to the dimensions; yet he had a screw to each side of his boat, which, when within it, he could manage himself, and which, by means of the leather that join'd the parts of the boat, contracted them to that degree that the boat would sink."

According to this description it would seem that Symons' boat was more like an early and crude edition of the telescopic submarine proposed by the brothers Rogers in the present century,[1] increasing or decreasing her displacement according as one half of her was pushed out or pulled in. However, this boat was made; and, whatever she looked like, she would seem to have been a fairly practical invention, for her builder is reported to have made several successful descents in her in the River Dart in the presence of large numbers of spectators, remaining under water for more than an hour together. But her efficiency brought no grist to the mill; the poor inventor, who had spent much more money than he could afford over her construction and trials, was quite disappointed in his hopes of making a profit on his expenditure. People were willing enough to be amused by watching his experiments, but they were not disposed to assist him financially. He bitterly complained that though there had been many "persons of quality" among the crowds who had occupied their leisure in looking on at the trials of his submarine vessel, he had not been able to collect more than twenty shillings altogether. What eventually became of Symons and his submarine, history does not relate.

[1] *Vide* Chapter XVIII.

To resume the "Story of the Submarine" in its chronological sequence, we have to go back to the year 1685, in which a Neapolitan Jesuit, Ciminius by name, claimed to have invented a submarine apparatus of the most perfect kind. In a letter which he wrote to the King of France on November 25, he stated that his invention would "enable men, and even armies, to rise and descend to the bottom of the sea, fully armed, their hands and feet at liberty; to stay there, sit down, walk and run for seven hours at a stretch, or even for a whole day." By the aid of his contrivance, he went on to say, maritime cities could be captured without their assailants showing themselves, and fireships could be conducted under water to burn fleets of ships. In short there was not much that Ciminius' apparatus could not do, according to his own account. The King of France received another letter, much of the same kind, three years later, the writer in this case being the Sieur Roger Doligny, who had to propose "A machine for travelling and working under water without inconvenience." He could, he said, construct such a "machine" which would be able to blow up or destroy ships, bridges, stockades and other obstacles, could pass under the chain closing an enemy's port, and, having entered, blow up or sink to the bottom their ships and galleys. It would be as adroit and agile as a fish and carry several days' provisions for the three or four persons who were to form her crew. The inventor is said to have made a small model of his proposed submarine which he offered to show the King, but history is silent as to whether the King consented to see it, as well as to its form and dimensions. A submarine-boat design was patented in this country in 1691 by Sir Stephen Evance, but no details are to hand. With the exception of the boat with which Symons experimented in the River Dart in 1729, the first half of the eighteenth century seems absolutely bare of submarine construction either actual or proposed. It is not until 1772 that the inventor of under-water apparatus is again to the fore. This time it is yet another Frenchman, Le Sieur Dionis of Bordeaux, who designed and built a regular submarine propelled by eight oars and provided with air when under water by an apparatus which apparently was very similar to that which Cornelius Drebbel contrived by aid of his "secret liquor." According to contemporary accounts, he took ten people across the estuary of the Gironde under water on May 28, 1772. The distance is stated to have been five leagues, and the time spent under water no less than four hours and a half. This must have been a much more efficient and scientific contrivance than the one with which J. Day, a Suffolk wheelwright, gained a good deal of notoriety about this period, and in which he eventually met his death. His apparatus, in fact, is hardly worthy to be called a submarine boat at all, as it had no means of getting about; but as it was an experiment as to the possibility of living under water without renewing the supply of air from the surface, it may perhaps be accorded a place in the story of the submarine.

Day had read or conceived something of submarine navigation, and, having got hold of a Norwich market boat, fitted it as a kind of submarine and was bold enough to descend in it in one of the Yarmouth Broads. He went down in thirty feet of water and found that he was able to stay down there for four-and-twenty hours and come to the surface again, none the worse for his experience. Very pleased with this successful experiment, he wished to proceed with his researches, but want of means stood in his way. In this dilemma he remembered that a certain Mr. Christopher Blake, a wealthy man in those parts, was notoriously fond of making wagers of all kinds. So he wrote to him as follows:

"Sir,

"I have found out an affair by which many thousands may be won. It is of a paradoxical nature, but can be performed with ease; therefore, Sir, if you chuse to be informed of it, and give me one hundred pounds of every thousand you shall win by it, I will readily wait upon you, and inform you of it. I am, myself, but a poor mechanic, and not able to make anything by it without your assistance.

"Yours, etc,

"J. Day."

After an interview, preliminaries were settled, and Blake was able to make various bets that Day would sink a ship in the sea, with himself in it, to a depth of 100 feet and remain in it for twelve hours without any communication with above, and at the expiration of that time rise up in the vessel. He lost his wager before the experiment came off, because there was a clause in it which provided that it should take place within three months, and Day was not ready by that time. Blake, however, did not abandon the inventor, but went down with him to Plymouth to see the result. In a fifty-ton sloop that had been purchased for the purpose, a strongly constructed cabin was built amidships fastened to four beams in the hold. It contained 75 hogsheads of air, and was fitted with a water-tight hatch. Valves for the admission of water were fitted to the fore and after portions of the vessel, and ten tons of stone ballast were placed in her hold. In addition, two weights, of ten tons each, were hung on either side to iron rods which, passing into the air-chamber, were fastened to nuts and levers which allowed of their detachment in order to cause the ship to come to the surface. On the day fixed, the doomed inventor went on board, taking with him a hammock, a watch, a candle, some biscuits and a supply of water. The hatchway was screwed fast, but it was found that the vessel would not sink until twenty more tons of ballast had been put on board. Then down she went, and nothing more was ever seen of Day or of his vessel.

The spot where this took place was between Drake's Island and the Prince of Wales Redoubt, where there are about 28 fathoms of water, and it is supposed that the pressure at this depth instantly crushed the boat, which with its unfortunate occupant was carried out to sea by some undercurrent. For though every appliance that could be made available by H.M.S. *Orpheus*, which lay near by, and all the resources of the Dockyard were put at Mr. Blake's disposal, not the slightest trace was found either of Day or of his sloop, although several days were spent in searching for them.

## CHAPTER IV

1775–1777

## CHAPTER IV

### 1775–1777

"Explosion Ships"—The "Devil Ships" of Antwerp—Benbow's "Infernal"—Bushnell's "Turtles"—His attempts to blow up H.M.SS. *Eagle* and *Cerberus*.

By this time the inventors and projectors of submarine boats had recognised that the only really effective weapon for under-water attack must be a case of explosive—a torpedo, in fact. So we hear very little more of augers or even under-water cannon or fanciful apparatus of that kind, though very occasionally, here and there, we find an inventor's mind running wild in these directions even in the nineteenth century.

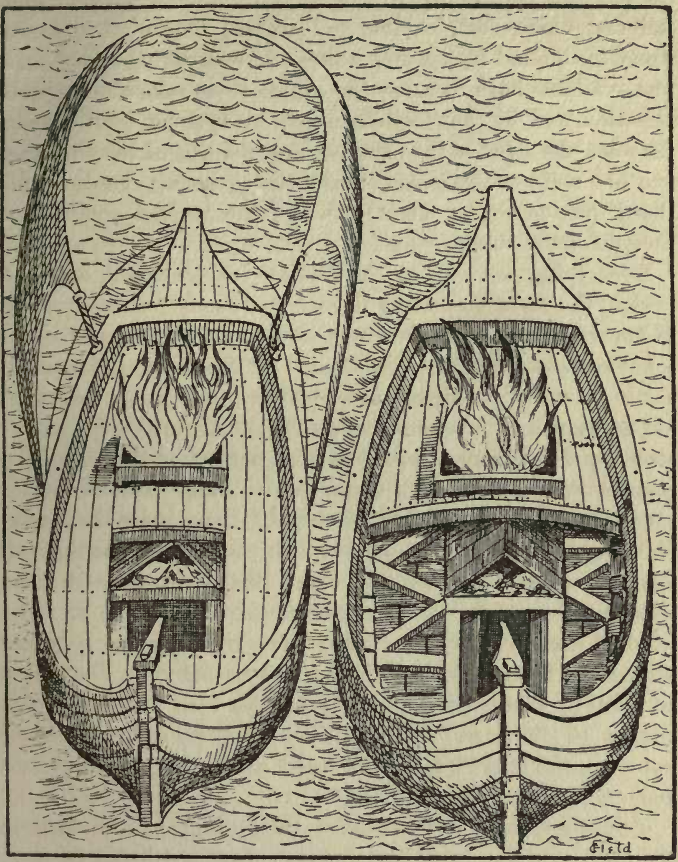
It will be impossible, therefore, to continue the story of the evolution of the submarine without some reference to that of the torpedo; the two things, boat and weapon, being bound up one with another in the later history of under-water war.

We have already seen that water-tight cases of "fireworks" were at times carried under water by divers with the object of injuring an enemy's ships, though unfortunately no recorded instance of their effects is to be found. The under-water "mynes and water-petards" used by Buckingham in the expedition to the Isle of Rhé have also been referred to, but here again nothing in the way of information as to their use or effectiveness has come down to us. But, on the other hand, there is a good deal of interesting matter available with regard to what were known as "Explosion Ships." These vessels were used at various times between 1585 and the beginning of the eighteenth century, and were without doubt a development of the fireship. The use of the latter, a small vessel filled with combustible materials, to destroy by fire the fleet of an opponent, dates from very remote ages indeed. They were used at the siege of Tyre, B.C. 333, and several instances of their later employment could be quoted from classical histories. The English first adopted them at the battle of Zuruckzee in 1370, and were attacked by them at La Rochelle in 1372. The Spaniards tried them against the English in 1406, and suffered severely from them themselves when, in 1588, Lord Howard of Effingham sent in eight blazing small craft against their Armada in Calais Roads. At this time there was a certain Italian engineer busily employed in England in the construction of Tilbury Fort and other sea-coast defences against the Spaniards. His name was Gianibelli, and he is noteworthy as having been the first to design and make use of explosion vessels or "Infernals," as they afterwards came to be called. This was three years previously, when he successfully blew up the fortified bridge which the Duke of Parma had thrown across the Scheldt to prevent relief being carried to Antwerp, which he was at that time closely besieging. The following description[1] of the "Devil Ships of Antwerp," shows that they were neither more nor less than a pair of huge surface torpedoes.

"Gianibelli procured or built two ships, the *Fortune* of seventy tons and the *Hope* of eighty, and with the assistance of Bory, a watchmaker, and Tunmerman, a mechanician, together with a proportion of workmen, he fitted them for explosive vessels as follows. The vessels being empty, along the whole length of the hold was laid a foundation of brick-work one foot thick and five feet wide. Upon this was erected a chamber of marble masonry, 40 feet long, $3\frac{1}{2}$ feet high by

[1] By Commander Galloway, R.N., in the *United Service Magazine,* 1895.

$3\frac{1}{2}$ feet broad, and with walls five feet thick. This formed the mine or chamber, which contained a charge of 7,000 pounds



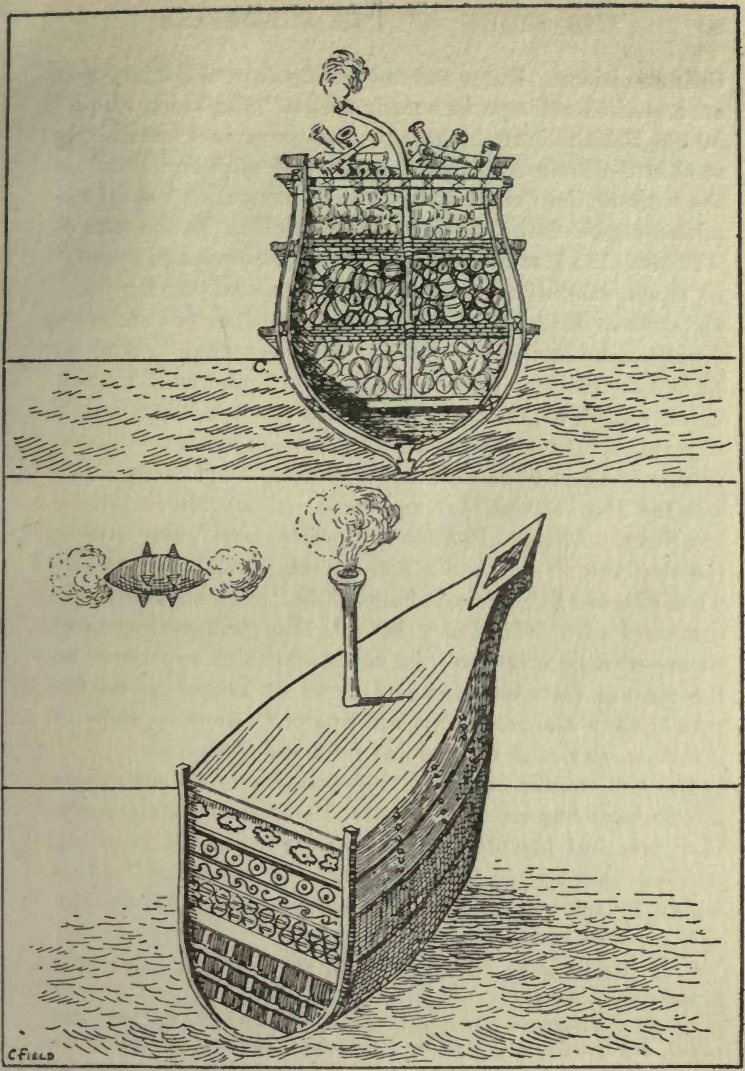
THE "DEVIL-SHIPS OF ANTWERP," 1585.
From an old Print.

of gunpowder made by Gianibelli himself, and of the greatest explosive energy then known. The top of the mine was formed of blue gravestones placed edgeways and six feet thick ; over this rose a roof or hollowed pyramid constructed of slabs of marble and containing round shot of various weights and calibres, chain-shot, chains, mill-stones, blocks of unhewn stone, ironbound beams and stakes and everything heavy that was available both to cause the explosion to take a horizontal direction and in their fall to injure everything they struck. Between the sides of the chamber and the ribs of the ship was another *ominum gatherum* of everything heavy, hooked and sharp (including harpoons) which 'this wicked witty man thought most damageable.'"

Everything fell out as the Italian had designed, and the bridge, the forts protecting it, and everybody and everything in the neighbourhood were swept away by the whirlwind of the terrible explosion of the "infernal." "The motion of panting earth extended its force and fear above nine miles," says an old account, which relates further that many of the big gravestones and millstones which had been packed on the top of the powder were carried to a distance of a mile. It was the remembrance of this terrible "infernal" that, more than anything, contributed to the panic which broke out in the Spanish Armada when they saw the eight British fireships drifting down on them, for "they were thought . . . to be of those kind of dreadful Powder Ships, which that famous Enginier Frederick Innibel, had devised not long before in the River of Skeld ; whereupon, crying out 'the Fire Antwerp,' that forrest of ships and vast gallions tumultuously cut their cables in their hawses, and so stood away in a shameful confusion, by the Northern Seas." [1]

Doubtless, too, the fact that their designer was then in England was known in the Spanish fleet and lent colour to

[1] From "Some Dialogues about Sea Services between a High Admiral and a Captain at Sea," by "Nathaniel Boteler Esq$^{re}$, lately a Commander and a Captain in one of H.M. Ships of War," 1685.



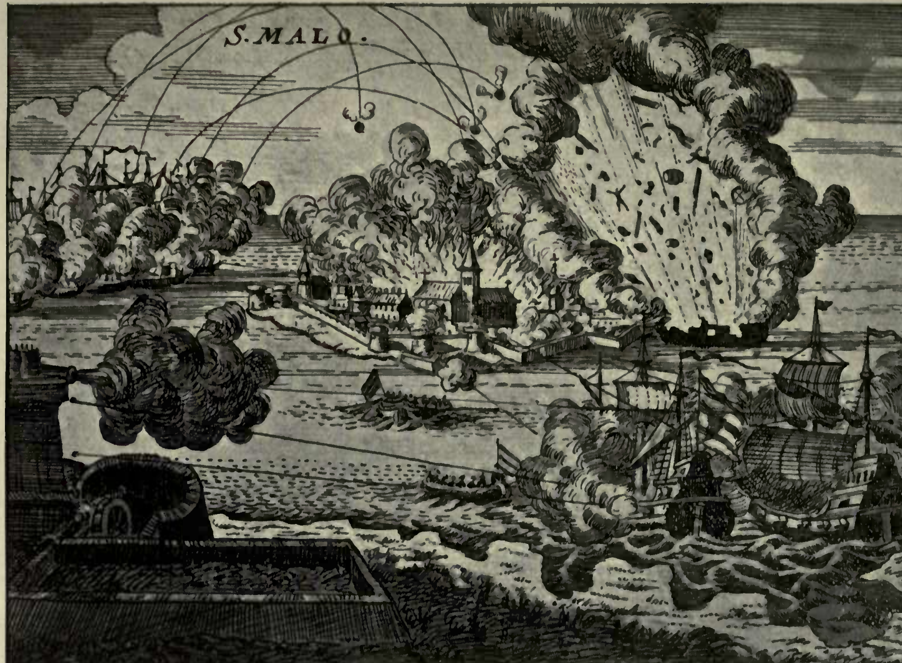

THE "INFERNAL' USED BY THE ENGLISH AT SAINT-MALO, 1693.
From Grose's "Military Antiquities."

their suspicions. But it was not till the days of Benbow that an organised attempt was made to use "Explosion Ships" in the British Navy. Fireships had been very extensively used in the fierce fighting between the English and Dutch in the wars of the Commonwealth and Restoration,[1] and committed a good deal of damage on either side. In the time of William III. a Dutchman in the British employment, Meesters by name, claimed to have invented a new kind of "infernal," and several vessels in the Royal Navy were equipped under his direction, and borne on the list as "explosion ships." Whether he had anything to do with the famous "infernal" carrying 20,000 pounds of gunpowder, and fitted very much in the same way as the "Devil Ships of Antwerp," which Benbow exploded fruitlessly against the walls of Saint-Malo, is not known. This was the first attempt that was made with an "infernal" by our Navy. Afterwards, other "explosion ships" were used on the northern French coast, notably at Dunkirk and Calais, when Meesters himself took charge of the "infernals" under the command of Sir Cloudesley Shovel. No good ever came of them—whether owing to want of enterprise or experience on the part of their captains and crews or incapacity on the part of their designer, was a moot point.[2] Anyway, ships of this class very soon disappeared from the Navy List.

The two courses on which the evolution of the submarine and torpedo had proceeded up to this time now meet in the very practical invention of the American, David Bushnell, who has been termed the "Father of the Submarine," a title which, by the way, has also been claimed both for his pre-

[1] On December 18, 1668, there were 26 fireships in commission in the British Fleet.

[2] "At the former (Dunkirk), the machine ships, as they are called, did nothing but blow up themselves, and the credit of their inventor, as some say; but he being come hither, complains he was not seconded with ships as he ought to have been."—Letter from Mr. Ellis to Lord Lexington, Whitehall, August 9, 1695.




THE ENGLISH "INFERNAL" BLOWING UP AT SAINT-MALO.

From an old Print in the Hôtel-de-Ville.

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decessor Van Drebbel and his successor Fulton. Bushnell, at any rate, is more entitled to it than the latter inventor.

David Bushnell was born at Satbrook in the State of Maine, and, according to his own written account, began to design his submarine in 1771, though it was not finished till four years later. Not only was this boat an extremely efficient vessel considering the limitations imposed upon the inventor by the backward position of scientific knowledge at that period, but the torpedo with which he armed it was also a well-thought-out and ingenious device. There is a considerable difference of opinion among writers as to whether it was propelled by oars or paddles or by means of an implement that was in point of fact a genuine screw propeller. Those who hold the first theory appear to consider that Bushnell could not have used a "screw" because the propeller is not generally considered to have been invented till thirty years later. But here the old adage that "there is nothing new under the sun" is very applicable, for it is not by any means certain to whom is due the honour of being the originator of this most important invention. "A screw to work in water, on the plan of a wind-mill," was invented by Robert Hooke in 1680, while a regular propeller is said to have been experimented with in France in 1730, thirty or forty years before Bushnell's time. So that it is not at all impossible for him to have heard of some such invention and to have adapted or improved it to his own uses. At all events the words he himself uses to describe it would certainly seem to indicate a "propeller." "An oar, *formed upon the principle of the screw*, was fixed in the forepart of the vessel; its axis entered the vessel, and being turned one way rowed the vessel forward, but being turned the other way, rowed it backward; it was made to be turned by the hand or foot." It is difficult to see how this description could apply to anything in the nature of the ordinary oar, scull or paddle. Moreover, he had another "oar" also "formed upon the principle of the screw" placed at the top of the vessel, which aided it to ascend or descend just in the same way that propellers were provided for a similar purpose in the Nordenfeldt and other comparatively modern submarines. It is inconceivable that this could be effected by a common oar.

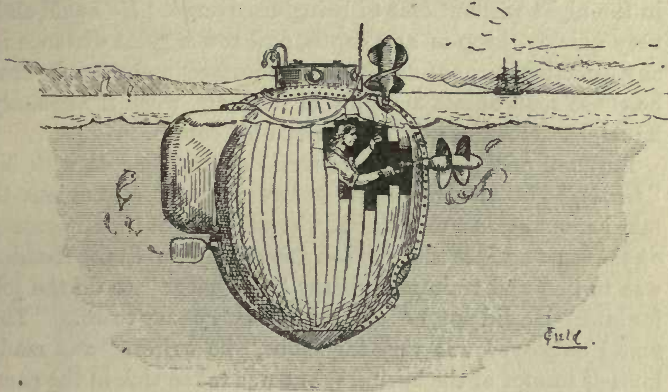
The boat itself was built of wood, and "bore some resemblance to two upper tortoise shells of equal size, joined together, the place of entrance into the vessel being represented by the opening made by the swell of the shells at the head of the animal. This form, while militating against speed, yet was the best possible for preserving horizontal stability, one of the greatest desiderata in a submarine vessel."

The following general description of Bushnell's "turtle" is abridged from an account published towards the end of the eighteenth century.[1]

"The inside was capable of containing the operator and air sufficient to support him for thirty minutes. At the bottom, opposite the entrance, was fixed a quantity of lead for ballast. At one edge, which was directly before the operator, was an oar for rowing forwards or backwards. At the other edge was a rudder for steering. An aperture at the bottom with its valve was designed to admit water, for the purpose of descending, and two brass forcing pumps served to eject the water within, necessary for ascending. . . . A water gauge or barometer determined the depth of descent, a compass rendered visible by means of phosphorus directed the course, and ventilators which, when submerged, were closed by the pressure of water, at once admitted a fresh supply of air the moment the top of the boat appeared above water. When the navigator would descend he placed his foot on the top of a brass valve, depressing it, by which he opened a large aperture in the bottom of the vessel through which the water entered at his pleasure; when he had admitted a sufficient quantity . . . and obtained an equilibrium, he could row upwards or down-

[1] In *The Britannic Magazine.*

wards, or continue at any particular depth with the oar placed near the top of the vessel *and formed like a screw.* The body of the vessel was made exceeding strong; and to strengthen it as much as possible, a firm piece of wood was framed parallel to the conjugate diameter to prevent the sides yielding to the great pressure of the incumbent water during a deep immersion. In the fore part of the brim of the crown of the machine was a socket and an iron tube passing through the socket;



BUSHNELL'S "TURTLE," 1776.

the tube stood upright and could slide up and down in the socket six inches; at the top of the tube was a wood-screw, fixed by means of a rod which passed through the tube and screwed the wood-screw fast upon the top of the tube; by pushing the wood-screw up against the bottom of a ship, and turning it at the same time, it would enter the planks; when the wood-screw was firmly fixed, it would be cast off by unscrewing the rod which fastened it to the top of the tube. Behind the submarine vessel was a place above the rudder for carrying a powder magazine, large enough to contain 150 pounds of powder, with the apparatus used in firing it, and was secured in its place by a screw. A strong rope extended from the magazine to the wood-screw above mentioned. When the wood-screw was fast in a ship, both it and the powder-case were cast off from the boat, and the latter being constructed so that it was lighter than water, rose up against the bottom of the ship to be destroyed. A clock-work apparatus was set in action at the same time and exploded the charge after a sufficient interval. The skilful navigator could swim so low on the surface of the water as to approach very near to a ship in the night without fear of being discovered. He could sink very quickly, keep at any depth, and row a great distance in any direction without coming to the surface, and when he rose he could soon obtain a supply of fresh air, when if necessary he might descend again and pursue his course."

Bushnell made an extensive series of experiments with his "turtle," but does not seem to have been at all anxious to take her out against the British, who were at that time operating on the coast against the revolted American Colonists. His idea was to find and train an efficient "navigator" to do the job for him. He did not, he says, find this very easy to do. "The first I employed was very ingenious," he writes, "and made himself master of the business, but was taken sick in the campaign of 1776 at New York, before he had an opportunity to make use of his skill, and never recovered his health sufficiently afterwards."

Eventually he procured a Sergeant Ezra Lee and despatched him to attack the *Eagle*, a British 64-gun ship which was in charge of a convoy of transports lying in the Hudson River not far from Governor's Island. The "turtle" was towed to the scene of action and left to its own devices. By this time it was getting towards morning, but it was still dark enough to allow Sergeant Lee to approach the *Eagle* undiscovered. When near enough to actually touch the stern he dived under water, got under the unsuspecting man-of-war, and set to work to attach his torpedo by means of the "wood-screw." The latter,

BUSHNELL'S NAVIGATOR ABANDONS HIS ATTEMPT UPON H.M.S. "EAGLE."

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however, came in contact with some iron strappings supporting the rudder hinge and failed to bite. There was a good deal of tide running, and being unable to work the "wood-screw" and the oar or propeller at the same time, the boat was swept away, taking the torpedo with her. The air, too, began to fail, and the adventurous Sergeant found himself obliged to come to the surface to renew it. When he came up it was fast getting light, and, despairing of again approaching the battle-ship without being fired on, he made up his mind to get away out of sight behind Governor's Island. Before long, however, the queer-looking object which he navigated attracted the attention of one of the boats pulling guard round the fleet. Seeing that she would very quickly overhaul him, he dived, at the same time letting go his torpedo, which soon afterwards blew up, to the great astonishment and consternation of the pursuing bluejackets. Bushnell's own story is that the British had troops on Governor's Island, and, becoming nervous of discovery as he was passing, Sergeant Lee cast off the torpedo because there was a considerable swell running and he thought it hampered his movements. Left to itself, with the clockwork running, it blew up in an hour's time. One thing seems to be certain, and that is that he got safely away. He made another attempt against the British shipping in the Hudson, but first missed the ship he was to attack and went a long way beyond her, and when he eventually got alongside was again swept away by the tide. Another trial was made by some other "operator," but with equal want of success. Eventually, while the "turtle" was being transported from one part of the river to another in a small vessel, the British came up with it and sank it. Bushnell afterwards contrived to raise his "turtle," but decided to forgo any further attempts to make use of her. But in the following year he himself went down in a whaleboat to try to blow up H.M.S. *Cerberus*—which lay at anchor between Connecticut River and New London—with a torpedo or "machine," as he calls it. It was to be drawn alongside the warship by a line, and was fitted with a gunlock arranged to explode it on contact.

On this occasion Bushnell seems to have made use of quite an elaborate apparatus, as will be seen by the following account in a letter from Commodore Symons to Admiral Sir Peter Parker dated August 15, 1777. "Wednesday night, being at anchor," he writes, "to the westward of New London in Black Point Bay, the schooner I had taken at anchor close by me, astern, about 11 o'clock at night we discovered a line towing astern that came from the bows; we immediately conjectured that it was somebody that had veered himself away by it, and began to haul in; we then found that the schooner had got hold of it (who had taken it for a fishing line), gathered in nearly 15 fathom, which was buoyed up by little bits of stick at stated distances, until he came to the end, at which was fastened a machine, which was too heavy for one man to haul up, being upwards of 100 lbs.; the other people of the boat turning out assisted him, got it upon deck, and were unfortunately examining it too curiously when it went off like the sound of a gun, blew the boat to pieces, set her in a flame, and killed the three men that were in the stern; the fourth who was standing forward, was blown into the water. I hoisted out the boat and picked him up, much hurt. As soon as he could recollect himself he gave me the following description, as near as he could remember:—It was two vessels shaped like a boat, about 20 inches long, and a foot broad, secured to each other at the distance of 4 feet by two iron bars, one at each end, and an iron tube or gun-barrel in the centre, which was loose (as he had himself turned it round with his hand); they swam one over the other, the upper one keel upwards; the lower one swam properly, but was so under water as just to keep the upper one a few inches above the surface; to the after iron bar hung a flat board, to which was fixed a wheel about six inches in diameter, and communicated itself to one on the upper side of the boat, of a lesser diameter. Opposite to these was another wheel, on the flat of the under one or loaded vessel, which had likewise communication with the wheels of the upper boat; it was covered with lead, and the keel heavily loaded in order to keep it down in the water. The fatal curiosity of the seamen set this wheel a-going, and during their looking at it, which was about five minutes from the time of its first being put in motion, it burst." [1]

Once more had Bushnell's contrivances failed, though in this case his torpedo had secured a few unfortunate victims. But, undeterred by his continued want of success, he in the last month of the year tried another dodge, which consisted in setting adrift a large number of kegs of powder, fitted as floating torpedoes, above the British shipping then lying in the Delaware off Philadelphia. Again his attempt ended in a fiasco which induced him to give up submarine warfare as a bad job. He paid a visit to France, and, returning to his native land, settled down in Georgia, where he lived till the age of 90 under the assumed name of Dr. Bush. The reason of this concealment of his identity does not appear, but we may conjecture that he wished to disassociate himself from the system of submarine warfare to which he had been formerly devoted, for though belligerents at this period did occasionally attempt to make use of torpedo attack, it was almost universally considered as mean, cowardly, and inhuman.

We shall find a notable instance of this feeling in the next chapter dealing with the projects and schemes of the great inventor Robert Fulton.

[1] Quoted by A. H. Burgoyne in his "Submarine Navigation."

# CHAPTER V

## 1780–1814

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### 1780–1814

Robert Fulton, his schemes and inventions—The *Nautilus*—The attack on the Boulogne Flotilla, 1804—The *Mute*.

Bushnell's partial successes in submarine navigation, if not in under-water attack, set other brains at work in the same direction. Between the years 1780 and 1796 no less than four Frenchmen busied themselves in designing submarines, though none of them got beyond plans and descriptions on paper. There was Sillon de Valmer, who projected a barrel-shaped under-water boat with a cone at either end. It was to be 54 feet long, propelled by oars, and to have a displacement of 8,000 cubic feet. Then there was one Beaugenet, whose plans are not recorded, but who claimed to be able to construct a submarine armed with cannon which he could take up to London Bridge without letting the British have any suspicion of his approach. M. Armand-Maizière was another inventor whose boat was to be propelled and raised or lowered by means of folding fins made on the principle of a bird's wing and actuated by steam; while finally a professor at the University of Aix, Jules Fabre by name, proposed an under-water vessel shaped like a peach-stone, by which, he said, the British Navy could be "ruined." Nothing whatever came of these projects.

But the year 1800 saw a really practical submarine afloat in French waters. This was the *Nautilus*, built after the design submitted to the French Directory on December 13, 1797, by the celebrated American engineer and inventor Robert Fulton.

This remarkable man was the Hiram Maxim of his age, so many and so ingenious were his inventions and projects, most of them brought to the greatest pitch of practical efficiency that was possible with the means at his disposal at the time in which he lived. Besides submarine boats and torpedoes he produced a steamboat, an ironclad, a panorama, and numerous patents for flax-spinning, rope-making, and apparatus, used in connection with canals. He aimed throughout at making a sufficiency of the "almighty dollar," and finding he could not induce the French Government to pay him to blow up British shipping, crossed the Channel to see whether the British Government would not make it worth his while to blow up French shipping. His first completed boat, the *Nautilus*, sometimes referred to as the "Bateau Poisson," or "Fish-boat," was launched on the Seine near Rouen on July 30, 1800, and at once carried out a series of experiments that lasted for three hours. The portion of the river selected was that lying between "Bapannul and the woodyard of Citizen Thibault," where there was 25 feet of water. The next day he took his boat down the Seine to Havre, where he carried out further trials. "Soon afterwards he built at Paris a second boat, more elegant than the first, and which bore proudly on its taffrail, in letters of gold, the name *Nautilus*. This new diving-boat had iron ribs and was sheathed with copper. It was of an elongated ovoidal form. On the deck was a groove in which lay a small mast which could be shipped by means of a hinge. In the interior, which was about six feet in diameter, were the handles of the oars, which were arranged in the form of a screw.[1] A reservoir, into which water was introduced, caused the *Nautilus* to descend at will; a force pump expelled the water and allowed the boat to ascend. Finished in June 1801, the *Nautilus* was tried on the Seine, above the Hôtel des Invalides. Fulton, having shut himself up in his boat, with a sailor, carrying a lighted candle, descended under

[1] Rather a vague description.

water, remained there twenty minutes, and emerged after having gone a considerable distance. He again descended in order to regain the point of departure. He then reappeared at the surface and sailed several stretches, amid the applause of the assembled multitude."[1]

After this "preliminary canter" in Paris, the new *Nautilus* was taken round to Brest for further experiments which were both extensive and successful, though the inventor quite failed to damage a couple of English brigs that were cruising on the coast. He made two attempts, but they on each occasion evaded him, being, he complains, either by accident or treachery, always forewarned of his designs. How he could have known the extent of the British information does not appear. He probably invented the excuse to explain his failure.

The *Naval Chronicle* of 1802 gives the following account of some of the Brest trials :—"Mr. Fulton not only remained a whole hour under water with three of his companions, but held his boat parallel to the horizon at any given depth. He proved the compass points as correctly under water as on the surface, and while under water the boat made way at the rate of half a league per hour by means contrived for that purpose. Mr. Fulton has already added to his boat a machine by means of which he blew up a large boat in the port of Brest : and if by future experiments the same effects could be produced on frigates or ships of the line, what will become of maritime wars, and where will sailors be found to man ships of war, when it is a physical certainty that they may every moment be blown up into the air by means of a Diving Boat, against which no human foresight can guard them ? "

The history of the last few years has proved the writer's fears as to the manning of the world's navies to be unfounded, although the submarine and the torpedo have attained a pitch of efficiency not dreamed of at the time he put his pen to paper. However, the French Government were disposed

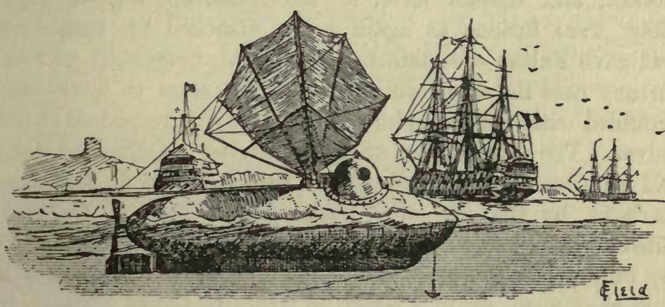
[1] Captain Maguire, U.S. Army, 1866.

to take much the same view of the matter, and despite the almost uniform success of Fulton's experiments, refused to have anything whatever to do with his boat, Admiral Decrès reporting that the invention was "fit only for Algerines and Pirates." An immoral weapon, he considered it, and he probably also was influenced by the fact that though the British Navy was superior to the French, yet the latter was a very good second, and it was not therefore politic to encourage a too cheap and too effective fighting craft.

Fulton's submarines merit a little more extended description than that which has already been given. What his first boat was like—the one built at Rouen—is not quite clear, as most of the diagrams of the *Nautilus* that have come down to us apparently refer to his second boat. Probably it was much the same, but, like Lake's *Argonaut II*,[1] it is said to have had a kind of superstructure added to it which gave it the appearance of an ordinary vessel when at the surface. To the particulars which have been given of the *Nautilus II* may be added the following :—At the top forward rose a dome-like conning-tower with glass scuttles, and just abaft it was attached a mast or folding framework of light spars which enabled sail to be hoisted when at the surface, but which stowed snugly along the top of the boat when submerged. The keel was formed of a heavy bar of metal forming a counterpoise and equilibrium. The anchors and the apparatus for hoisting them were in a compartment right forward, while amidships was the hand-worked crank engine that revolved the propeller, which by some accounts was a screw, and according to others a wheel fitted with elliptical buckets. The torpedo mechanism was practically the same as in Bushnell's "turtle," the "wood-screw" coming through the dome of the conning-tower, but the torpedo itself was fitted with a gun-lock fired by means of a lanyard instead of the clockwork contrivance that Bushnell's had.

[1] *Vide* Chapter XVII.

The bargain that Fulton tried to make with the French Government was that he should be paid 40,000 francs down—10,000 of which he had already received towards the expenses of his experiments—that he should receive a proportionate sum for every British man-of-war he succeeded in destroying, and a "patent giving himself and his crew the quality of belligerents, so that if they were captured they should not be hanged as pirates." But, as we have seen, the French naval authorities had quite made up their minds. Caffarelli, the Maritime Prefect of Brest, expressly forbade him to attack



FULTON'S "NAUTILUS," 1800.

an English frigate that was off the coast, because "this type of warfare carries with it the objection that those who undertake it and those against whom it is made will all be lost. This cannot be called a gallant death." We have seen what Admiral Decrès' views were, and finally Admiral Pléville le Pelly, the Minister of War, refused to accept Fulton's terms because, he said, "it seems impossible to serve a Commission for Belligerency to men who employ such a method of destroying the fleet of the enemy." As for Napoleon, he had made up his mind that Fulton was a charlatan and an adventurer. Without doubt he was the latter, as he soon showed, for, despite the claims that he had made of wishing to assure the liberty of the seas by attacking the English and so vindicating the republican principles he pretended to hold, he, on the rejection of his proposals by the French Government, at once went over to the enemy's country, arriving in England in 1804. He does not seem to have taken his submarine with him. Probably he had no chance of doing so. We may be sure that the French naval authorities looked out for that. What became of it cannot be said.[1]

The British, although they had not considered that Bushnell was quite "playing the game" with his insidious modes of attack, and though later, in the American War of 1812, they were furious at again being attacked by torpedoes, yet gave Fulton a certain amount of encouragement at first. In any case the naval authorities do not seem to have been troubled with any scruples about employing torpedoes themselves. The same year that he arrived in England they did all they could to destroy the French flotilla in Boulogne harbour by the use of "Catamarans" and "Coffers" filled with explosives. Whether these were made or designed by Fulton is not known for certain. It seems very probable that they were, for in a letter he wrote to Count Marbois in 1809 he practically admitted that he had had a hand in their construction, pleading as an excuse that he had played traitor to both French and English. He says, "Lord Sidmouth invited me to England, Mr. Pitt adopted my plan in part; I knew if it succeeded against the Boulogne Flotilla, the ingenuity of the French engineers would be exerted; they would soon get possession of the engines with the mode of using them, and the invention would recoil on England to the destruction of her marine."

This letter shows that Fulton was at least as unscrupulous as he was clever. There are documents which show that he

[1] This, of course, refers to his second boat. His first submarine was dismantled and left on the beach near Havre, where its remains were to be seen many years later.

received at one time £1,653 18*s.* 8*d.* from the British Government "in satisfaction of all claims," and that another sum of £1,533 13*s.* 7*d.* was paid to Messrs. Cutler & Co. on his account for clockwork apparatus they had made for him. It is very probable that this was what was used to explode the infernal machines or floating mines which were towed to the attack of the Boulogne Flotilla by the "catamarans." These are described as consisting of "two pieces of timber about 9 feet long and 9 inches square, placed parallel to each other, at such a distance as to receive a man to sit between them on a bar, which admitted of his sinking nearly flush with the water, and occasionally immersing himself, so as to prevent his being seen in the dark or by moonlight. "The person who had charge of this notable contrivance was a sailor clad in black guernsey, waistcoat and trousers, with a black cap which covered his face; he was furnished with a paddle, and being seated in his marine car, it was intended that he should take the clock-machine in tow. This instrument consisted of a copper case about 18 or 19 feet long, and something similar in shape to a coffin; its interior was furnished with combustibles, which were to explode by the striking of a clock within, which was to run a certain number of hours. The sailor in the catamaran, under cover of the night, dropping silently down with the tide, was to attach this machine to the cable of the enemy's vessel, and thus the projector hoped that the sleeping and unsuspecting crew would be instantly destroyed."

According to another description by an officer who took part in the attack on the French flotilla, "the 'coffers' are made of thick plank lined with lead. A plank is left out for filling it. When filled the plank is put in, nailed and caulked, paid all over with tar, covered with canvas, and paid with hot pitch. Some of them, when full, might weigh two tons. I may compare their outward appearance to a large log of mahogany, formed like a wedge at each end. There was a line fixed at one end, with something like an anchor. This line and anchor was floated with pieces of cork, intended to hook their cables, that the coffer might swing round and lay alongside: the other line is the towing line. The coffers are weighted with shot, so as only just to float, by which means they would scarcely be struck by any shot in the water, and could pass undiscovered."

Lord Keith was in command of the British fleet, flying his flag on board the *Monarch,* and at 9 p.m. on the night of October 3, 1804, the catamarans, with their submarine mines in tow, accompanied by a number of fireships, which each carried a large magazine of powder in addition to other combustibles, were sent in on their errand of destruction. Great things were expected of this novel mode of attack. It is even said that William Pitt and Lord Harrowby watched the operations from Walmer Castle, though beyond a very distant glare in the sky they cannot have hoped to see anything at all. But it turned out the most dismal fiasco, and enabled the French to hold the English up to Europe as "the authors of a cowardly and horrible attempt against the laws of war." The French contrived to dodge all the fireships, which went ashore and blew up in quite a magnificent manner, and the mines only succeeded in destroying a pinnace with the loss of twenty-one men. General Soult relates the incident as follows:—

"The pinnace No. 267, commanded by Captain Groney, being near the passage of Wimmereaux, perceived an English sloop under sail, which appeared to be directing its course towards the port; wishing to seize it, he gave orders to board it. Michael Abraham Cloquet, sailor, was the first who mounted the sloop; five others followed, and they extinguished the fire, but in seeking for the helm, which had been taken away, they perceived another vessel, very long, floating below in the water, which scarcely presented any surface, and which the pinnace accosted. Hardly had they cut the cable, when


THE "CATAMARAN" ATTACK ON THE FRENCH FLOTILLA AT BOULOGNE.

p. 68]

the fireship blew up the pinnace, and swallowed all the men that were on board."

The attack on the Boulogne Flotilla was indeed a case of "Much cry, little wool." In England the news of the attack and its failure was received with mingled disgust and derision. Such operations were considered to be in the nature of hitting below the belt, and the public generally regarded them with but little favour. Here is a specimen of a derisive ballad published at the time:

> "Catamarans are ready"
> (Jack turns his quid and grins),
> "Where snugly you may paddle
> In water to your chins."
>
> "Then who my blocks will fasten,
> My casks and coffers lay?
> My pendulums set ticking
> And bring the pins away?"
>
> "Your project new?" Jack mutters,
> "Avast, 'tis very stale:
> 'Tis catching birds, land-lubbers,
> By salt upon the tail."[1]

There are many more verses to the same effect. The line "And bring the pins away" has reference to the fact that a reward was offered to each sailor who brought back the safety-peg that was inserted in the coffer of which he had charge, and which put the clockwork in action by its withdrawal.

Pitt, however, still coquetted with the idea of torpedo attack, and, encouraged by him, Fulton gave a torpedo demonstration off Walmer Castle in which he succeeded in blowing up the brig *Dorothea* in the presence of Sir Sidney Smith, Lord Keith, and a number of other distinguished naval officers. About the same time he attempted to destroy two French ships off Boulogne. But the long-headed Lord St. Vincent, who was at the head of naval affairs, would have nothing to do with his schemes. "Pitt," he told the inventor in the

[1] Cobbet's *Weekly Political Register*, October 27, 1804.

course of an interview in which he explained his torpedo and the recent experiment at Walmer, "is the greatest fool that ever existed, to encourage a mode of war which they who commanded the seas did not want, and which, if successful, would deprive them of it." That finished Fulton in England, and in 1806 he betook himself to the land of his birth. There he obtained some little assistance from Congress and continued his torpedo experiments, without making any remarkable progress with them. In 1809, as we have before noted, he again approached the French Government, with whom he attempted to drive the following bargain. He wanted to be guaranteed "1000 francs per gun of each vessel belonging to the enemy which he should destroy by his submarine bombs and torpedoes"; and should England be finally beaten, one of the conditions of peace was to be that she should pay him, "his heirs and assigns, two millions of pounds sterling." But the French naturally had had enough of Fulton, and did not jump at his offer. In 1814 he again turned his attention to submarine navigation, and constructed the *Mute*, a huge "submersible" 80 feet 6 inches long, 21 feet wide, and 14 feet deep. It was capable of accommodating 100 men, and was covered with iron plating at the top, which was itself made of timber a foot in thickness. It was moved by paddle-wheels, and is said to have received its name from the silence with which its propelling machinery worked. The *Mute* was armed with "colombiads," or under-water guns, with which Fulton had previously made some fairly successful experiments, cutting cables and sinking an old hulk. But she was very very slow, and before her trials were completed her inventor and designer died at the age of fifty. He left behind him a mass of writings and plans and the memory of a prolonged attempt to overcome the difficulties attending submarine navigation and under-water warfare. Despite his want of material and monetary success, he is rightly recognised as having been one of the greatest pioneers in submarine navigation.

## CHAPTER VI

1814–1850

## CHAPTER VI

### 1814–1850

Under-water attacks in the American War of 1812—Attacks on H.M.SS. *Ramillies* and *Hogue*—The brothers Couëssins' submarine—Johnson's submarine, intended to provide for Napoleon's escape from St. Helena—Cervo's, Payerne's, and Philips' submarines.

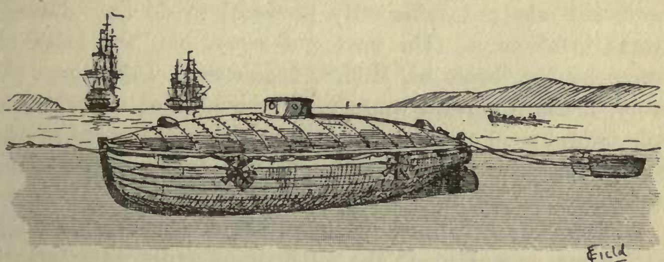
During the war between Great Britain and the United States in 1812–14, the British men-of-war employed on the American coast were subjected to a considerable number of torpedo attacks of all kinds, especially those which lay at the entrance of Long Island Sound off New London. The 74-gun ship *Ramillies* came in for more of these than any, probably because she was flying the Commodore's broad pennant as senior officer's ship. On at least one occasion the attempt seems to have been made by a submarine, very possibly one of Fulton's experimental boats, although it is stated to have been the invention of a person living at Norwich, an inland township not very far from New London. The inventor tested his boat by taking her three times right under the *Ramillies*. The first time he miscalculated his supply of air, and, coming to the surface to replenish his stock, found himself just under the towering stern of the 74-gun ship. The sentry aft spotted him at once and sang out "Boat ahoy!" but does not seem to have discharged his musket at the strange apparition. But an alarm gun was fired, the ship beat to quarters, and, fearing a torpedo, cut her cable and got under way. Meanwhile the boat dived and made off. The third time the boat—which was propelled by paddles and was capable, it is said, of moving under water at the rate of three miles an hour—came up directly under the battleship, and the inventor made fast to her keel and attempted—like Bushnell's navigator under the *Eagle* several years previously—to screw a torpedo to her bottom. But although he spent fully half an hour over the job, and actually succeeded in boring into the hull of the ship, he finished up by breaking his screw, and had to abandon his attempt. After a great number of attacks the Commodore retaliated by embarking nearly a hundred American prisoners of war, a fact which he notified to the United States Government, so that if blown up they would share the fate of the ship and her crew.

The following description of what may be called a semi-submarine boat, sent home by a naval officer, shows one kind of craft the Americans were in the habit of employing in such attempts. "American pilot-vessels for towing torpedoes," he says, "have been invented in New York, for the purpose of propelling through the water the infernal torpedoes intended to blow up the British line-of-battle ships. A winch inside this vessel turns two wheels on the outside, and which are placed on the larboard side. These wheels impel both the pilot-vessel and the torpedo attached to it at the rate of 4 miles an hour. Within the vessel are twelve men. The bottom of it is not much unlike that of a boat, but its top is arched. The scantlings are those of a ship of 100 tons: the planks are of inch-and-half stuff, and these being covered over with iron plates half an inch in thickness, are not to be injured by shot. On the top is a scuttle for the crew to enter, and this opening is also the look-out where a sentinel is constantly placed. Two air-holes, forward and abaft, give sufficient air to the crew. The vessel draws 6 feet of water, but one foot only is to be seen above the water, and this being painted of a dingy white, is not perceivable. The torpedo is, of course, attached to the stern of this vessel, ropes leading to it from 2 ring-bolts in the after part. The torpedo is filled with powder and com-


H.M.S. "RAMILLIES" ATTACKED BY A SUBMARINE —See p. 73.

bustible matter, and in its outside there is a gun-lock to which is fastened a string, which leads to a small scuttle of the pilot-vessel. Having towed this infernal machine close to the vessel which it is intended to fire, this string is pulled the moment the torpedo touches her, and the pilot-vessel, altering her course by means of a rudder attached to her, goes off in the general confusion."

One of the attempts on the *Ramillies* was peculiarly dastardly. She was short of provisions, a fact which somehow or other became known to the enemy, who fitted out a schooner in New York and filled her hold with powder, covering it over



PROBABLE APPEARANCE OF AN AMERICAN "TORPEDO-PILOT," 1812.

with barrels of flour. An ingenious piece of clockwork attached to a gunlock was arranged to explode the powder at a certain hour. The vessel was captured by the British boats, as had been intended. According to the American calculations the prize would have been ordered alongside the *Ramillies* to hoist out her provisions, in which case there would have been an end of the fine 74 and her captain—Nelson's friend Hardy. As it happened, the schooner was ordered to anchor near another prize, and when she blew up the prize crew were the only victims.

It appears that many of these attempts were organised at the neighbouring town of Stonington, for, writing on August 12, 1814, Sir Thomas Hardy reports his bombardment of that place, which had been "conspicuous in preparing and harbouring torpedoes, and giving assistance to the enemy's attempts at the destruction of His Majesty's ships off New London." The *Victorious* picked up a big torpedo containing 6 barrels of gunpowder suspended from a raft in Lynehaven Bay in 1813 which is said to have been invented by Lieutenant Mix of the United States Navy, an officer who attempted to blow up the *Plantagenet*; and in the following year the *Hogue*, then lying in the dangerous vicinity of New London, was attacked by a whaleboat carrying a spar torpedo which exploded under the starboard bow, but was not sufficiently powerful to do any damage worth mentioning. The boat got away, but was later on burnt by the boats of H.M.S. *Maidstone.* This closes the story of the American torpedo-campaign. Not many actual submarines were used in it, but in tracing the story of the Submarine we cannot well pass over matters which have such a close connection with its development.

In England, in the meanwhile, although considerable indignation was expressed at the methods of under-water attack employed by the Americans, its possibilities were not lost sight of. One Hodgman is said to have experimented with a submarine in 1801, and in a military work published in 1811 there is a description of a "machine," which is nothing less than a torpedo, "used for the purpose of setting fire to and destroying bridges." In 1814 the *Naval Chronicle* gave an account of a submarine under construction, in reference to which it remarks, "It is supposed Government intends this formidable invention to counteract the torpedo system of America." The boat is described as being in a state of considerable forwardness, and was a singular vessel "in shape much like a porpoise." It was 27 feet long, 5 deep and 5 broad, arched over and sharp at each end, was principally constructed of wrought and cast iron, and was proof against 12-pounders at "point blank range." It was fitted with sails for propulsion at the surface which, like those of Fulton's *Nautilus*, could be struck in two minutes. The boat was said to be able to dive to any depth, remain below for twelve hours at a stretch, and move at four knots an hour by means of oars fitted for the purpose. "The proprietor," adds the description, "can attach any quantity of gunpowder to any sunken body and explode the same at pleasure." The last sentence seems to indicate that the mysterious vessel was intended for a wrecking boat or submarine worker, rather than for warlike purposes. It is a great pity that so little information is given about her. The place of her construction is not mentioned, neither is the name of her "proprietor" nor of her designer.

Abroad inventors were still at work. In France the brothers Couëssin produced a boat in 1809 in which Napoleon took considerable interest. It was over 30 feet long and something like an enormous barrel with the addition of conical ends. It was built of wood and constructed in the most massive manner to withstand the pressure of the water. It had sails for use above water and oars for propulsion when submerged. But it could only crawl about at a knot and a half an hour, and moreover was not a true submarine—that is to say, a boat which could at times be entirely cut off from the surface—for it relied for its air supply on a couple of long flexible pipes or hoses which were buoyed at the surface. These were on one occasion very nearly her undoing, for the water got down one of them and she sank. Luckily the crew was able to stop the inflow, and she was got to the surface. The *Nautile*, as she was called, did not fulfil the expectations of her designers or their patrons, and, like hosts of other submarines, was abandoned.

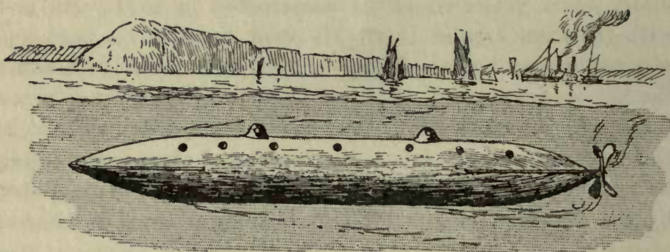
The next boat to be noted is a somewhat remarkable one that was built by a noted smuggler by the name of Johnson, who is said to have been originally an officer in the British Navy and to have carried out some of Fulton's experiments for the Admiralty or at least made similar ones. Possibly he was the "proprietor" of the boat building in 1814 which is mentioned above. He was what is known as a "cool customer," and it is related that in the course of one of his experiments in a submarine it got foul, when under water, of a ship's cable and remained immovable. Johnson calmly pulled out his watch and said to his assistant, "We have but two minutes and a half to live unless we can get clear of that cable." They contrived to do so, and not very long afterwards Johnson seems to have got into communication with some of Napoleon's agents who were trying to arrange for his escape from St. Helena. The temptations held out to him were too much for his patriotism, and he agreed to place himself and his skill and experience at their disposal. The escape was to be made in a large submarine, which he set to work to build. He was promised £40,000 the day she was finished, and wealth "beyond the dreams of avarice" if he brought the project to a successful termination. The boat was a big affair, no less than 100 feet long and provided with two folding masts. It was probably intended that she should make the greater part of the passage to St. Helena under sail, and arrive off the island at nightfall. She was then to dive to avoid the British cruisers and get close in shore. Thence her commander was to despatch a messenger to the Emperor and wait as long as was necessary. It is quite possible that a man of Johnson's boldness and resource might have been successful, but "there's many a slip 'twixt the cup and the lip." On the very day that the boat was so far finished that he was about to set to work to fasten on her copper sheathing, the news arrived that the Great Napoleon was no more. It was a sad blow to Johnson's hopes of ill-gotten gain, but he determined to continue the study of submarine navigation, and later on exhibited another underwater boat in London—(what became of the first one does not appear. Possibly there was only one, which was brought forward a second time). This was intended for use by the Spanish Committee against the French fleet then blockading Cadiz; but the project fell through.

As the nineteenth century advances, the plans and projects for submarine navigation become so numerous that it will be necessary to confine our attention to those which were actually constructed, although some of the paper designs are so interesting, so curious, and so grotesque that it is proposed to devote a chapter to a few of the most remarkable at the end of the book.

Shuldam, an American officer, was the first to build a submarine after Johnson. This was in the year 1823. It did not turn out a success, and that is about all we know concerning it. Cervo, a Spaniard, adopted the form of a sphere for an under-water vessel which he constructed in 1831. He met with the same fate as Day. He went down in his boat and was never seen again. The year 1835 is remarkable because the famous inventor M. Gustave Zédè, who has done so much for submarine navigation, then made his first appearance in this connection. His was a very minor and secondary part, as he was merely the secretary of a committee that was appointed by the French Government to report on a small submarine boat that had been invented by a M. Villeroi in 1832. It was only 10 feet long and 3 wide, but the inventor made some very successful descents, and in 1835 he repeated his experiments in the presence of Sir Sidney Smith and many other naval officers, most of them, of course, French. As to the after fate of Villeroi's boat, history, as is almost universally the case, is entirely silent. Possibly the fatal accident that had overtaken Dr. Petit of Amiens the year previous had prejudiced the public against these dangerous craft. After manœuvring at the surface at Saint-Valery-sur-Somme, the doctor ventured on his first descent—and his last. He was found next morning at low tide sleeping his last sleep in the coffin-ship he had made, which was lying in the mud of the harbour.

It was not till 1846 that a really practical submarine vessel was invented by Dr. Payerne, a Frenchman. It was rather an under-water worker than a war-vessel, and proved of great use in the construction of the big Cherbourg breakwater.

Like Simon Lake's wrecking boat, which we shall notice later on, it had a chamber in which the pressure of air could be raised sufficiently to prevent the entrance of water when a manhole was opened. This gave the divers whom she carried ingress and egress, so that they could carry on their work below water. Dr. Payerne seems to have constructed two or three submarines between 1843 and 1859. The following description of one of them appeared in an English journal in 1854:[1] "The inventor, Dr. Payerne, has not only discovered means to descend to the bottom of the sea and to work there at his ease



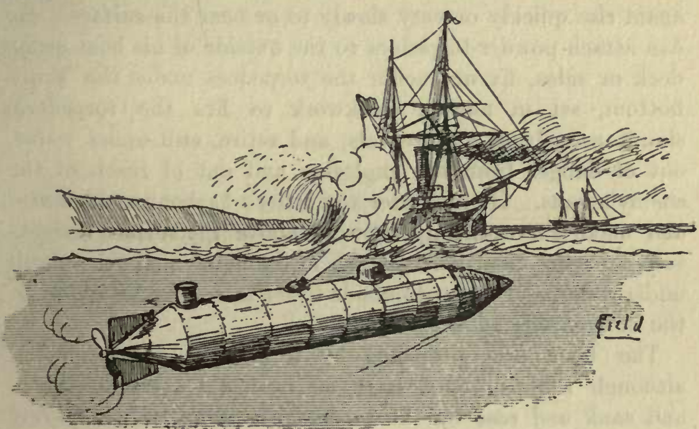
PHILIPS' SUBMARINE, 1851.
By favour of the *Illustrated London News.*

with a body of operatives, and to remain there as long as he pleases, replacing by chymical proceedings the oxygen absorbed, but he has discovered a method of directing the boat under water by steam, as if it were on the surface. He has engaged to start from any harbour in France and to reach the coast of England, though navigating under water."

About this period considerable attention was directed to a couple of cigar-shaped submarine boats that were constructed by Lodner D. Philips, an American shoemaker. They were both 40 feet long, but one was rather bigger round than the other. The first was merely for submarine exploration and navigation, and had no armament. The second was intended

[1] *The Illustrated London News.*

for under-water attack, and was armed with a gun or "colombiad" firing upwards through the iron plating with which the upper part of the boat was covered and passing through a ball-and-socket joint which permitted the elevation to be adjusted without letting water into the boat. Besides this she carried a torpedo in a kind of well aft, which on being released was to float up under the bottom of the ship to be attacked, while yet another torpedo, spherical in shape, reposed in a recess at the bow ready to be taken in tow by a species of




PHILIPS' SECOND SUBMARINE, WITH UNDER-WATER GUN.

subaqueous rocket which could be fired from just above it. The boat was cylindrical with conical ends, and seems to have proved a considerable success. It was launched on Lake Michigan in 1851 and carried out several public trials. On one occasion the inventor, taking with him his wife and two children, spent the whole day in exploring the bottom of the lake without coming to the surface to renew the air supply, and on another fired his "colombiad" through the bottom of an old hulk without any difficulty. Unfortunately he experimented once too often, and met his end in the depths of Lake

Erie. It is supposed that he descended too low, and that his boat was crushed by the enormous water-pressure.

The following are some of the claims he put forward as to the capabilities of his invention. "He has while in his boat (this would probably be the smaller one) under water, by means of machinery working through its side, sawed off timbers 14 inches square. He can sink his boat from the surface almost instantly, either to a few inches or feet from the surface of the water, or to 100 or more feet, and again rise quickly or very slowly to or near the surface. He can attach powder-torpedoes to the outside of his boat on its deck or sides, fix or anchor the torpedoes under the ship's bottom, set in motion clockwork to fire the torpedoes, simultaneously or at intervals, and retire, still under water, out of danger from the explosion and out of reach of the enemy's guns. He can enter an enemy's harbour under water and make surveys, only showing above the surface a sight-tube no more than half an inch in diameter, and retire, still under water, and proceed outside to sea and make his report to the commander of a fleet or ship."

The boat was propelled by a hand-worked propeller, although Philips hoped later on to instal a steam engine, and sank and rose by the process of filling and emptying a series of water-tanks. A Mr. William Delaney, who had been associated with him in the construction of his earlier boats, brought the plans of a larger one to England in 1859 and submitted them to the Government. Nothing further seems to have been done in the matter. The new boat was to have been 60 feet long and 7 feet 6 inches in diameter, and had the peculiarity that its propeller, being fitted with a species of universal joint, could perform the functions of a rudder in addition to its ordinary work of driving the vessel forward. The forepart of the boat was fitted with a kind of closely fitting ferrule or cap so that, in the case of collision, the boat could cast it off and go astern out of danger.

# CHAPTER VII

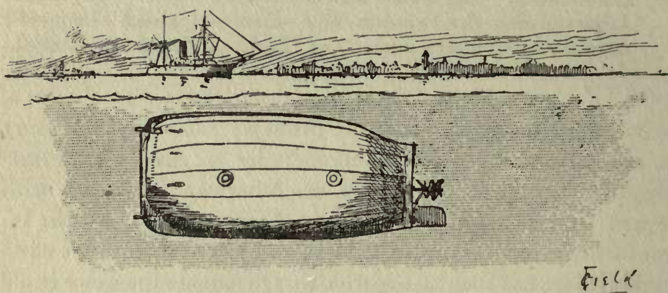
1850–1860

## CHAPTER VII

### 1850–1860

The story of Bauer, the German inventor of submarines—His *Brandtaucher*—The *Diable Marin* built for Russia—Submarine Affairs during the Crimean War—Deschamps and Vilcoquet's submarine—Conseil's boat—The *Ictineo* of Narciso Monturiol.

"Of all naval devices that have been made the object of painstaking invention, there is probably none whose history at once dates back so far and includes so many and heart-breaking failures." So writes an American journalist with regard to the submarine torpedo boat. And of all the inventors who have grappled with the subject of submarine navigation, there has been no one who from personal experience could more freely endorse this than the German inventor Wilhelm Bauer, who built his first submarine in the year 1850. The story of Bauer is one continued series of disappointments, due not so much to inferiority of design or workmanship on his part as to the action of the naval authorities of the various nations who, one after the other, coquetted with his inventions. Born at Dillingin in Bavaria in 1822, he entered the army when twenty years of age, and after serving as a cavalryman for seven years his mechanical aptitude caused him to be transferred to the artillery. During the years 1848–50 an intermittent war raged between Germany and Denmark. At this period the fine war-fleet which Germany now boasts was in its feeblest infancy, and no match for the comparatively powerful Danish Navy. The whole German coast was practically open to its attack, and the damages it committed in the course of hostilities set Bauer's mind to work on the subject of a submarine boat which would cause the Danish raiders to keep at a more respectful distance. The project was enthusiastically taken up by the army engaged in Schleswig-Holstein, which subscribed the bulk of the money that was required for the construction of his first submarine—about £600. It was a curious-looking craft, short, narrow, and deep in proportion to its breadth. It was built in the workshops of Messrs. Schneffel & Howaldt at Kiel and christened *Die Brandtaucher*, or the "Marine Diver," by its inventor. It



BAUER'S "BRANDTAUCHER," 1850.

had a displacement of 35 tons and was driven by a screw actuated by a hand-turned engine amidships.

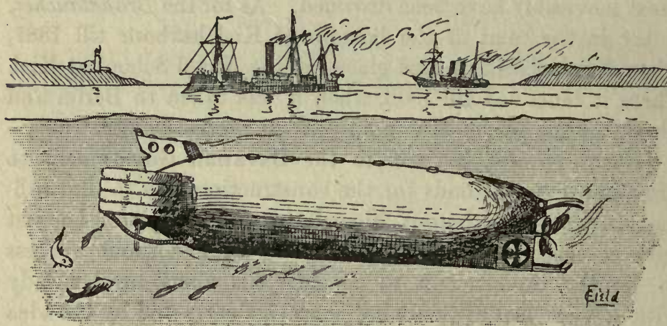
At the end of the year Bauer took out the *Brandtaucher* towards the Danish fleet then blockading the port of Kiel, with the result that the Danes became so much alarmed at the appearance of this new engine of war that they stood much farther out to sea. In February 1851 Bauer made a second trial, from which he barely escaped with his life. Accompanied by a couple of sailors he took the boat below water and dived so deeply that she was unable to resist the pressure of the water and began to leak in the most alarming manner, finally settling on the bottom in 60 feet of water. Bauer, however, kept his wits about him, and after a long argument with his crew, who had given up all hope, induced them to assist him to pump more water into the boat till the air contained in it was at such a state of compression that the pressure equalled that of the water outside. He was then able to open the scuttle and escape with his men to the surface. His friends above water during this crisis caused him more anxiety than anything else, as, in their efforts to grapple the sunken submarine, their grapnels kept on banging against the glass scuttles, threatening to break them in at every moment. Had this occurred, Bauer and his companions must inevitably have been drowned. As for the *Brandtaucher*, it lay in the mud at the bottom of Kiel harbour till 1887, when it was fished up and placed in the Naval School at Kiel. There it remained till 1906, when it was taken to Berlin and placed in the Naval Museum.

Bauer appealed in vain to the Bavarian Government to provide him with funds for the construction of a second submarine, and then betook himself to Austria, where he met with a severe disappointment. He tried without success to get the Government to consider his plans, until a lady with a great deal of Court influence was attracted by the idea and persuaded the Emperor to see him. As a result of this interview a commission was appointed to examine his plans. They were reported upon favourably, and a considerable sum of money was voted to Bauer to enable him to continue his experiments. Then at the last minute the Minister of Commerce, Von Baumgarten, whose Department had been one of the largest subscribers, was seized with misgivings and raised such a storm of opposition to the project that it was dropped.

But Bauer, it has been well said, was "the most persistent inventor to be found in the whole history of submarine navigation,"[1] and made up his mind to "try again" in another quarter. He came to England, and was fortunate enough to

[1] A. H. Burgoyne in "Submarine Navigation."

find a warm ally in the person of the Prince Consort. Money was forthcoming, and the inventor set to work on a submarine and a corvette as well. But he was not allowed to carry out his plans in their entirety. Scott Russell, Charles Fox, and the celebrated engineer Brunel were associated with him in the construction of his submarine, while Lord Palmerston is also said to have had a finger in the pie. The result was that "too many cooks spoiled the broth." The boat began her trials, and soon finished by sinking and drowning a large number of men. Bauer and his invention were at once at



BAUER'S "DIABLE MARIN," 1855.

a discount in this country, although it is said that his plans were retained or copied by some of his assistants in the building of the ill-fated boat. Anyway, Scott Russell brought out a submarine a year or two later which bore a very suspicious resemblance to a boat that Bauer built about this time for the Russian Government called the *Diable Marin*. It was intended to be employed at the siege of Sebastopol, and cost the Government £7000 to build. She was to be propelled by oars pulled by men in diving-dresses supplied with air by a tube with a funnel-shaped float. It also sank on its trials and drowned the crew.

After leaving England Bauer had approached the

Government of the United States, but they would not have anything to do with him. He next went to Russia, then at war with England, France and Turkey, where he was taken up by the Grand Duke Constantine and built the *Diable Marin* referred to above. The new boat was 52 feet long and over 12 feet wide, and was somewhat of the same shape as the ill-fated *Brandtaucher*. It was propelled by a single screw driven by gearing connected with a kind of treadmill which was 7 feet in diameter. When it was desired to descend, water was pumped into three big cylinders, 10 feet high and 4 feet 6 inches in diameter. To ascend they were, of course, emptied again. There was a smaller cylinder whose duty was to keep the boat steady—a kind of ballast tank.

The mode of attack by the *Diable Marin* was to be a somewhat curious one. A big mine holding 500 lb. of powder was carried forward, and to fasten this to the bottom of an enemy's ship a pair of long, thick india-rubber gloves were fitted to the hull of the vessel so that a man standing right forward and looking through a pair of thick glass scuttles provided for the purpose, could put his arms into the gloves, detach the mine, and affix it where required.

There was an opaque black fog hanging round Cronstadt in the small hours of the morning of May 26, 1856, and a sentinel perched up on some of the immense granite fortifications that had held the British Baltic Fleet so long at bay suddenly saw a mysterious object floating close to his post. Presently he discerned a man standing upon it, and challenged. To his surprise he received the correct countersign, and, bewildered and alarmed at what he considered a supernatural manifestation, he threw down his rifle and took to his heels. This was about three in the morning. Sentry after sentry was equally flabbergasted, and so Bauer made a kind of triumphal entry into the impregnable harbour.

After this the inventor carried out a very large number of successful trials with his boat. Submerged 17 feet under water he wrote letters to his Russian patron, to the King of his own country, and to his mother.

When Alexander II. was crowned, Bauer shipped a band of four musicians and celebrated the occasion by having the Russian National Hymn played under water while his crew joined in with the words. He was submerged for four hours while this ceremony went on. It is not known whether he found out if the fishes had any ears for music or not. But somehow or other Bauer seems to have got himself disliked in naval circles. Possibly he bored people with his inventions and projects. They wanted to get rid of him, and so endeavoured to find out something his boat could *not* do. He was told to pass under a certain ship that lay in very shallow water, but he was not informed of the depth. The consequence was that the propeller got entangled in a mass of seaweed and could not be extricated. Bauer only just managed to save his life and those of his crew by pumping out all the water and letting go the emergency safety weights. Up came the bow to the surface and they scrambled out, all but Bauer, who was still engaged below. He held on till a sudden inrush of water drove him out. This is said to have been his one hundred and thirty-fourth experiment in submarine navigation, which shows what an indefatigable and pertinacious inventor he was. But after this the Russians had had enough of him; and after he had raised his *Diable Marin*, a job which took him four weeks of incessant hard work, a final disaster overtook him in the total loss of his boat, which went down in deep water off Ochda, a long way from land. According to one account she was deliberately taken out and sunk by order of the Russian Admiralty. Then he was ordered to build a submarine corvette to carry 24 guns, and this was followed by an intimation that he should betake himself to Siberia in order that he might the better keep her construc-

BAUER AND THE RUSSIAN SENTRY.—See p. 89.

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tion a State secret. This was the last straw. Bauer saw that the Russian Government was bent on making things unpleasant for him, and asked permission to quit the country. Four times had he to make this request before it was granted. He wandered to France, Switzerland, and back to his native land, often in dire distress from want of funds. His last attempt in the direction of submarine navigation was in 1861, when he attempted to float a company in Germany for the construction of a novel submarine which he entitled a "Brûleur des Côtes."[1] But sufficient money was not forthcoming, the project fell through, and at length his determination to succeed gave way. Worn out by repeated disappointments he settled in Munich, where he fell into a decline and, after being bedridden for seven years, died in 1875. So died Wilhelm Bauer, a clever man, cool, brave and determined, but the victim of never-ending ill-luck.

We have referred to the intention of the British Government to make use of a submarine in the war with Russia. It was probably induced to try this system of attack by the torpedo attempts made on the British Baltic Fleet. More than one ship was struck by Russian submarine mines, but they were too feeble to do more than shake things up generally and break the crockery. In 1855 an attempt was made by the British to blow up one of the Russian line-of-battle ships in the harbour of Sebastopol. Boatswain John Shepherd, R.N., took in a torpedo in a punt on two occasions, his attempt being described by Lord Lyons as "a bold one and gallantly executed." He does not seem to have been successful in his endeavours, but his bravery brought him the coveted distinction of the Victoria Cross.

As may naturally be supposed, the Crimean War, like other campaigns before and since, stimulated the activity of inventors and designers of warlike material, and among the rest those who studied submarine navigation and under-

[1] *Vide* Chapter XVIII.

water attack. We have referred to Bauer's boats and that accredited to Mr. Scott Russell, but we must not overlook two other somewhat notable inventions which were brought forward in the year 1855. In this country there was Babbage's submarine, which was, in point of fact, merely an elongated diving-bell. Instead of being circular it was 12 feet long, 5 high and 3 wide. It was to be fitted with some means of propulsion by hand, and water-ballast tanks ran round the lower edge. Like other diving-bells, it was open at the bottom, and when experimented with was moved by means of a hawser or long rope anchored at one end and passing over a drum in the centre of the vessel. Thick glass scuttles admitted a certain amount of light, and divers issuing from the boat were to place torpedoes below or in contact with the ship to be attacked. It was a quaint and rather ingenious adaptation of the long-known principle of the diving-bell, but it never achieved any success, and was probably sold for old copper.

In France MM. Vilcoq and Deschamps produced a little boat only intended to carry one man. It had the peculiarity that he wore a kind of diver's helmet and drew his supply of fresh air direct from reservoirs with which he was connected by flexible tubing. After he had breathed it, the air passed out again into the body of the boat. It was built of copper with a dome amidships provided with strong glass scuttles and surrounded outside with a kind of shelf on which lay the various tools which the navigator might require to make use of in his mining operations. He sat with his head in this dome and with his arms thrust into long flexible gloves which permitted him to use them outside the vessel while with his feet he worked the pedals which turned the propeller. It was a well-thought-out little vessel, but too small to have come into general and practical use. One of the inventors—Deschamps—made a second attempt to solve the problem of submarine navigation with a very similar boat in 1860.

But in attempting to raise a sunken vessel in the River Seine he was badly hurt, and narrowly escaped losing both his life and his submarine.

Conseil of Havre is the next inventor who actually carried out trials with a submarine of his own invention. They were not altogether successful according to the report of Admiral Bouet-Willaumez, Captain Bourgeois, and Engineer Mangin, who were present at its trials on the Seine between the Pont Saint-Michel and the lock de la Monnaie. Its horizontal rudders enabled it to plunge and rise fairly efficiently, but when submerged the inventor, who was on board, seemed to have no control over its direction. Its propeller was driven by a set of cranks turned by six men. The boat weighed 3 tons, and had no particular features of interest. Its speed was perfectly tortoise-like—not more than one and a half knots an hour could be got out of it. Conseil could not help recognising the defects of his boat, but, nothing daunted, set to work to build another and an improved edition of it. It was also bigger, and, remembering the feeble speed of his former boat, he cast about to find a more powerful means of propulsion than hand-driven mechanism. He eventually hit upon a turbine engine, but it was a very different affair from the powerful and perfected turbines with which we are familiar to-day. Not to put too fine a point on it, Conseil's notion was an entirely impracticable one. His turbine was to be turned, not by steam, but by water coming down a pipe from the surface of the water in which the boat was navigating. It could therefore only be used when the boat was well beneath the surface, and unless the water could be pumped out of the boat as rapidly as it came in, it would be swamped. But to do this would require much more "man-power" than was necessary to drive the boat along.

In the same year that these futile attempts were being carried out in France, the *Ictineo* ("Fish-boat"), invented by

Senhor Narciso Monturiol, was being experimented with at Barcelona with excellent results, if we may believe the various accounts that were published at the time. She is said to have been provided with a battery of under-water cannon and to have made excellent practice with them at the bottoms of vessels, while a formidable steam-driven auger at the bows recalled the methods of mediæval under-water attack. But it is believed that both guns and auger existed only in the imagination of the journalists of the period. The *Ictineo* is said to have been tried more than sixty times, and to have been able to manœuvre in fifty feet of water as easily as on the surface. A special apparatus manufactured oxygen as fast as it was wanted, so that a crew of ten men were able to remain below water for five hours at a stretch. But although these numerous trials ought, one would think, to have proved the efficiency of Monturiol's invention, it seems to have come to nothing in the end, like so many others. The fact is that until the evolution of electrical and internal-combustion motors, the designers of submarine craft were hopelessly handicapped by the difficulty of propulsion. But they had to struggle on without them for a good many years after this.

## CHAPTER VIII

1860–1864

## CHAPTER VIII

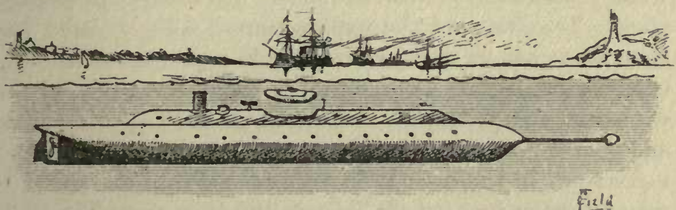
### 1860–1864

Villeroi's submarine for the United States Government—The submarine built by Admiral Bourgeois and Engineer Brun—Her Trials—Alstitt's submarine—The Confederate *Davids*—The Attack on the *New Ironsides*—Hunley's *David.*

THE decade upon which we are now entering has no very great advances to show in the construction and evolution of submarine vessels. But attempts were made, with more or less good results, to introduce steam and electricity as modes of propulsion. It is noteworthy, too, for the great use of submarine mines and torpedoes in the Civil War in America, during which, also, various submarine craft were built and made use of on more than one occasion during the progress of hostilities. The mines and torpedoes that were employed scored many successes. No less than seven armour-clads and a dozen other vessels were destroyed by means of these devices at one time and another, but only one single vessel, the Federal corvette *Housatonic*, was sunk by a submarine, so far as is known, and on this occasion the attacking boat shared the fate of her victim. Many more or less futile attempts were made, especially by the Southerners, to employ submarine torpedo-boats in the attack on their enemy's ships of war, which will be related in due course; but before doing so it will be necessary to glance at one or two vessels of this class which were constructed by French inventors and which took no part in the war.

We have already had occasion to refer in a former chapter to a submarine that was invented by M. Villeroi in 1832 and experimented with in 1835 with rather promising results. Now in 1862, thirty years later, this inventor again appears on the scene. This time his boat was built to the order of the United States Government, who probably intended to make use of it against the Confederate flotillas which were giving their navy so much trouble in the War of Secession, which had broken out the year previous. Villeroi's new submarine was very much larger than his early craft. She was built at Philadelphia, and was 35 feet long and had a diameter of 3 feet 9 inches. Her shape was cylindrical with a pointed bow and rounded stern. There were several curious points about this vessel. Among others we may note the two huge copper buoys which, carried in deep wells or recesses at either end of the vessel, could be sent up to the surface, where they assisted to support the submarine at varying depths. Then there was a peculiar system of propulsion. Eight men, seated in the centre portion of the boat, each manipulated a pair of folding oars or sculls. This proved very unsatisfactory, and eventually a hand-turned propeller was substituted. There was a closed chamber right forward which enabled divers to enter and quit the vessel, and just abaft of this was a little dome which served as a conning-tower for the commander of the vessel. Villeroi intended to equip his new submarine with quite an array of offensive weapons, including the time-honoured auger. In addition to this mediæval device, a loaded cannon was to be placed outside the hull on each side of the conning-tower, and on either bow was a series of saw-edged horizontal fins which the inventor imagined might cut gashes in the bottom of an enemy's ship as the submarine scraped along against it. But as the boat proved a complete failure when she came to be tried, this remarkable armoury was not fitted. She finished her career off Cape Hatteras, where she foundered in a gale of wind.

It may have been noticed that the inventors of under-water vessels have almost always been civilians. There were one or two exceptions—William Bourne, who had served in the Elizabethan Navy, for one, and Johnson, the ex-naval officer and smuggler, for another. It is possible that this fact may have had something to do with their general want of final success. Familiarity with the ever-changing ocean must go for something in the attempt to design a new type of vessel, whether for use above or below water. But in the early 'sixties an experienced French naval officer, Captain Bourgeois, turned his attention to submarine navigation. With him was associated M. Brun, a naval engineer. Here, then, we have



BOURGEOIS AND BRUN'S "PLONGEUR," 1863.

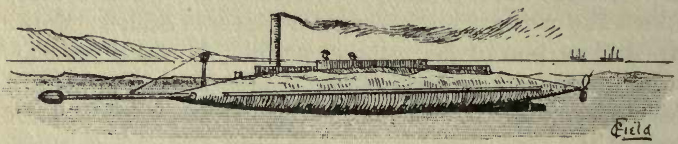
a combination of talent that should go some way towards success. And so it did. The under-water boat that these two officers constructed, if not doing everything that was expected of it, yet was a great step in advance of anything that had hitherto been built, and the experiments that were carried out with her were of very great assistance to those who had given themselves up to the study of submarine navigation.

The Bourgeois-Brun boat was launched at Rochefort on April 16, 1863. She had been nearly three years building, and was constructed entirely of sheet iron. In shape the *Plongeur*, as she was called, was not unlike a cigar with the upper side very much flattened, so that amidships her cross-section was that of an ordinary, but rather shallow, boat. She was driven by an 80-h.p. engine, actuated by compressed air carried in a number of horizontal tubular reservoirs. Below these were other somewhat similar tanks for containing the water required to sink the boat to the desired depth. Along the centre of the upper part of the *Plongeur* was a low superstructure or ridge, with a recess containing a lifeboat, in which the crew could escape to the surface in the case of an accident when submerged. This apparatus was tested and found to act very well. The *Plongeur's* trials were carried out with the greatest caution. After a species of preliminary canter at the surface between Rochefort and Charente, in which she only averaged the poor speed of three knots, the underwater experiments were taken in hand in a basin at the former place. The first time she was submerged a big cylinder was fastened to her, so that her crew could regain the surface by climbing up ladders fixed within it. The event proved the wisdom of this precaution, for the water burst open a scuttle and poured into the boat. One experiment after another was carried out in the basin, and with such good results that it was determined to try the boat in the open sea. The trials took place about the middle of February 1864, and were attended with a good many mishaps, and finally the *Plongeur* got aground off Fort Vaseux. There she had to stay till the next day, when she was got off without having suffered any very considerable damage. But though the *Plongeur* in many ways marked a great step forward in the evolution of the submarine, she suffered from a want of longitudinal stability. That is to say, that when she was under water she never could be got to proceed in a line parallel to the surface. She would continually either dive or direct her bows upwards. Life on board must have been a perpetual see-saw. This defect was most likely mainly attributable to her great length and flatness. Anyway, after a few more trials in the basins of Rochefort Dockyard, she was given up as a bad job.

The story of the Submarine now once more takes us across the Atlantic to America, the country in which so many under-water craft had already been designed, and which was to play such an important part in their future development. In the early part of 1861 the terrible and prolonged Civil War broke out between the Secessionist States of the South and the rest of the Union. The United States, from its situation and constitution, had never been a military country. Both army and navy were small in proportion to the size and standing of the nation. Both sides, therefore, set to work not only to raise men, but to improvise new and, if possible, cheap methods of attack. The submarine at once presented itself to the belligerents as fulfilling both of these conditions. The United States Government, as we have already seen, tried to get a practical boat built by M. Villeroi, but without success. About the same time another submarine was built at Mobile by an American of the name of Alstitt. It was a peculiar-looking affair, not a bit resembling the fish-like boats that had been constructed by other inventors. It was more like the hull of the small ironclad ram then just coming into vogue in our own Navy. It had a steam-engine for propulsion when at the surface and a couple of electric motors for use when submerged. It was to attack by letting go buoyant cases of powder below an enemy's ship. Right forward it was fitted with a big horizontal rudder, to enable it to dive or rise at will. This, however, did not do what was expected of it, and it is pretty evident that the boat was an absolute failure. Had it not been so, we should certainly have heard of its use in the war then raging. As it was, it passed quietly into oblivion.

If the North entertained the idea of using the submarine to attack the Southerners, the latter were no less determined to use the same means to destroy the ships of their enemy which were keeping Charleston so closely blockaded. They remembered the story of David and Goliath of Gath, and so christened the various submarines they constructed "Davids," in the hope that they would treat the Federal ironclads in the same way that the shepherd boy of Scripture dealt with the Philistine giant.

Their first boats were hardly true submarines. They began by cutting down a gunboat at Charleston and turning it into a partially submerged torpedo-boat. The *Wabash* was approached by some queer-looking craft in April 1864, which disappeared when she slipped her cable and opened fire. Mr. H. W. Wilson, in his "Ironclads in Action," suggests that it may have been this vessel. But it is at least as likely to have been the *David* which attacked the ironclad *New Ironsides* on October 5, 1863, and which we are now about to describe. This was one of several similar boats that were



A CONFEDERATE "DAVID," 1863.

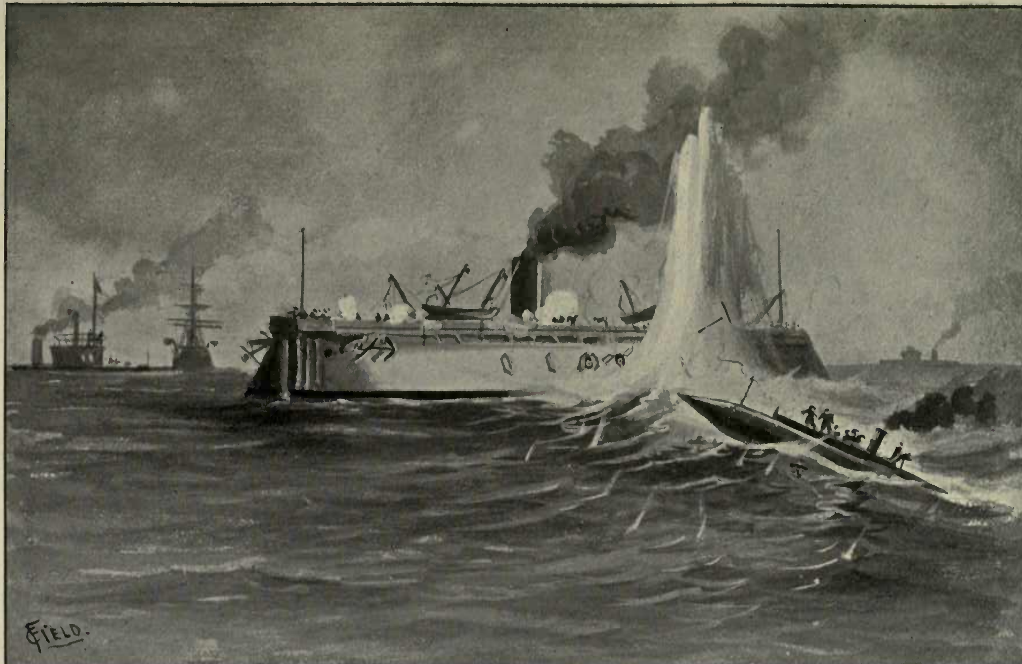
constructed about this time, and of which eight were found by the Federals when Charleston surrendered. She was shaped very much like a cigar, and was about 50 feet long and 9 feet in diameter amidships. Though they had the appearance of submarines, it is doubtful whether these boats were ever intended to go entirely under water. They do not seem to have been provided with horizontal rudders, and they were driven by an ordinary steam-engine with a funnel, which, however, was telescopic and could be reduced very considerably in height in order to avoid observation. Moreover, these vessels always attacked in an awash position, and it seems likely that this method of approach was the one intended for them.

The *New Ironsides* was (for those days) a big, hulking monster with sloping flanks, carrying ten big guns a side.

She lay at anchor in the middle of the blockading squadron. In addition to her material strength, her crew contained the most efficient gunners in the Federal fleet, and she was naturally the object of many attempts on the part of the Confederates. One of these was made, as we have already observed, on October 5, 1863. The crew of the *David*, which was lying off Morris Island, consisted entirely of volunteers. She was commanded by Lieutenant Glassell, and with him were Captain Stoney as chief officer, and an engineer named Tombs. At 9.15 p.m., by which time it was pretty dark, the little craft got under way. Only a small portion amidships appeared above water. At the bow was a long spar or pole, carrying a torpedo containing sixty pounds of gunpowder at the end. Glassell's orders were to destroy as many of the Federal ironclads as he could, but as he only seems to have been provided with a single spar torpedo it is difficult to see how he could have hoped to damage more than one. Anyway, the *New Ironsides* was his first objective. The *David* was capable of steaming at seven knots an hour, but it is probable that she approached her prey much more slowly than this. At full speed the noise of her engines, and possibly sparks from her funnel, might have betrayed her. As it was, she was not heard at all, but was suddenly observed floating in the dark water by the look-outs on board the *Ironsides*. She was quite near then, and they were not sure whether she was not a plank floating on the sea. She had gone round outside the fleet, and came in from seaward. Lieutenant Howard, the officer of the watch, guessed at once what she was. But he thought they might as well hail the mysterious object, and "Boat ahoy!" rang out into the silence of the night. The answer was a sparkle of musketry from the coamings of the *David*, and Howard fell mortally wounded. Before the *Ironsides* could open fire in reply, the torpedo touched her side. There was a terrible crash, the ship trembled from stem to stern, and an enormous column of water soared aloft to fall in a deluge upon her decks. So severe was the shock that one of her crew had his leg broken. The *Ironsides*, unable to use her big guns at so close a range, now opened a heavy musketry fire on the *David*, which was kept up as long as she could be distinguished in the darkness, which was only a very few moments. A subsequent examination proved that the *David's* bark was worse than its bite. The torpedo had failed to injure the armourclad. What had happened to the assailant? When the explosion took place every one on board thought they were going to be swamped. Overboard they went, headed by their commanding officer, who was eventually picked up by a Northern coal schooner. Another of her crew got on board the *Ironsides*. Tombs the engineer, looked round, and seeing that the *David* was still afloat, swam back to her and found the pilot, who was unable to swim, clinging to her gunwale. They both got on board and contrived to navigate her back to Charleston in safety, although a couple of Federal monitors had started in pursuit, aided by boats lowered by the *New Ironsides*.

The Confederates now determined to have a regular submarine boat with which an attack could be made actually under water. A craft of this kind was accordingly taken in hand by Captains Hunley and McClintock and built at New Orleans. Before they could get it away the city was taken by the Federals, whereupon its builders sank it lest it should fall into the hands of the enemy. Many years afterwards she was recovered intact.

Her constructors got away to Mobile, where they set to work on another submarine which was practically a replica of the first. She was 25 feet long, 5 feet wide, and 6 feet high. She was towed round to Fort Morgan *en route* to attack the blockading squadron off Charleston. Unluckily bad weather came on, and the new submarine foundered. Her crew escaped. Undeterred by such constant ill-luck, the Confederates got a third boat built at Mobile, whence she was brought




THE "NEW IRONSIDES" ATTACKED BY A CONFEDERATE "DAVID."

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overland to Charleston. This boat also bore a strong resemblance to Hunley's first submarine, but was 60 feet long, elliptical in transverse section, and carried a crew of nine men. Eight of these propelled the vessel by operating cranks on the screw shaft; the ninth was the pilot. The first idea was to take her below an enemy's ship, towing a mine behind her at such a depth below the surface that it would strike the vessel's bottom and explode on contact, but eventually she was fitted with a spar torpedo. There were no arrangements for renewing the air, so that with her comparatively large crew she could not expect to remain long under water. She was built of boiler iron, and ingress was obtained by a couple of circular manholes, or hatches, in the upper surface. In the next chapter we shall see how far she fulfilled the projects of her designers.

# CHAPTER IX

## 1864–1870

## CHAPTER IX

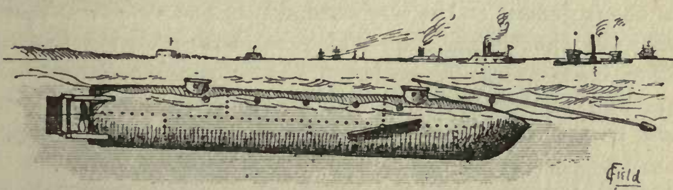
### 1864–1870

The Disastrous Trials of Hunley's *David*—Drowns Crew after Crew—Sinks the *Housatonic* and goes down with her—Herr Flach's submarine and her fate off Valparaiso.

THE new *David* proved herself to be a very deadly weapon—to her friends. Before she came in contact with the enemy she had drowned no less than thirty-five men. Her first commander was Lieutenant Paine, who took her out for a preliminary cruise off Charleston. She was in the awash position with her manholes open, with the result that she was swamped by the swell raised by a paddle steamer which passed close by without noticing the little submarine. Paine was looking out of one of the hatches and managed to escape, but his crew of eight went down in the boat and were all drowned. She was fished up and prepared for further trials. There seems to have been a great reluctance to try her actually under water, or even with her manholes closed, so that the same accident took place over again, the only difference being that she was swamped by a sudden squall instead of by the wash of a steamer. Again Paine escaped, and with him a couple of his men, who just managed to scramble out in time. Again she was brought to the surface, and again she capsized just off Fort Sumter, where she was lying at anchor. Three men escaped besides Lieutenant Paine, who does not seem to have been born to be drowned. Paine was about "full up" of the boat by this time, and no wonder! so that when she was raised a third time, he handed over the command to one of her constructors. A fourth crew of eight men was found for her, and brave fellows they must have been to adventure themselves in such a coffin. And a coffin she proved to them also. They took her up the Cooper River, where she foundered in deep water, drowning the whole nine of her occupants. The actual cause of this catastrophe is not clear. There was no one left to tell the tale.

It seems hardly credible that yet another crew should have been forthcoming for these deadly experiments with a boat that, so far, seems to have fully demonstrated her unseaworthiness, but she was once more brought to the surface, manned, and prepared to again tempt Providence. This time she varied her performances by fouling the cable of a ship at anchor. But the result was the same. Down she went like a tin pot. Seven of her crew lost their lives on this occasion. When she was got afloat again for the fifth time, the Confederates evidently came to the conclusion that as she did nothing but sink she might just as well sink alongside a torpedoed enemy. As a matter of fact this is what actually happened. There was a fine new Federal corvette, the *Housatonic*, lying outside the bar off Charleston harbour, and it was determined that she should be the object of attack. On this occasion the *David* went out short-handed. Besides Lieutenant Dixon of the 21st Infantry, who went in command, there were only Captain Carlson, another military officer, and five men on board. One can well imagine that by this time volunteers were inclined to fight shy of the vessel which had entombed so many fine seamen. However, on the night of February 17, 1864, she set out on her last voyage.

The Federals were aware that their opponents were experimenting somewhat largely with submarine vessels, and only a month before this the Minister for the Navy Department at Washington had written a special letter of warning to Vice-Admiral Dahlgren, who was in command of the blockading fleet off Charleston, telling him that he had information that the Confederates had become possessed of a new vessel so formidable that it was capable of destroying the whole of the ships under his orders. Descriptions of the various torpedo craft belonging to the Southerners in Charleston were enclosed, together with a set of suggestions as to the best way of parrying or defeating their attacks. The Admiral naturally considered that the ironclads lying inshore would be the most likely ships to be attacked, but he circulated a general warning to the whole of the ships employed on the blockade that they should take every precaution against being surprised, and should make every preparation to beat off a torpedo




THE BOAT THAT SANK THE "HOUSATONIC," 1864.

attack. The Confederates, on their part, calculated that the ships lying furthest outside would be hardly likely to apprehend attack, and therefore would be the easiest to surprise; and they therefore carried out the same manœuvre as they did in the case of the *New Ironsides*, and, getting the *David* over the bar, sent her round to attack the *Housatonic* from seaward.

The February nights were dark, and she got within a hundred yards of her objective before she was discovered by the officer of the watch on board the *Housatonic*, Lieutenant M. J. K. Crosby. It was the old story. Something was seen "like a plank floating in the water." It must be observed that even now, when actually carrying out an attack, and after all her previous disastrous experiences, the *David* was being navigated in an "awash" position and not under water, as she should have been. The fact is that the crew refused to have the hatches shut down.

It was a quarter to nine when she was discovered. The *Housatonic* at once beat to quarters, slipped her cables, and went astern. But there was no time to escape the impending blow. Two minutes after the *David* was discovered she was alongside. She was equipped with a spar torpedo loaded with a hundred pounds of powder, and as the *Housatonic's* guns could not be depressed sufficiently to touch her, Dixon was able to choose the exact spot where he considered his torpedo would be most effective. This was just forward of the mainmast on the starboard side in line with the magazine, of the situation of which he was probably aware. Then came a stunning explosion, the unfortunate *Housatonic* trembled all over as she lifted on the top of an immense wave, and immediately began to settle down stern foremost, heeling over to port as she sank.

And what of the *David*? We can imagine the tense feeling on board when, to the quiet wash and tinkle of the water along her thin coamings and the subdued murmur of her simple machinery as the crew hove round on the crank shaft, succeeded the loud roll of the *Housatonic's* drums, the shrill piping of her boatswains' whistles, the shouting and crackle of the rifle fire. There were no lights on board, all was pitch darkness save only where the open manholes showed two round patches of the dim night sky. The foremost one is obscured as Dixon, leaning out, brings the boat alongside the high sides of the enemy and seeks for her most vulnerable point. Then chaos and death. With the detonation of the torpedo came the inrush of water. Boat and crew were doomed and went to the bottom with their victim, the nose of the boat jammed in the hole the explosion had made. On board the sinking *Housatonic* all was confusion and panic. Captain Pickering, her commander, had been stunned and bruised by the concussion, and it was a case of every man for


THE SINKING OF THE "HOUSATONIC."

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himself. All hands made for the rigging as she sank, but some of the more self-possessed of the crew contrived to get one of the boats afloat and pulled off to the *Canandaigua*, which lay near by, in search of assistance. This was promptly rendered, so that, according to the report of Lieutenant Higginson, who was left in command of the *Housatonic* on the disablement of her captain, the whole crew was saved with the exception of Ensign Hazeltine, Mr. Muzzy, the captain's clerk, John Williams, a quartermaster, and Thomas Parker and John Welsh, seamen gunners. These five went down in the ill-fated ship.

The loss of the *Housatonic* naturally created a great sensation in the Federal fleet, and Admiral Dahlgren at once wrote to the Government to propose that a reward of £4,000 or even £6,000 should be offered for every *David* captured. Nothing seems to have come of this, but, on the other hand, no more of the Federal ships were destroyed by submarines so far as is known.

The late Admiral Hobart Pasha gives an account of an attack made by one of the cigar-shaped Confederate *Davids* which were described in the last chapter.[1] The name of the ship attacked does not appear. Very possibly it was the *Minnesota*, as it is said she was to have been attacked at the same time as the *New Ironsides*. If this should have been so, there must have been more than one *David* out on the warpath that evening. "I remember on one occasion during the war," writes the gallant Admiral, "when I was at Charleston, meeting in a coffee-room at that place a young naval officer (a Southerner) with whom I got into conversation. He told me that that night he was going to sink a Northern man-of-war which was blockading the port, and invited me to see him off. I accompanied him down to his cigar-boat, as he called it, and found that she was a vessel about 40 feet long, shaped like a cigar, on the bow of which was placed

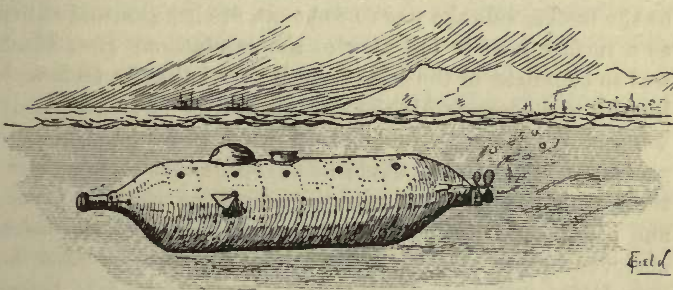
[1] Quoted by Mr. Herbert Fyfe in "Submarine Warfare."

a torpedo. On his stepping on board with his crew of four men, his boat was immersed till nothing but a small piece of funnel was visible. He moved off into the darkness at no great speed—say at about five miles an hour.

"The next evening, on visiting the coffee-house, I found my friend sitting quietly smoking his pipe. He told me that he had succeeded in making a hole in the frigate which he had attacked—which vessel could, in fact, be seen lying in shallow water some seven miles off, careened over to repair damages. But he said that, on the concussion made by firing the torpedo, the water had rushed in through the hatches of his boat and she had sunk to the bottom. All his men were drowned. He said he didn't know how he escaped himself, but he fancied that he came up through the hatches, as he found himself floating about, and swam on shore."

The Federals about this time again took in hand the subject of under-water attack; but, having apparently given up the submarime proper as a bad job, contented themselves with building three semi-submarine vessels which by the admission of water into ballast tanks could be brought to an awash position and so would present a smaller target to the enemy's guns. These vessels were the *Stromboli*, *Spuyten Duivel*, and *Keokuk*. The first two were fitted with torpedo apparatus, and the *Stromboli* was sent down to Hampton Roads in November 1864 for the express purpose of attempting to blow up the Confederate ironclads. She does not, however, appear to have damaged any of them. The *Keokuk* was merely a double-turreted monitor not carrying any torpedoes. These three ships will be described farther on in the chapter specially devoted to "Semi-Submarines."

The remainder of the 'sixties was not signalised by the production of many new types of submarine. The events of the War of Secession in America had not gone far to demonstrate either their practicability or their efficiency. Flach's submarine, which was constructed at Valparaiso in 1866, is of considerable interest. She was designed for the purpose of raising the blockade which was being carried out by the Spanish fleet, war having broken out between Spain and her former colonies, Chili and Peru. Her inventor and constructor, Herr Flach, was a German settled in Valparaiso, and he evinced the greatest confidence in his invention. The boat was made of sheet iron and was more or less cylindrical with cone-like ends sloping away more at the under part than the upper. She was 40 leet long with a diameter of 8 feet, and provided with twin screws. The only motive agency being



FLACH'S SUBMARINE, 1866.

hand power, her progress was necessarily slow—only three or four knots an hour. Inside the boat were four large cylinders containing compressed air, besides a smaller one charged with oxygen for purifying the foul air when necessary. She was provided with a series of detachable safety-weights, fourteen in number, which formed a kind of keel. She was so balanced that she only just floated, so that the turning of a couple of small horizontal fins was sufficient to make her dive. Her armament consisted of a small rifled gun mounted on deck for above-water use and a species of breech-loading mortar built into the bows firing a forty-pound projectile. Flach's scheme was to get close to the ship to be attacked and fire this gun into her bottom. This peculiar weapon was fitted with a species of cap which could be placed in position while the gun was being loaded and removed just before firing. The little cannon on the outside of the vessel had a kind of dish-cover, which fitted over it when the boat was going to dive.

Flach took her for several trips, probably above water only, and reported that she had proved herself entirely satisfactory. A public demonstration of her capabilities was determined on, the programme being that she should dive and cross the bay, which was about five miles wide, below water. On arriving at the farther side she was to come up, fire her gun, and return as a surface boat in full view of the spectators. Herr Flach was so confident in the safety of his vessel that he took with him on this occasion his son and six others. But everybody was not of the same opinion. A Yankee skipper who was present thought that it would be advisable that some connection should be established with the submarine when she dived, and attempted to make fast a line to her without being observed by her inventor. Flach, however, noticed what he was doing, and slashed it through with his knife just before getting down the hatchway, whither the other passengers had preceded him. He screwed fast the cover and the fatal voyage began. The boat's propellers were seen to revolve and she very slowly gathered way. Then her fins were turned downward and she slid below out of sight. The place where she was expected to emerge on the far side of the bay was watched eagerly hour after hour, but darkness fell without any signs of her. Then a rumour spread abroad that she had come up and was now on her way back to port. But the story soon proved to be false, and she was nowhere to be seen at daybreak. Nothing more was heard of her till a boat from H.M.S. *Leander*, which was lying in the bay, reported a continuous stream of bubbles coming up very near the spot where she had made her dive. The water was very deep here—nearly

27 fathoms—but she was located, and found to be jammed hard and fast in the mud, nose downwards. There is little doubt that as soon as she began to dive the heavy weight of the gun forward took charge and carried her right down, despite the feeble resistance offered by the little fins, which doubtless were turned upwards to counteract her too sudden descent. With great difficulty ropes were made fast to her, but they proved unequal to the strain of lifting her. It was then determined by the officers of the British warship who had undertaken the salving operations, to try and pass chain cables round her. But before this could be carried out a sudden summons arrived for the *Leander* to proceed instantly to Callao, where fighting was going on between the Spanish squadron and the forts and British interests might be in jeopardy. There was nothing for it but to obey the order, and the unfortunate submarine had to be left to its fate. There she lies with her cargo of corpses to this day.

One more submarine remains to be noticed before we quit the decade ending in 1869, if we except the semi-submarine iron-clad invented by Otto Vogel in that year, of which we will treat later. This is the boat that was designed by M. Alexandrowski, a Russian, and which was built at Winan's shipbuilding yard at St. Petersburg in 1868. It is stated to have had a displacement of no less than 600 tons, so that it must have been a very big affair for an under-water vessel. Other accounts say that her displacement was not above 300 tons. But as she was over 120 feet long, about 12 feet wide and more than 13 feet deep, she was of very considerable size at any rate. Her cross-section was like a triangle with curved sides, and she was propelled by a pair of screws driven by a compressed-air engine which gave her a speed of 6 knots. Her inventor carried out a good many trials in her with considerable success, including the blowing up the hull of an old ship with a spar torpedo. But the Russian Government could not make up its mind to purchase the boat, and in the meanwhile she dived too deep and was crushed. She was got up again; but her career as a submarine torpedo-boat was at an end, and henceforward she was relegated to the inglorious but useful duty of serving as a landing pontoon.

# CHAPTER X

1870–1888

# CHAPTER X

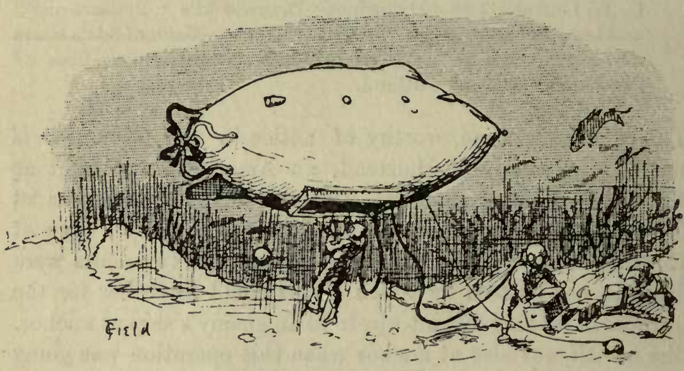
## 1870–1888

Halstead's *Intelligent Whale*—the first "Holland" boat—The Rev. G. W. Garret's two submarines—Drzewiecki's "Podascophe" and her successor—More "Holland" boats—Nordenfeldt's boats and their trials at Landskrona and Constantinople—Loss of *Nordenfeldt III* off Jutland.

THE first submarine worthy of notice in the 'seventies is the one invented by Halstead, an American, and built at Newark by General Hoxsey. This was in 1872.[1] She was 26 feet long and 9 feet deep, and was intended to carry a crew of 13 men. Her propeller was hand-driven, and two doors were fitted in her bottom by which divers could leave her for the purpose of making fast a torpedo to an enemy's ship at anchor. She herself was also at anchor when this operation was going on, so that it would appear that an attack could only be made when a hostile ship chose to lie in very shallow water—otherwise the diver would not be able to get at her. Great difficulty was experienced in getting a crew for her, till a General Sweeney induced two others to accompany him and took her down in 16 feet of water. The General then put on a diving costume and attached a torpedo to the bottom of a small vessel, which was blown up with great éclat. The United States Government then bought the boat and carried out another trial, which was a dead failure. Since that time the *Intelligent Whale* has become a "lion" in Brooklyn Navy Yard, where it is preserved as a relic for the delectation of sightseers.

[1] Her plans date from 1866.

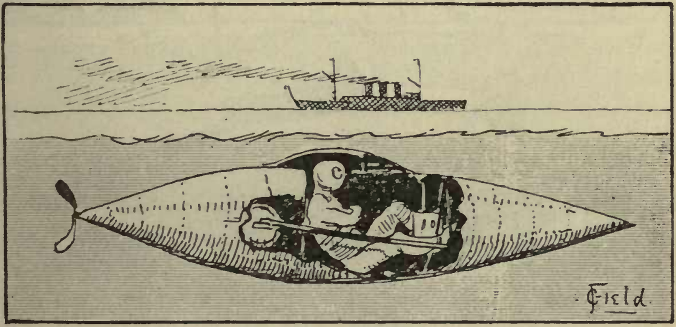
Three years later a very important submarine invention made its début. This boat is noteworthy not on account of its size or perfections, but because it was the first of the series of submarine craft invented by John P. Holland and the direct ancestor of the modern submarines in our own and the United States navies. The first *Holland* was a tiny affair with just enough room in it for one man to sit down amidships and work the pedals that turned the propeller. It was only 16 feet long, 2 feet deep, and 20 inches wide, and it is probably




THE "INTELLIGENT WHALE," 1872.

the very smallest submarine ever constructed. The "crew" had to wear a diving-dress and drew air from reservoirs at either end of the vessel. Five little torpedoes were carried, which could be put out through the dome and fired from a distance by electricity.

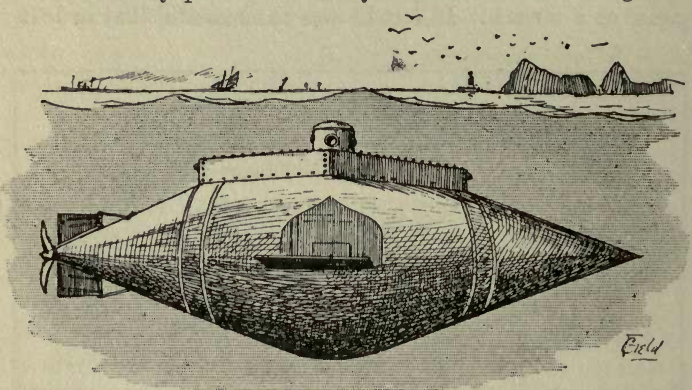
The Rev. George William Garret, an English clergyman, is responsible for the next boat we have to notice. It was built at Liverpool between 1876 and 1878 and patented in the latter year. It was 13 feet long and 5 feet in diameter, almost like an egg with very pointed ends. The propeller was turned by hand, and the boat brought to a balance between sinking and floating by letting water into tanks at the bottom. In this condition she could be raised or lowered by a very small addition or diminution of weight, which was effected by screwing a piston in or out of a cylinder whose outer end was covered with gauze to prevent any small objects in the water getting in and jamming the mechanism. The inventor carried out his experiments in a dock at Liverpool, and several times remained under water for a long period at a stretch. In fact he was so successful that in 1879




THE "HOLLAND I," 1875.

he had another and a larger boat built. This one was nearly 50 feet long, and sheathed amidships with thick timber. It was driven by a steam engine having an extraordinarily large boiler which occupied almost the whole of the central portion of the boat. Enough steam could be generated to carry the vessel a dozen miles after the furnaces and chimney had been sealed up preparatory to diving. There was a secret arrangement for keeping the air fresh which was attended to by the pilot in the conning-tower, and which amply sufficed for the other two men who formed the ship's company. Mr. Garret christened his new boat the *Resurgam*—quite a misnomer as it turned out, for she went down off the Welsh coast and never came up again.

At the same time that Garret was building his first boat a Russian rejoicing in the unpronounceable name of Drzewiecki was engaged on a very weird-looking submarine at Odessa. He called it a "Podascophe," and in shape it was not unlike a dish-cover on the top of a short cylinder with pointed ends. Like the *Holland No. I*, it was a one-man boat driven by pedals and was just about the same length—



GARRET'S "RESURGAM," 1879.
By favour of the *Engineer*.

16 feet. A couple of torpedoes fitted with rubber "suckers," to make them stick to the hull of the ship to be attacked, were carried outside and were put in position by means of long gloves protruding from the top of the boat as in one or two other submarines that we have already mentioned. The Russian Government considered the results of the trials of this vessel sufficiently encouraging to induce them to order a second and a larger boat from the inventor. This one was about 20 feet long, and was driven by pedals worked by the feet of four men seated back to back amidships with their heads in a species of conning-tower with thick glass scuttles all

round. The propeller could be turned up or down or sideways, so that it assisted either to dive or ascend as well as in the steering. Sliding weights at bow and stern also caused the vessel to direct her nose upwards or downwards. Like her predecessor she carried her torpedoes outside, but now they were placed in recesses in the upper part of the hull, before and abaft the conning-tower. Her trials, which were carried out in the Lake of Gatchina, were so satisfactory that it is said that the Russian Government ordered no less than fifty similar vessels to be built. Whether this is true seems extremely doubtful. Another boat with improvements, which we shall notice later, was built in 1881, but it is difficult to believe that the Russian Navy was ever in possession of a submarine fleet of this size. Some of them might have been useful in dealing with the Japanese squadron which blockaded Port Arthur for so long.

In 1877 Holland had built a second boat at New York. It was shorter than his first but fatter, being 10 feet long, 3½ feet wide, and three feet deep. Its screw was driven by a small gas engine, and the boat was experimented with for a long time on the Passiac River. The inventor was not pleased with this boat, and eventually took the machinery out of her and sank the hull under the Falls Bridge at Paterson.

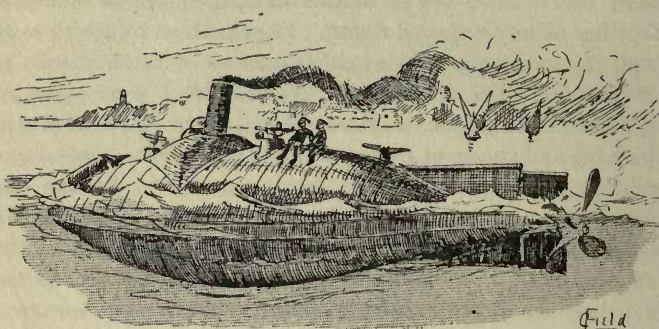
Two years later he started on a third submarine. It seems probable that this boat is one and the same with a submarine known as the *Fenian Ram* which appeared about this time. Mr. Holland, in an article in *Cassier's Magazine*, writes as follows : "Interest in submarine boats was again stimulated by the success of the *Fenian Ram* in the United States. This boat was so named by a facetious reporter who was annoyed because he could not get all the information he wanted. It was launched on the Hudson River in New York in April 1881. The experiments made with it threw a great deal of light on the subject of submarine work. It was proved that guiding the boat by direct vision when submerged was impracticable, that steering a straight course under water, although not regarded as a difficulty by any one up to that date, was a problem that must be solved before submarine warfare could be made practicable under modern conditions."

Now the *Holland No. III* was also launched at New York in 1881, and the inventor's longitudinal section of her is practically identical with that of the *Fenian Ram* with which he illustrates the above-quoted article. It is evident, too, that he had no difficulty in finding out about her internal construction, in spite of the secrecy complained of by the Yankee reporters. The *Holland III* was 31 feet long, 6 feet in diameter, and cigar-shaped. She had a displacement of 19 tons and was driven by a 15-h.p. oil engine. In her bow she carried a pneumatic gun 11 feet long, from which a 9-inch projectile could be driven in a straight line to a distance of 130 feet. A manhole for the egress and ingress of divers was fitted on her underside. This boat, after a series of very useful experiments, was also dismantled and left at New Haven.

As Holland did not produce another boat for some years, we must turn our attention to a series of submarine vessels that were produced by Nordenfeldt, the well-known Swedish machine-gun maker. The performances of Garret's boats seem to have drawn his attention to submarine navigation, and he undoubtedly had the aid of this gentleman's collaboration, though his name does not appear in the nomenclature of the Nordenfeldt boats.

The way in which the *Resurgam* could bottle up steam to work her engines after the fires were sealed up was doubtless one of the main points that appealed to Nordenfeldt, for he made use of a similar system in every one of his submarines. He began to study the question of submarine navigation, or it would be more correct to say brought out his first patent, in 1881, but it was not till 1885 that his first boat commenced her trials off Landskrona in Sweden. She was 64 feet long, 9 feet wide, and 11 feet deep, cigar-shaped and with a displacement of 60 tons. She was built of steel, with a glass dome amidships serving for a conning-tower. Her motive power was steam, and while at the surface her fires could be stoked in the ordinary way, the smoke being driven out through two channels leading out astern. When diving, the fires had to be sealed and reserve steam was used which was kept at high pressure in two special receptacles. She carried a crew of three men and sufficient air to last them for about six hours. Besides the propelling engine there were two others whose functions were to work a propeller placed horizontally on either side of the boat, which when set in motion compelled her to sink and kept her at any required depth. Should these refuse to work from any cause, the boat would at once come automatically to the surface. The trials of the *Norderfeldt I* were attended by a most distinguished audience including the Prince of Wales, the King and Queen of Denmark, and the Czarina. Naval and military officers from almost every country in Europe and from Japan and Brazil were also present. No submarine has had such a distinguished "send off" before or since. Her trials went off fairly well considering the bad weather of the first day, the damage to her rudders by fouling the tow rope by which she was attached to a steamer when coming out of harbour, and an accident to one of her stokers on the last day. She navigated at the surface at about four knots in the awash position, and went under water for a minute or two on several occasions. She was eventually purchased by the Greek Government, who carried out a further, and it is said successful, series of experiments in the Bay of Salamis. Although the Whitehead automobile torpedo had at this time been in use for a number of years, it is curious to note that the *Nordenfeldt I* was the first submarine vessel to be equipped with this weapon, which she fired from a tube fitted to her bows.

Nordenfeldt was not altogether satisfied with his first boat, and in 1887 two others were built at Chertsey, which were designed by him in conjunction with the Rev. W. Garret. Each of these was driven and built on very much the same principles as the former one, but the screws for immersion were placed at the top of the vessel instead of on either side. Her torpedo tube, too, was placed on the bow instead of inside, and she carried a couple of small Nordenfeldt machine guns on her deck for use at the surface. Mr. Garret and her engineer Mr. Lawrie went out with one of them to Constantinople to superintend her trials, which were much handicapped by the inefficiency of the Turkish crew. The published accounts of what may be called her début before the Sultan were



THE "NORDENFELDT II," 1887.

very promising, but later on she does not appear to have done so well. The following is an extract from a newspaper[1] of the period: "At 2.30 p.m. a loud murmur of admiration and surprise arose from the old bridge at Galata, heralding the approach of the *Nordenfeldt*. She came down the Golden Horn at a rapid rate, threading her way skilfully between the lighters and caiques that would persist in keeping their course in spite of the pilot launches, and shot the bridge without slackening speed—no easy feat considering the narrow width of the opening and the adverse set of the current which sweeps across it. Thousands of spectators were collected on the

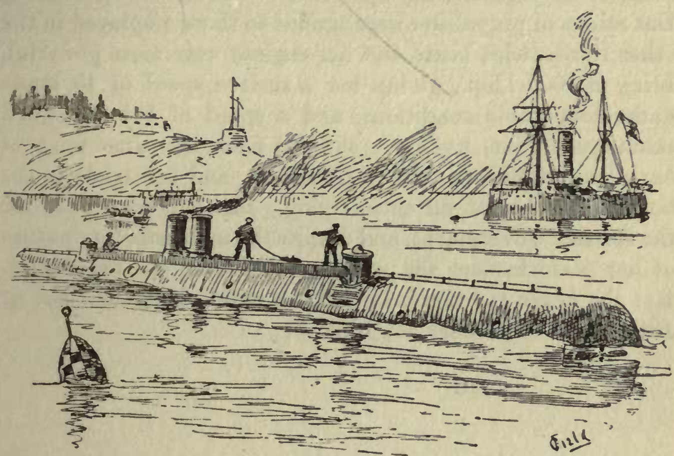
[1] *The Engineer.*

bridge, as also at Seraglio Point, and many others were afloat in caiques. It was amusing to hear the comments on her appearance. The 'whale-ship' was conferred upon her as a name by the general verdict, and it certainly seemed most apropos, as little was to be seen of her above water but the dome and upper part of the torpedo tube, which might easily have been taken in the distance for the hump and fin of some great denizen of the sea. In obedience to the orders of the Sultan, who himself directed the manœuvres from the shore, the boat lay for some quarter of an hour, in the very strength of the current, off Seraglio Point. She maintained her position with the greatest ease by a few turns of the screw, while the attendant launches found it impossible to stem it. While in this position she narrowly escaped serious injury owing to the traffic. A large lighter crossing the stream, and hugging the wind to save ground, passed too close and was struck by the screw. Fortunately she was empty, and so it was easy to get at the hole made in her bottom, and she reached the shore in safety. As for the *Nordenfeldt*, a few inches off the end of one of the blades was the only damage sustained.

"Being directed to attack a steamer lying off the Scutari shore, as a surface boat, the *Nordenfeldt*, turning in a little over her own length, darted across the current. End-on, very little was seen of her, and the eye once removed, she was not very readily discovered again in spite of the direction being known, on account of the absence of smoke and the very light colour of the outside painting. Even on the broadside there was little of the hull to be seen while running, on account of the screen formed by the bow wake. She seems to divide the water like a plough, throwing up a bank on either side, thus forming a furrow in which she would have run completely out of view but for the small chimney necessarily kept in place for the maintenance of combustion. As she neared the vessel two jets of water were suddenly thrown upward, to fall in showers of spray. This marked the moment of delivering her attack. The tube doors being thrown open for the release of the Whitehead, the water rushing in forces out the air through the vent holes at the rear, with the above-described effect. At that moment she looked more like a whale than ever, and might easily have been taken by the most knowing Greenlander for a big fish spouting.

"Returning to Seraglio Point, she was next directed to run as a surface boat against the current. In this trial for speed, her performance was a remarkable contrast to that of the attendant launches. Instead of keeping their position as pilots, they were soon left far behind. According to the revolutions and distance run in a given time, she did her eight knots over the ground against a current that was running but very little less than five. On her return from this run orders were given for a second attack to be made upon the steamer, on this occasion as a submarine boat. The vessel being at no great distance, she steamed slowly ahead so as to afford time for getting rid of the extra buoyancy, and closing up. Soon there was little to be seen of her but the hump-like dome, and having turned towards the enemy, it was very difficult to keep her in view. Suddenly she was lost sight of, to appear however shortly afterwards rounding the bow of the steamer from the other side. She had, as it were, dived to deliver her blow, and then turned off to avoid pursuit. No jet was thrown up on this occasion, the escaping air losing all force before reaching the surface. The Sultan expressed himself highly satisfied with the performance of the boat."

But quite another story was told when her official trials took place. It was found impossible to keep her in a horizontal position when below water for more than half a minute together. She had no horizontal stability whatever, and see-sawed up and down the whole time she was under water. The first time she tried her torpedoes was also the last, as her performances on this occasion were appalling. Directly her bows were lightened by the departure of the Whitehead, her stern plunged violently downwards. On another occasion she was all but swamped by the wash of a boat that came suddenly alongside as she was about to sink and had not finished closing the cover. Luckily Mr. Garret had his wits about him, and succeeded in making fast the hatch in spite of the inrush of water. She sank like a stone, but by blowing water out of her ballast tanks she was brought to the surface again. However, the Turks decided to buy the boat in spite of her disabilities, though it



THE "NORDENFELDT III," 1889.

was some time before the inventors could get the money out of them. As might have been expected, they made no use of her when they had got her. No engineers could be got for her, her crew deserted as fast as they were appointed to her, and she was left to rust away in the arsenal at Constantinople.

But Nordenfeldt made up his mind to build yet another and a still larger submarine. This one was built at Barrow-in-Furness and, fully equipped, had a displacement of 245 tons. She was quite a different shape from her predecessors. She was 125 feet long and 12 feet in diameter amidships. But here was the only portion of her that was round in section, as she got flatter and flatter forward and abaft till she ended in vertical knife-edges. Her deck and two conning-towers were covered with one-inch steel armour, which would have made her impervious to all machine guns of that period when running awash. Her horizontal propellers for immersion worked in recesses cut in the stem and stern. She had a crew of a captain, mate, two seamen, an engineer, his assistant, two firemen, and a cook. Her means of propulsion were similar to those employed in the other Nordenfeldt boats, but her engines were more powerful, being of 1000 i.h.p., giving her a surface speed of 15 knots under favourable conditions, and a speed of 5 knots when submerged. She, however, suffered from the same want of horizontal stability as her elder sisters, and her trials in the Solent were not at all encouraging. She had been built for the Russian Government, and despite the unsatisfactory nature of her performances she was despatched to St. Petersburg. But she never got there, as she was wrecked on the coast of Jutland on September 18, 1888.

## CHAPTER XI

1880-1890

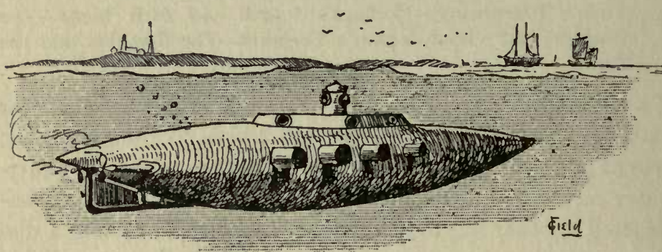
# CHAPTER XI

## 1880–1890

Progress of Submarine Invention during the 'eighties—Campbell and Ash's *Nautilus* and her trial at Tilbury Docks—Professor Tuck's *Peacemaker*—Holland's fourth and fifth boats—The Goubet boat—Waddington's *Porpoise*—The *Gymnote* and the *Peral.*

We have already mentioned an enormous submarine that was built by Alexandrowski in 1868, but which, like many others, proved an unsuccessful attempt to solve the problem of underwater navigation. Undeterred by failure, this inventor constructed another big under-water boat in 1881, having a displacement of no less than 460 tons. No details are available as to its peculiarities, but it is evident that it was little, if any, more successful than its predecessor, although it is said that the Director of Naval Construction at L'Orient, one of the French naval ports, spoke very highly of the project. The other Russian submarine designer, M. Drzewiecki, also returned to the charge in 1881 with a boat which, except for a few slight improvements, was a replica of his second one. And again three years later we find him responsible for yet another submarine, which also was very like the others except that pedal propulsion gave place to an electric motor supplied with electricity from accumulators ranged along the sides of the vessel. It only attained a speed of four knots, and when the Coast Defences were transferred from the Admiralty to the War Department in 1886, further experiments with submarines were abandoned for the time being.

Compared to France and the United States, England has produced very few inventors of submarine vessels. The Rev. G. W. Garret was, of course, a notable exception to this rule, and now we have to describe a submarine invented by two others of our fellow-countrymen, Messrs. Campbell and Ash. The *Nautilus*—a name very familiar to readers of Jules Verne's exciting romances—as she was called, attracted a considerable amount of attention in her day, though that day was a short one. She was built to the inventors' plans by Messrs. Wolseley & Lyon, and carried out



CAMPBELL AND ASH'S "NAUTILUS," 1884.

her trials in one of the docks at Tilbury in 1886. She was made of Siemens-Martin steel, was 60 feet long and 8 feet wide, and had a displacement of 50 tons. She was of the very usual cigar shape, although more curved below than above from a longitudinal point of view, and fitted with twin screws driven by electrical motors. The means provided for sinking and rising recall those of old William Bourne, the Elizabethan gunner, whose design for a submarine boat we have fully noticed.[1] Both boats effected this by an alteration in their volume—Bourne's by pushing in or out a portion of each side, and the Campbell and Ash boat pushing in or out four cylinders on each side. Drawn in, the volume of water displaced was

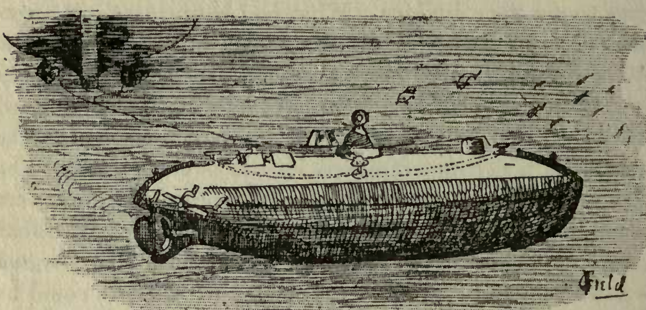
[1] *Vide* Chapter I.

decreased, when she would sink. Driven out again by screw gearing turned by the motors on board, the vessel's displacement was increased, and she came to the surface again. That was the theory, but, as will shortly be seen, it did not work very satisfactorily.

When her most important trial took place at Tilbury, she had several distinguished visitors on board, including Lord Charles Beresford and Sir William White, the well-known Naval Constructor. Down she sank right enough, but she remained below so long that the spectators on shore began to get very anxious. What had happened ? It afterwards transpired that there was a deal of soft mud in the bottom of the dock, into which the *Nautilus* settled comfortably down, with the result that her cylinders could not be pushed outboard. The mud offered too much resistance for the mechanism, which was designed for use in clear water. The air supply began to get short, and passengers and crew were beginning to lose hope, when Sir William White suggested that all hands should collect at one end of the boat. This caused the other end to lift clear of the mud, the cylinders could be pushed out and the boat came to the surface. The engineer, who had quite recovered any alarm he may have felt, was now full of confidence, and immediately opened the scuttle to shout to those on shore that they were going to make another descent. But most of those on board had had enough of the *Nautilus*, and " were not taking " any more experiments. They thought they would look better from terra firma. So the sanguine engineer was hauled down out of the hatch that he was blocking and there was a general exodus to the shore. The unlucky submarine got a bad name, and disappeared from public notice.

In 1884 Professor J. H. L. Tuck of San Francisco invented a submarine to which he the next year gave the somewhat suggestive name of the *Peacemaker*. He appears to have made over his owner's rights to the " Submarine Monitor Co."

of Fifth Avenue, New York, who built her from his designs. She was first constructed in such a way that her captain, wearing a diver's dress and helmet, stood in a kind of well amidships up to his waist, so that he had free use of his arms to steer the vessel and manipulate the torpedoes. There were two of these provided with cork floats, electro-magnets, and electric detonators. They were stowed on the upper part of the vessel and connected together. It was supposed that they could be released below the ship to be attacked, and



TUCK'S "PEACEMAKER," 1884.

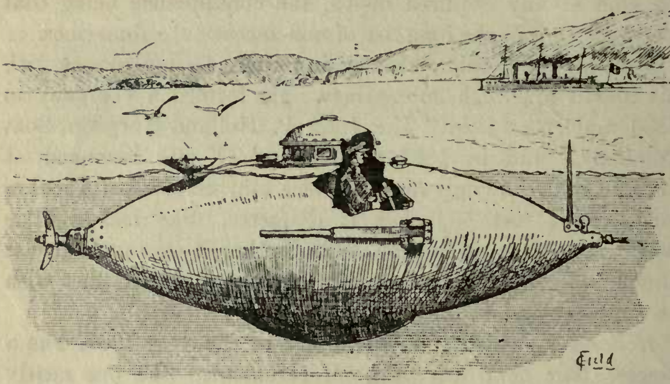
would float up and stick to her, one on either side of her keel, after which the boat would go to a safe distance and fire them by electricity. Eventually, in 1885, the idea of having the captain half outside the boat was given up, and a little dome substituted for the well in which he stood. He now was placed inside the boat with his head in the dome, which was protected from injury by a sort of comb or ridge running fore and aft of it. The boat was built of iron and steel, was 30 feet long, 7 feet 6 inches wide, and 6 feet deep. Not the least notable feature of the *Peacemaker* was the "fireless engine," an invention based on the discovery that a solution of caustic soda can be utilised under certain conditions to produce the heat necessary to generate steam. She dived and rose by the use of side rudders or deflectors placed at bow and stern, and was lightened or weighted by the admission or expulsion of water from her ballast tanks. According to some accounts she was fitted with a horizontal propeller to facilitate sinking and rising which was placed immediately under the centre of the boat, but as there are other palpable inaccuracies in these accounts it is probable that this was not the case. While the trials went off fairly well, they also proved that she could not be kept at any required depth, the consequence being that she went to join the long list of non-successful submarines.

Holland about this period again puts in an appearance with his fourth and fifth submarines. He formed a company in 1883 under the title "The John P. Holland Torpedo Boat Company," and in 1884 the *Holland IV* was launched at Jersey City. She only displaced one ton, was 16 feet 4 inches long, and 2 feet 4 inches in diameter. She had a little petrol motor for propulsion, but whether it or anything else about her was successful cannot be related, as she met with an accident and sank.

*Holland V*, which took the water in the year 1885, was a bigger affair than any of her forerunners. She was nearly 40 feet long and 7 feet in diameter. She also had a short life, coming to grief on the rocks. She was, however, refloated, and patched up sufficiently to be available for experiments in enclosed waters, docks, etc. She was to have been armed with a couple of the pneumatic guns invented by Lieutenant Zalinski of the United States Army, for throwing aerial torpedoes filled with heavy dynamite charges, and for this reason is generally referred to as the "Zalinski boat."

Again Holland suspended operations—at least publicly—for a considerable period, and in the meantime another French inventor attracted a great deal of attention. This was M. Goubet, who in 1885 patented a design for a little submarine which bore in many respects a strong resemblance to some of

Drzewiecki's productions. His first boat, a small affair of only a ton displacement, was completed and launched in 1887 and was tested at Toulon and Cherbourg. Its principal peculiarity was that instead of being built up, it was cast in a single piece of bronze. It was short and fat, just over 16 feet long, nearly 6 feet high, and a little over 3 feet wide. Its crew of two men sat back to back amidships, just as they did in Drzewiecki's boat. They did not, however, propel the boat, as this was done by an electric motor. The screw, being

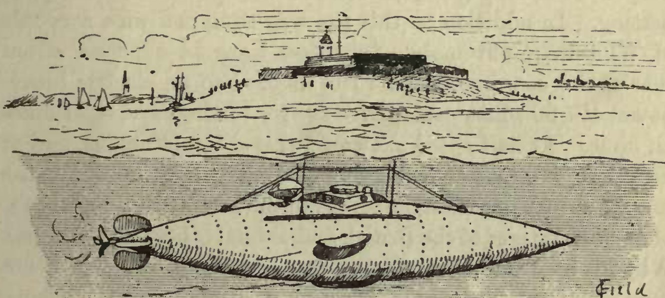


THE "GOUBET I," 1885.

fitted with a kind of ball-and-socket joint, could be turned in any direction, and so took the place of a rudder.

As armament the *Goubet I* carried a little torpedo fitted with spikes that, on being released, was supposed to float up and stick tight to the hull of an enemy, where it could be exploded at leisure. Her inventor carried out a number of trials and experiments with his little craft, but none of them were sufficiently convincing to induce the French Ministry of Marine to take it up. He produced a second and a larger submarine a few years later, of which anon.

Probably one of the most carefully-thought-out submarines was the *Porpoise*, an electrically propelled boat which was launched at Seacombe near Liverpool in the year 1886. Its inventor, Mr. J. F. Waddington, was a member of a ship-building firm, so that he had a considerable amount of scientific and technical knowledge to assist him in his designs. It was cigar-shaped, 6 feet in diameter at the centre, with a total over-all length of 37 feet. Like Nordenfeldt's boats, the *Porpoise* had horizontal propellers for assisting her to sink and rise again to the surface, but they were arranged in an entirely different way. They were not apparent, looking at the boat

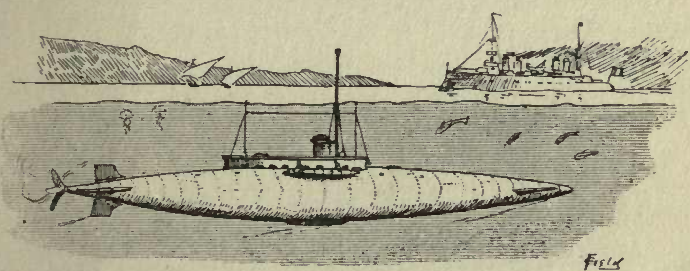


WADDINGTON'S "PORPOISE," 1885.

from the outside, because they were placed in two wells or tubes running right through the boat from top to bottom, one being aft and the other forward. Two propellers were placed in each well on the same shaft. Each pair had a little motor to drive them, so that the ends of the boat could be raised or lowered either together or independently.

To keep the vessel in a horizontal position whilst submerged, a pair of horizontal rudders were so fitted that they carried out their duty automatically. They were connected with an electro-motor having a worm gearing so contrived that when the vessel was on an even keel it remained stationary. The slightest cant upwards or downwards set it at work again, turning the rudders in such a way as to counteract the deviation. When corrected, it at once stopped running again. To further assist diving and rising, a pair of large inclinable side planes were fitted amidships worked by a lever and counterpoise, while in case of emergency the boat would at once come to the surface by the release of a heavy safety-weight placed immediately below the centre of the hull. Abaft her conning-tower, which was situated amidships, the *Porpoise* carried a torpedo or mine arranged to float up much like that carried in the *Goubet I.* This was intended for the purpose of attacking ships at anchor when protected by torpedo netting. In addition to this she was equipped with a couple of Whitehead automobile torpedoes hung in clips on either side of the conning-tower. The motor had an electric horse-power of 7·96 which could drive her for ten hours at eight miles an hour. At half speed she could travel for 110 miles, and at her most economical rate about 150 miles. Mr. Waddington carried out his experimental trials in the Mersey in the presence of representatives of the British and several other Governments. Why his boat was never adopted by any Naval Power it is not very easy to say. Possibly because the British naval authorities were against submarines *in toto* and because the French were at this time much taken with a boat designed by a fellow-countryman. Both the United States and the German Navies were at this time in a stationary and non-progressive position, while the Russians, as we have already seen, after experimenting pretty extensively with submarines, had abandoned them for the time being.

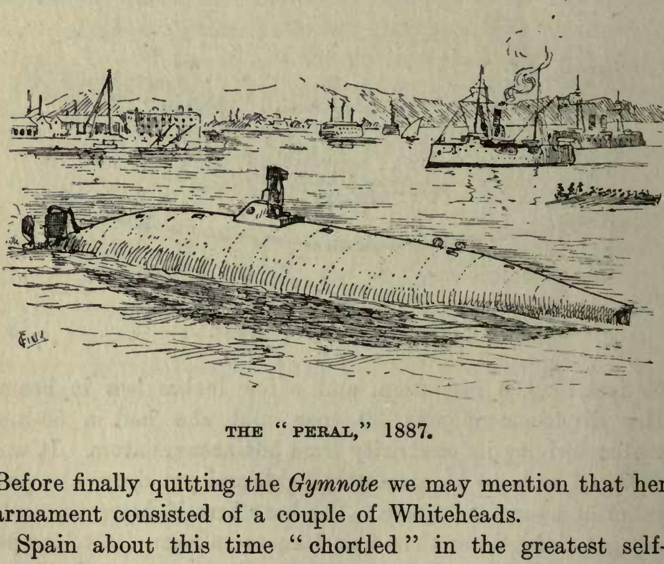
The French boat to which reference is made was the famous *Gymnote* of M. Gustave Zédé, which may be regarded as the immediate ancestor of the big flotilla of submarines which the French Navy now possesses. In any case she was the first submarine to appear on the Navy List. Her conception was due to M. Dupuy de Lôme, the celebrated engineer whose name is commemorated in that of a cruiser in the present Fleet of the Republic. But death prevented him from bringing his plans to their fruition, and they were eventually completed and presented to Admiral Aube, the Minister of Marine, by M. Gustave Zédé. This was in 1886; and as the design met with the Admiral's approval, the boat was taken in hand at once by the Société des Forges et Chantiers de la Méditerranée, her construction being closely supervised by M. Zédé and M. Romazzotti, then first-class Assistant Engineer of Marine. September 1888 saw her launched and afloat. The *Gymnote* was built of steel and was in the form of a cigar. She was



THE "GYMNOTE," 1888.

59 feet long, 6 feet deep, and a few inches less in beam. Her displacement was 30 tons and she had a 55-h.p. motor deriving its electricity from 564 accumulators. It was designed so as to be extremely light, and yet drove the propeller at an immense rate. The boat herself, however, could not get along faster than 6 or 7 knots an hour. A telescopic conning-tower was fitted for observation on the surface, and a periscope or optical tube for use when below. The *Gymnote*, when her tanks were so full that she barely floated, was driven under by means of planes that inclined the axis of the boat downward. According to *La Science Moderne* her trials at Toulon were so successful that "those present at these experiments could not conceal their real feelings, not being

able to believe in so perfect a result." But with all this perfection, no more boats were built exactly on her lines. The *Gymnote* nevertheless has proved a most useful experimental craft, and appeared on the French Navy List till quite recently. One experiment she found herself unable to carry out, and that was to take M. de la Porte, the Reporter of the French Naval Budget, below for a submarine trip in 1899. This gentleman was of such a Falstaffian figure that it was found impossible to get him down through her narrow hatchway.



THE "PERAL," 1887.

Before finally quitting the *Gymnote* we may mention that her armament consisted of a couple of Whiteheads.

Spain about this time "chortled" in the greatest self-satisfaction over a submarine invented by a naval lieutenant, Don Isaac Peral by name. This famous vessel, which was launched at the Arsenal of Caraca in 1887, was 70 feet long and 8 feet 6 inches in diameter, and of the usual cigar shape. She carried a torpedo tube in her bows, and was driven by a couple of 30-h.p. electric motors, each turning a single screw. There seems to have been no particularly

THE "DUMMY" SUBMARINE. A RECENT RUSE IN NAVAL WARFARE.

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By favour of the *Sphere*.

unique or novel feature about the *Peral* except an electric lamp for examining the bottom of the sea. Glowing accounts appeared of her trials, and so satisfied were the Spaniards with her capabilities that they saw in her the forerunner of a fleet of such vessels which would enable them to regain their former naval prestige. A public subscription was started to build them, but what became of the money is unknown. No more *Perals* were built, for it turned out that so far from being what was claimed for her, she was never able to get back to harbour but in tow of a tug. And this is the boat of which a Buenos Ayres journal of the period wrote that a squadron of them would "give absolute supremacy to Old Spain, who will impress her law upon all nations, humiliating the haughtiness and pride which were wont to swagger under the mask of a hypocritical humanity and, as insidious meddlers, to extend their dominions, increase their influence, and an odious supervision over feeble nations." Who can the writer have been referring to? Had the *Peral* been of the least use we may be sure the Spaniards would have endeavoured to make some trial of her against "Uncle Sam's" ships in the war with America, instead of leaving her rusting away at Cadiz. But her inventor scored heavily. Upon no designer of submarines has descended such a sudden shower of rewards. Lieutenant Peral was created a Marquis and presented with the handsome "indemnity" of 500,000 pesetas for his designs and labours. No doubt a large number of people would be glad to let any Government build a submarine for them at the same figure.

The *Peral* brings us to the end of the 'eighties, and at the same time to the last of what may be termed the experimental stages in the evolution of the submarine. Science had meanwhile made such forward strides that the inventors of the succeeding decade had their path very much smoothed for them and, although naturally a certain number of failures have to be recorded, the under-water torpedo-boat became a *fait accompli* and a submarine flotilla began to be built up in several of the most important of the world's navies. These boats, and even the latest types, may be, and doubtless are, some way off perfection, but nevertheless they have reached such a practical stage that they have been formally recognised as component parts of almost all modern navies.

# CHAPTER XII

1890–1900

## CHAPTER XII

### 1890–1900

Early German submarines—The Italian submarines *Pullino* and *Delfino*—Van Wittens' big submarine—The Famous *Gustav Zédé*, her trials and manœuvre exploits—The *Goubet II*—What a Descent is like—Fontés' submarines—Alvary Templo's "Aquapede"—Simon Lake's first attempt—the *Argonaut Junior*—More "Holland" submarines—The "Baker" boat.

Germany, with the sole exception of being the country in which Bauer's first boat was built, has not hitherto appeared at all in the story of the evolution of the submarine. For one thing she had been too busy fighting on shore, and later on consolidating her empire, to have much time to attend to matters nautical. But by 1890 she had the nucleus of a formidable fleet and fully intended to go further in the development of her sea-power, and in this year she began very quietly to experiment with submarine craft—so quietly that she contrived to keep the fact of her being possessed of a couple of these boats secret from the usually well-informed Austrian Marine Almanach and other publications of the same sort which give tables of the naval strength of the various Powers. Meanwhile she professed to laugh the "unterseeische boot" to scorn. The German experimental submarines were built at Kiel and Dantzig and are said to have been of the Nordenfeldt type which we have already described. They were biggish boats of 200 tons apiece, over a hundred feet long, and 11 or 12 feet in diameter. Moreover their speed both above and below water compared very favourably with that of other submarine craft that had been constructed up to date. These boats took part in the manœuvres of 1890, but their performances did not reach the English press. Another similar but smaller boat was built at Kiel the next year, but none of the three attained the degrees of perfection that the exacting German authorities demand for their fighting *matériel*. But though no more were built immediately, the question of under-water navigation was not lost sight of by the Kaiser's Admiralty, as we shall see later.

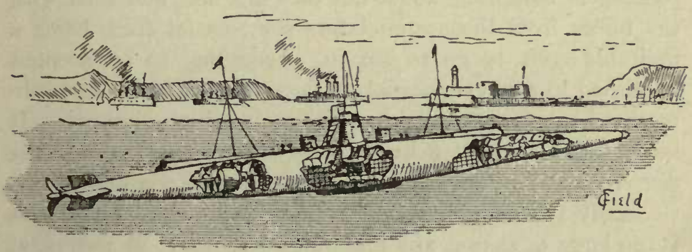
Italy, too, began to devote some attention to this branch of naval warfare, and in 1892 Pullino, a naval engineering constructor, built a submarine at Spezzia which is known by his name. The *Pullino* had a displacement of 15 tons and was about 40 feet long, drove herself below water by means of horizontal propellers like the Nordenfeldt boats, and generally carried out her trials with marked success. The results of the experiments with the *Pullino* emboldened the Italian Admiralty to improve her into a larger submarine of a similar type. This boat was named the *Delfino*, and was launched in 1894.[1] She was a very much larger vessel, costing £12,000 and having a displacement of over 100 tons. She, like her predecessor, was propelled by electrically driven engines, and beat all other submarines in under-water speed, as she is said to have kept up 10 knots an hour for a considerable period when submerged. She is fitted with a couple of torpedo tubes and carries an air supply sufficient for twelve men for eight hours.

In the same year that the *Pullino* was launched, a big cigar-shaped submarine is said to have been built according to the designs of Van Wittens, a Dutch shipowner in Newfoundland. Little is known about this vessel except that she was considerably over 200 feet long, carried 14 men, and was fitted with twin screws. She is said to have proved very

[1] Possibly the *Delfino* was merely the *Pullino* after improvements and alterations. *Vide* Chap. XIV., under heading "Italy."

successful under water, but what became of her cannot be ascertained.

In dealing with the next submarine we have to notice we are treading on much surer ground. This is the *Gustave Zédé*, whose plans were based on the data gained during the experiments with the *Gymnote*. The construction of the new boat, which it was intended to christen *La Sirène*, was entrusted to M. Gustave Zédé and M. Romazzotti, a naval constructor, and it was built in the Mourillon Yard at Toulon. But before it was ready for launching M. Zédé died, and to commemorate the important part the deceased engineer had played in the




THE "GUSTAVE ZÉDÉ," 1893.

evolution of the French submarines, the *Sirène's* name was changed to the *Gustave Zédé*. She took the water on June 1, 1893, and great things were expected of her by the experts. She was built of "Roma" bronze, which is not liable to corrosion by sea-water, and had a displacement of 270 tons. She is 160 feet long, with a beam of 12 feet 6 inches. Her propelling apparatus consists of a couple of electric engines of 360-h.p. apiece, supplied with electricity from a series of accumulators, which turned out to be very troublesome to the inmates of the boat. They began by nearly setting the boat on fire by "short-circuiting," and when this defect was remedied gave off such poisonous fumes that crew after crew suffered severely from their effects. The *Gustave Zédé*, while preserving the cigar-like shape of the *Gymnote*, was much longer in proportion to her breadth, while the upper part was flattened for a considerable portion of its length. She carried three 18-inch Whitehead torpedoes but only one tube to fire through, which was placed right in the bows.

Despite the experience gained in the *Gymnote* experiments, the designers of the *Gustave Zédé* soon found that she was far from fulfilling their expectations. Owing, very possibly, to her great length, the new submarine was not only horizontally unstable, but was very difficult to steer on account of the way she "yawed" violently from side to side. Her crew and passengers were flung about like dice in a box, and what with the fumes from the accumulators she was far from being a desirable craft to go to sea in. According to an account published in a naval journal at the end of 1894,[1] "The submarine boat *Gustave Zédé* has disappointed its admirers. It lately made trials at 8 knots, with several plunges, and the discovery was made that urgent modifications were necessary. Generally speaking, it seems to be established that the boat is too large to answer any real purpose in war. Moreover, at the moment of descent, its inclination is sometimes so great that the screw emerges, and, meeting with no resistance from the water, revolves with great rapidity. Under these circumstances, in the narrow space allotted to them it becomes very difficult for the men to preserve equilibrium, and the value of the boat as a fighting craft becomes very problematical. The greatest depth to which the *Zédé* has yet descended is 17 metres. The men on board have suffered from some affection of the mucous membrane of the throat, and a medical officer was instructed to report upon the matter."

At the surface, however, the *Zédé* appears to have proved a very respectable sea-boat, making several trips of considerable length in rough and choppy seas in a very creditable manner. Her designers were determined that she should be a success,

[1] *The Naval and Military Record.*

THE "GUSTAVE ZÉDÉ" AT AJACCIO.—See p. 153.

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however disheartening her early under-water performances might have been, and with the most admirable perseverance they went on making alteration after alteration, trial after trial, and improvement after improvement until she really began to approach their ideal, as the following account, translated from the *Temps*, of experiments carried out in 1901 (eight years, it must be remembered, since her launch) goes to prove. The "A" squadron of French battleships was lying at Ajaccio in Corsica, and the *Zédé* was told off to go and attack them. She left Marseilles without her departure being perceived by the pilots on the quays, and the following day arrived off Ajaccio just as the fleet was putting to sea. "The presence of the submarine," says the *Temps*, "was not suspected till a curious shock was felt" (on board the *Charles Martel*) "and a white furrow was perceived on the surface of the water. Then, a couple of hundred yards distant, a black cylinder, which was the optical tube of the submarine, was observed. This sudden and unexpected attack, which had been so cleverly carried out by Lieutenant Jobard, awakened a general enthusiasm. It came to the surface a few moments later, and, saluted by the lighter batteries of the *Jauréguiberry* and *Charles Martel*, it dived once more, but, in crossing the course of the *Jauréguiberry* too close to that battleship, exposed itself to certain destruction. The *Jauréguiberry* had to alter course to the left to avoid this." But the submarine was adjudged by the umpires to have been destroyed, as indeed she would have been.

Here we will leave the *Gustave Zédé*, the prototype of most of the modern French submarines, and turn our attention to a second boat constructed by M. Goubet, which, though never successful in getting adopted by any of the Naval Powers—unless we accept an extremely improbable story to the effect that 300 were ordered by the Russian Government [1]—had yet

[1] This probably is merely another adaptation of the "yarn" about the 50 Drzewiecki boats. *Vide* Chapter X.

very many points of interest about her. His first vessel was considered too small for practical torpedo work, and the inventor therefore decided upon building an improved and larger edition. The *Goubet II* was nearly 27 feet long and 7 feet in diameter, made of three bronze castings securely bolted together. Being much shorter than the *Zédé* and other spindle-shaped boats, she had little or no trouble as regards horizontal stability. What she was like inside is best shown by the following extracts from an account published in *Le Yacht.* "The interior aspect," says the writer, "is very attractive and very simple. It is all painted white and seats of varnished india-rubber, covering the accumulators, are placed to port and starboard. In the centre, close to the tube of the conning-tower, is placed a wheel by which the rudder is worked, or rather a steering-wheel by which the propeller is moved. The shaft of the screw is articulated with that of the motor by a 'Goubet joint' in such a manner as to allow of the boat performing evolutions in any direction. All about the dome are placed glasses, thanks to which one is able to inspect the horizon when at the surface. My position is forward. I am comfortably seated on a seat in the form of a horseshoe, and find within my reach: 1st, a pair of oars which are moved by turning a vertical axle, and of which the paddles fold up when coming forward for a stroke; 2nd, on either hand a cock for letting water into the ballast tanks; 3rd, at my feet two flywheels between which is a lever for working a double-ended suction-pump. In the stern, which is reserved for the engineer, is the motor, a large tank for water in case a sudden dive were a necessity, and an electrically worked rotary pump—a new apparatus applied for the first time in the *Goubet II*—for the purpose of maintaining the vessel at an even depth when in motion submerged. We will call it the 'automatic immersion regulator.' The entrance hatch is closed. We are going to submerge. The water-cocks on both the starboard and port sides are open. We can hear the water running into the ballast tanks, and yet the stability is in no way affected. The surface of the water mounts up the look-out glasses, the needle of the manometer is slowly rising. The top of the conning-tower is awash. The water-cocks are turned off. Immersion is complete, and we remain motionless in an equilibrium. The cocks are again open for a moment to allow of a glass of water to enter the tanks, and the new position of equilibrium is at 10 centimetres below the surface. This (the surface) divides the view of the optical tube pushed out above the dome in two equal lengths, just as in the cylinders of a telescope. The vision seen is very clear, and yet we are only showing a half of the prism which forms the top of the optical tube. It is about the size of a five-franc piece." [1]

Despite her stability, which was very much superior to that of any other submarine that had ever been invented—unless perhaps we may except Bushnell's "turtle"—despite a variety of fairly satisfactory trials, the French Government rejected *Goubet II.* It was said that her speed was too slow and that it was hard to maintain her at any particular depth below water. One reason which very probably influenced the authorities was that they had decided to put their money on the *Gustave Zédé*, and big boats of her type; and, as we have seen, they were at this time carrying out very extensive experiments with the *Zédé*, which they were determined to make a success. So the rival submarine was thrown over and her designer in disgust betook himself to England. Here he sold his invention outright for £4,000 and a third share of the profits to a syndicate who formed a company under the title of "The British Submarine Boat Company." The company, however, does not seem to have done anything to justify its existence. Anyway, in September 1902, the *Goubet II* was seized by the inventor's creditors as she lay in dock and sold.[2] She eventually became the property of a M. Maire, and it is

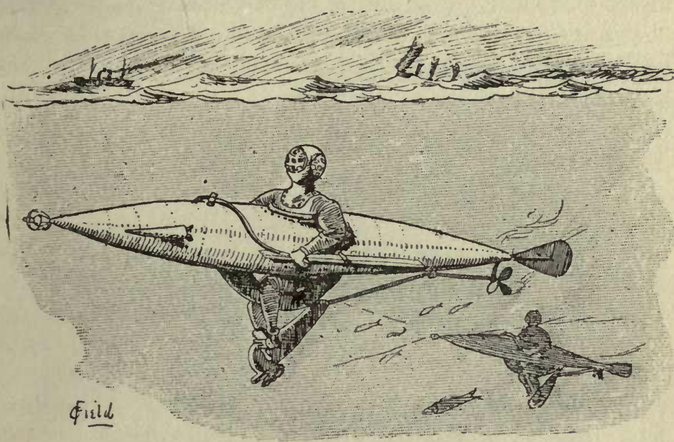
[1] As quoted by Mr. A. H. Burgoyne in "Submarine Navigation."
[2] Pesce, "La Navigation Sous-marine."

said that at the present time she is to be seen on the Lake of Geneva, where she takes tourists for under-water trips at a sovereign a time. The fare seems rather excessive for the run, —which is a short one—but a bonus is presented to the adventurous traveller in the shape of a life insurance policy for the journey. Goubet had one order for a couple of submarines for the Brazilian Government.

The inventor did not last long after his second boat was "sold up," as he died in January 1903. He was evidently not "one of the lucky ones." Had he been, and had his life been spared a few years longer, it is very probable that we should have heard a good deal more of the "Goubet" submarines, which, whatever their shortcomings, had some very excellent characteristics.

Before going on to describe the very successful submarines constructed by Mr. Simon Lake of Baltimore, we may note in passing that Lieutenant Fontes de Mello, of the Portuguese Navy, invented a submarine which was launched in 1890. It was not a very interesting craft, as it had no means of propulsion. Probably it was made merely for experimental purposes, to provide data for another submarine constructed from the designs of the same inventor which was launched in 1892. The *Plongeur*, as Fontes' second boat was called, had a displacement of 100 tons and was 72 feet long. She was tried at sea, and in the opinion of the Portuguese was much superior to any foreign submarine.

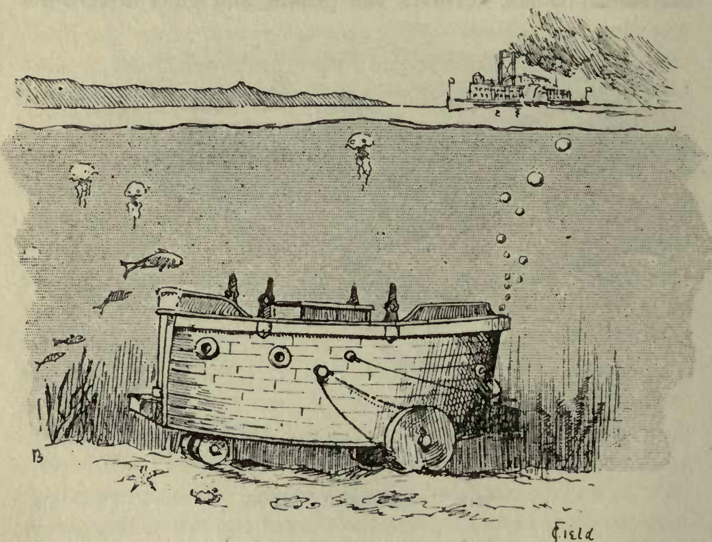
Another noteworthy, because curious, attempt to provide for under-water locomotion was the "Aquapede," or under-water cycle, invented by an American workman in Brooklyn, Alvary-Templo by name, in 1896. Imagine a huge cigar 16 feet long and 2 feet in diameter with an electric lamp at one end, propeller and rudder at the other, a frame underneath supporting a pair of bicycle pedals, and a big hole cut transversely through the middle from top to bottom. That may give some idea of the "Aquapede," which was actually built, and in which the inventor claimed to have made several enjoyable under-water trips. Clad in a diver's costume, he attached his india-rubber air-tubes to the air-chambers at either end of the cigar, and got through the central hole till he found himself seated on a species of saddle just below it, with his feet on the pedals. Seizing the bicycle handles placed in front of him, the voyager admits water into his ballast tanks, revolves the pedals, and gaily adventures



THE "AQUAPEDE," 1896.

into the depths below. But his example did not seem to bear fruit. The "Aquapede" has not yet become quite as common as the bicycle, though invented rather more than ten years ago.

But the queer little wooden submarine built by Alvary-Templo's fellow-countryman, Mr. Simon Lake, in 1894-5 was the precursor of a series of very successful submarine vessels. She was built of yellow pine timber, painted with coal tar, and was 14 feet long, $4\frac{1}{2}$ feet wide, and 5 feet high. She was a most unambitious boat, only hoping to be able to move along the bottom on three wooden wheels turned by hand-cranks within. She looked a cross between a dinghy and a box on wheels. She was not intended for warlike purposes, and is only mentioned here because she is the direct ancestor of the formidable *Protector* submarine, which we shall have occasion to describe farther on. Like her immediate successors *Argonaut I* and *Argonaut II*, the *Argonaut Junior*, as she has been termed, was primarily designed for salvage operations

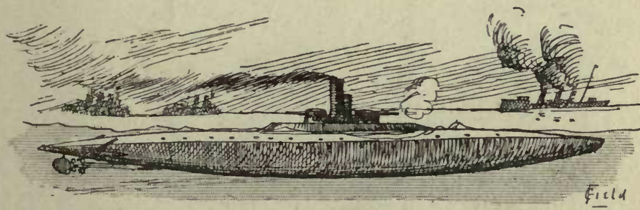


LAKE'S "ARGONAUT JUNIOR," 1895.

below water. Her function was to take down a diver to the place where his services were required. On arrival he was able to leave the boat through a specially contrived door or hatchway. This feature, as well as the wheels for moving on the sea-floor, have been retained in the later models which will be described in the chapter on Submarine Workers, and even in the *Protector*.

It is now necessary that we should return to Mr. John

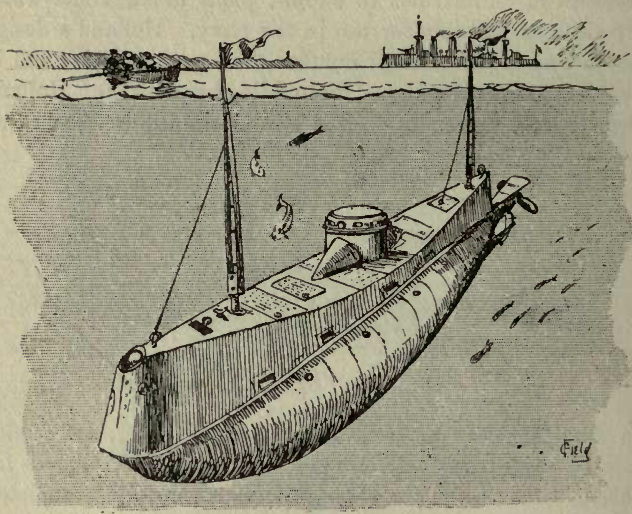
Holland, whom we last heard of in connection with the *Zalinsky*, or *Holland No. V*, in 1885. In 1892 he took out a patent for a vessel which he called the *Plunger*, but which never was built. But he utilised the plans of this, his sixth boat—of course with considerable modifications—for the construction of *Plunger II*, or *Holland No. VII*. This design was submitted to the United States Government in consequence of an invitation to the designers of submarines to submit plans of an under-water torpedo-boat suitable for use in the navy. Holland's design was chosen out of a large number that were sent in, and in 1895 the contract was signed for building her with the "Holland Torpedo Boat Company." She was an ambitious vessel of no




THE "HOLLAND VII" OR "PLUNGER," 1897.

less than 100 tons displacement and 85 feet long, fitted with three torpedo tubes and two steel-armoured gun turrets for fighting when at the surface. But before she was completed the Holland Company had so far advanced with another boat which they considered would be infinitely superior, that they suggested the abandonment of the *Plunger* in favour of their new design. They offered to refund the Government all expenses connected with the *Plunger II* if they would give them the contract to build them their *Holland VIII*. The Government, seeing that the Holland Company were ready to stake so much on their new idea, agreed to the proposal, and, accounts being squared up, the *Plunger* was abandoned, although she had actually been launched, and the *Holland VIII* was proceeded with.

This boat turned out after all to be more or less an experimental one, as eventually she was altered very considerably. She was a porpoise-like vessel 55 feet long, nearly 11 feet in diameter, and of 75 tons displacement. Her single propeller was driven by a gas engine when at the surface and by an electric motor when below, both being placed on the same shaft and connected or disconnected as required. She carried a



THE "HOLLAND VIII," 1902.

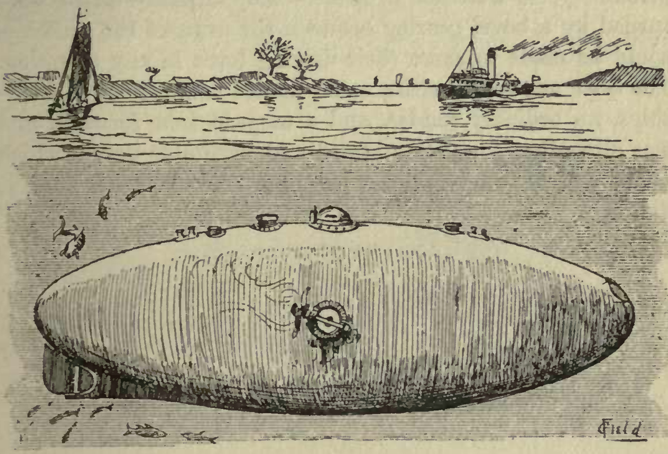
torpedo tube, a tube for throwing aerial torpedoes, and a submarine gun, the latter being placed aft and inclined upwards, as was the aerial torpedo tube forward. In attacking a ship, the *Holland* was intended to advance till near enough to use her aerial torpedo, containing 100 pounds of guncotton. Having fired this she would at once dive, go nearer, and fire her Whitehead. If this missed she would pass underneath her enemy, letting go her after submarine gun as she left her astern.


A SUBMARINE CAUGHT AT THE SURFACE BY DESTROYERS.

p. 160]

Altered and transformed into the *Holland IX*, she was purchased for the United States Navy, and of her we shall treat further in a later chapter.

Although Holland, as we have seen, was the successful competitor among those inventors—a considerable number, by the way—who had submitted plans of submarines in response to the invitation of the United States Government, he was run very close by Mr. G. C. Baker of Chicago, who not



THE "BAKER" BOAT, 1892.

only sent in designs but actually built a very excellent submarine. This boat, which carried out some very successful experiments in 1892, had some rather unique features, and is well worthy of a short description. To begin with, her inventor went back to wood in the construction of her hull, which in form was like an elongated and flattened egg. She was sheathed outside with thin steel. Her displacement was twenty tons, she was 46 feet long, 9 feet wide, and 13 feet deep. For surface work she had a steam-engine, which could also be utilised to charge the storage batteries with the electricity needed to propel her when under water. She was provided with two propellers, which were attached to her in a very ingenious way, so as to be utilised not only for propulsion either backwards or forwards, but also for ascent and descent. The short shaft on which each screw was placed was held in a species of fork or crutch placed on either side of the boat amidships. These crutches could be revolved by suitable machinery, so that the propellers they carried—which were turned by a bevel gearing between the arms of the crutch—could be made to exert their driving force in any direction. The boat was fitted with a small domed conning-tower amidships, an ordinary rudder, and a torpedo tube forward, and was altogether a well-considered and creditable design which might well have brought her inventor a better return than it did.

## CHAPTER XIII

### SUBMARINES OF TO-DAY

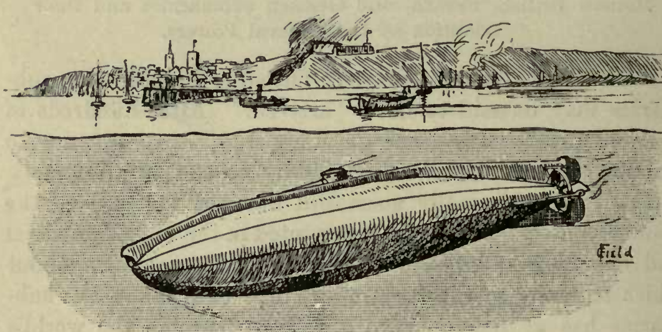
## CHAPTER XIII

### Submarines of To-day

**Modern British, French, and German submarines and their adoption by these Naval Powers.**

We have now reached a stage in our story in which the submarine may be said to have "arrived." After hundreds of years of experiments, some quite hopeless, others seeming to promise success, some ending fatally to the experimenters, others apparently really successful but not followed by the results which might have been expected in the way of practical and extensive adoption of the boats and apparatus about which so many satisfactory reports had been made, the submarine has at length taken a definite place in the world's navies. It will be impossible in the space at our disposal to continue the history of the development of the submarine on the same lines as we have so far followed, but a general account will be given of the types of submarine belonging to each of the Naval Powers, their numbers and characteristics.

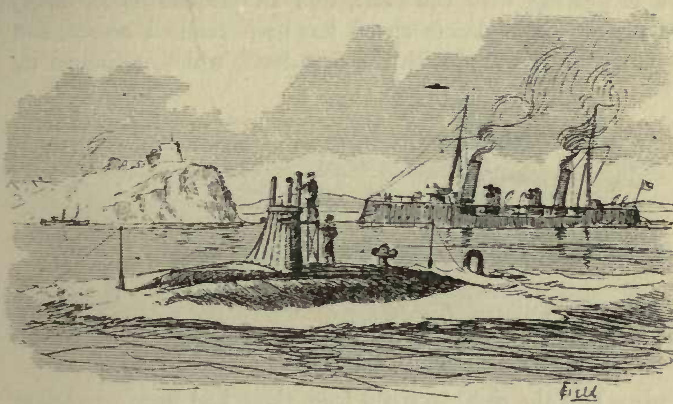
Great Britain.—Till a comparatively recent date both the Government and the people of this country had always been averse to the employment of submarine torpedo vessels. We have heard Lord St. Vincent's opinion with regard to Fulton's submarine, and for years afterwards these little vessels were wisely and consistently discouraged by the premier Naval Power, and when Foreign Powers began to experiment with them and even adopt them, they were stigmatised as being the "weapons of the weak." In 1900 the First Lord of the Admiralty, answering a question put to him in the House of Parliament, said that "the Admiralty had not designed a submarine boat, and did not propose to design one, because such a boat would be the *weapon of an inferior Power.* But he qualified this by saying, "But if it could be produced as a working article, the Power which possessed such an article would no longer be an inferior but a superior Power." The experiments made by the French in under-water attack and submarine navigation about this time, and the confidence they loudly proclaimed



THE "HOLLAND X."

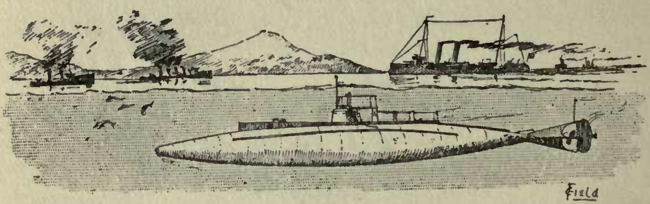
that they felt in the formidable nature of the submarine vessels they had built and that were under construction, awakened a certain amount of uneasiness in this country, and, urged on by the press and by various persons who made naval affairs their study, the Admiralty, having made their own inquiries into the matter, came to the conclusion that the Holland Torpedo Boat Company had turned out about as near an approach to "a working article" as was to be had, and ordered five of their submarine boats. The company had already constructed several of a more or less uniform type, while the French boats were all different and to a great extent experimental. The avowed object of the Admiralty in purchasing the five "Hollands" was to find out the best means of defeating the attacks of submarine vessels, and also by means of actual experiment to form an opinion of their own as to their real value. As several sets of submarines, each composed of larger boats than its predecessor, have been built and ordered since then, there can be little doubt as to what that opinion turned out to be.

The exact details of all British boats have been wisely and



A SUBMARINE OF THE "A" CLASS.

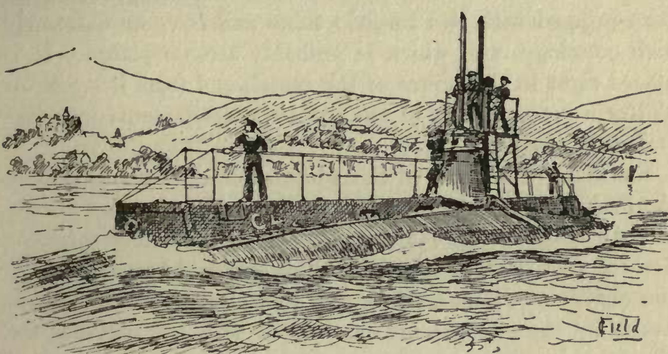
carefully preserved as a secret, but there is a consensus of opinion that the first five were practically identical with the six "Hollands" of the *Adder* class ordered for the United States Navy in June 1900. They had a displacement of 120 tons, were 63 feet 4 inches long, and 11 feet 9 inches wide. These perfected "Hollands" (*Holland X* type) were cigar-like to a certain extent, but their fatness in proportion to their length, combined with the alteration in their outline made by the addition of a shallow superstructure which came right down over the point of the bow, and the tail fins and rudders, gave them very much the appearance of a porpoise. They resembled these fish in another way, and that was the way in which they—as well as the later "Hollands"—put their noses down and plunged below. They were really "diving boats," and did not attempt to submerge themselves horizontally as did the "Nordenfeldts" and the Campbell and Ash boats, for instance. They have but one screw propeller, which is driven by a 190-h.p. gasoline engine when at the surface. When the boat is navigating under water, this engine is thrown out of gearing with the shaft, and an electric motor takes its place. Eight knots speed has been realised above, and 5 knots under water with the first boat, which, although its



A SUBMARINE OF THE "B" CLASS.

designs and the right to build from them had been purchased from the Holland Torpedo Boat Company, was actually constructed by Messrs. Vickers, Sons & Maxim at Barrow-in-Furness, where it was launched on November 2, 1901. Its four sisters were somewhat improved models, and were able to travel rather faster. The array of dynamite guns and aerial torpedoes which figured in some of the previous "Holland" experimental boats had disappeared, the only offensive weapon carried being a torpedo tube in the bow.

The original five "Hollands" were followed by four improved boats known as *A*1, *A*2, *A*3, and *A*4. These vessels, except *A*1, which was about 20 tons smaller, had a submerged displacement of about 200 tons, and while of rather less diameter than the earlier boats, were nearly forty feet longer. They are provided with 12-cylinder Wolseley petrol engines for use at the surface, and with electric motors for navigating below water. Thirteen of these boats were built in all, but the last nine were fifty feet longer than those which preceded them. All the " A " class have high conning-towers and are fitted with periscopes. It will be observed that the British submarines were losing their original porpoise-like form and approaching more nearly to the long spindle-shape favoured by the French designers. The next batch of sub-



A SUBMARINE OF THE " C " CLASS.

marines, the " B " class, eleven in number, are of very nearly the same dimensions as the later " A " boats, but they displace 300 tons of water as against the 200 tons displacement of the latter. To improve their seagoing qualities they have a comparatively high built-up platform running from the conning-tower to the bow. They are quicker divers than the " A " boats. The last of the " B " submarines were finished and in commission by the beginning of 1907. Meanwhile the Admiralty had determined on the construction of still larger under-water craft, and eleven boats, to be known as the " C " class, were ordered in 1905 and 1906. This number was eventually increased, and sixteen of these now appear in the Navy List. No. 18 has just been launched, and several others are under construction.

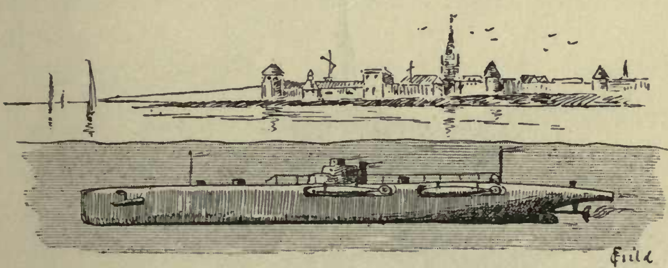
Thanks to the commendable secrecy which is preserved with regard to our newest types of war-vessels, full details of the "C" class of submarine are not available. It may be said, however, that while of about the same length as the latest "B" types, they have an increased displacement, speed, and range of action. At the surface they are able to travel at 14 knots, and below water their speed is proportionately good. They are equipped with two torpedo tubes and have an extremely high conning-tower, which is probably armour-plated. It is placed right in the centre of the vessel, and from it a narrow platform for use when at the surface extends some way fore and aft.[1]

France.—The story of the adoption of the submarine into the French Navy is by no means such a straightforward history as that we have just related. The British Admiralty having decided on a type, bought a batch of identical boats, and each successive set of submarines was the outcome of the lessons learnt by the experiments carried out with the previous set. The French, on the other hand, sought for perfection in various different directions, employing different designers and building a variety of types. Moreover, their submarine fleet is divided into two classes: submarines proper for home defence, and submersibles for offensive purposes. The difference between the two types may be shortly stated as follows: "The genuine submarine is a vessel built only for travelling beneath the

[1] According to the *Scientific American* of September 26th, 1908, the "D" class will be of an entirely different type. There will be no superstructure, it states, and the boat "comprises three structures built side by side, and forming one unit. Centrally placed is the submarine proper, conforming to the general elongated craft with tapered ends, but on either side, like outriggers, are placed two smaller cylindrical structures about half the length of the central section."

water; electricity stored in accumulators is the motive power, and the distance which can be covered is limited. The submersible torpedo-boat is constructed with a petrol or other engine for use when on the surface, and only at the last practicable moment, probably not until it has reached the scene of action, does it go under water; submerged, it is propelled, like its sister ship the genuine submarine, by electricity. Consequently the submersible has the far greater radius of action."[1] By this standard it will be seen that all the British boats belong to the last category.

As we have seen in a former chapter, the *Gustave Zédé*

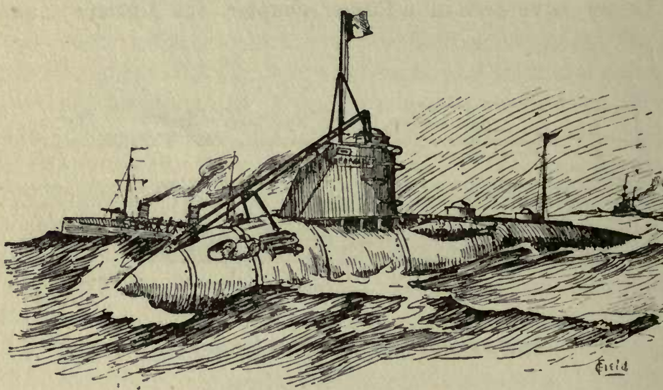


THE FRENCH SUBMERSIBLE "NARVAL."

turned out to be a somewhat disappointing boat, and her designer, M. Romazzotti, set to work to produce an improved copy. This was the *Morse*, launched at Cherbourg in 1899, after being some years under construction, thanks to various alterations in design and equipment which were considered to be improvements on what had originally been intended. The *Morse* was very like her predecessor, and was a genuine submarine of 146 tons displacement, 118 feet long, and 9 feet in diameter amidships. She carried a bow torpedo tube, and dropping gear on either side of the conning-tower.

[1] Mr. Archibald Hurd, "The Success of the Submarine."—*Nineteenth Century*.

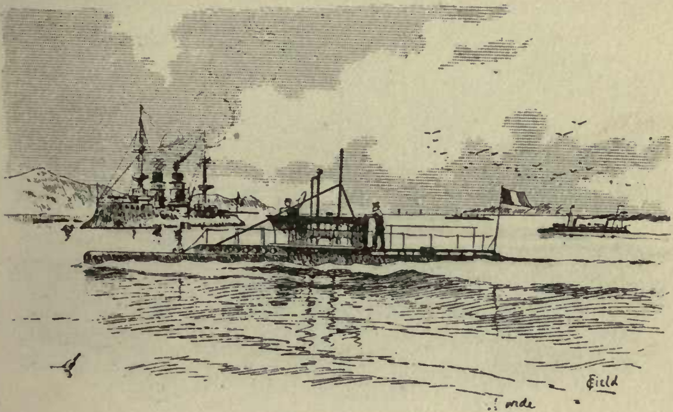
Her trials were productive of good results, but the Minister of Marine considered that a boat of the submersible type should now be constructed. But during the time she was being built, M. Lockroy, the famous French Minister of Marine, had instituted a competition in which prizes were offered for the best designs for submarine and submersible boats, and various appliances connected with them. The principal result of this competition was the building of the submersible *Narval* from the designs of M. Maxime Labeuf, Chief Naval Constructor at



THE FRENCH SUBMARINE "FARFADET."

Toulon. This vessel, which was completed in the year 1900, is a peculiar craft built like an ordinary torpedo-boat with a double skin, and is submerged by the admission of water into the space between the two skins. She has a displacement of 106 tons, and is not cylindrical in shape like the *Morse* and most other submarines. Her upper works being flat, form a deck, and the conning-tower, funnel, and periscope project above this, giving her at a distance a novel and peculiar appearance. At the surface she is driven by a triple-expansion steam-engine whose furnaces burn petroleum fuel, but when under water she has recourse to an electro-motor. She carries four Whiteheads in recesses at the edges of her upper deck, and these can be swung outwards and set going by special apparatus contrived by M. Drzewiecki. The principal drawback discovered in the *Narval* in the course of her trials was the time taken to effect submergence. This has been improved in later models.

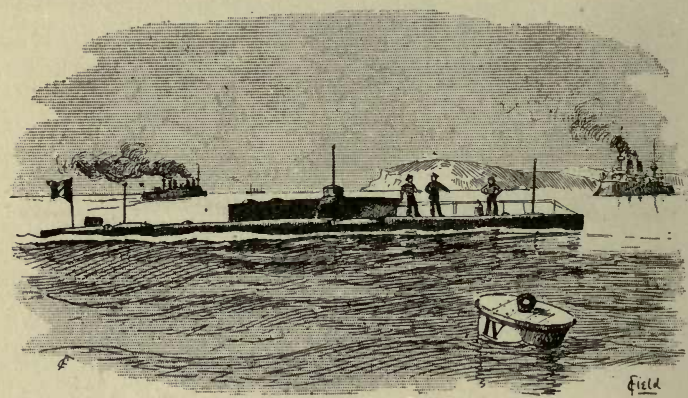
Following the *Narval* came four 185-ton submarines of what is known as the *Farfadet* type, designed by M. Maugas, driven entirely by electricity. They are adaptations of the Romaz-



THE FRENCH SUBMARINE "BONITE."

zotti class of boat, but differ a good deal in appearance as their conning-tower is very far forward. Almost simultaneously the *Français* and *Algérien*, which were paid for out of a public subscription opened by the *Matin* at the time of the Fashoda "incident," were completed. They may be regarded as improved *Morses*. In 1902 two improved *Narvals* were finished, called the *Triton* and the *Sirène*, these being followed by *Silure*, *Aigrette*, *Espadon*, and *Cigogne*, also *Narvals*, but of course with various improvements suggested by experiments with the older boats of the same class. Between 1904 and 1905 twenty small 68-ton boats, really little *Gustave Zédés* with certain minor improvements, were completed. These are known as the *Perle* class, and are provided with a benzol motor for use at the surface and an electric one for use below. They have a surface speed of 8 knots, which falls to 4 or 5 when submerged, and carry one torpedo tube apiece. They can well be called "microbes de la mer."

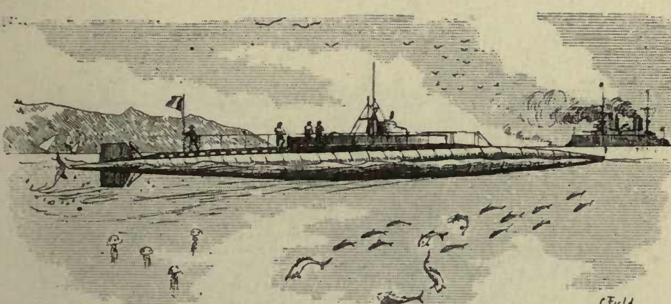
After this big batch of submarines comes an era of experimental boats again, the "X" designed by M. Romazzotti,




THE FRENCH SUBMARINE "ALGÉRIEN."

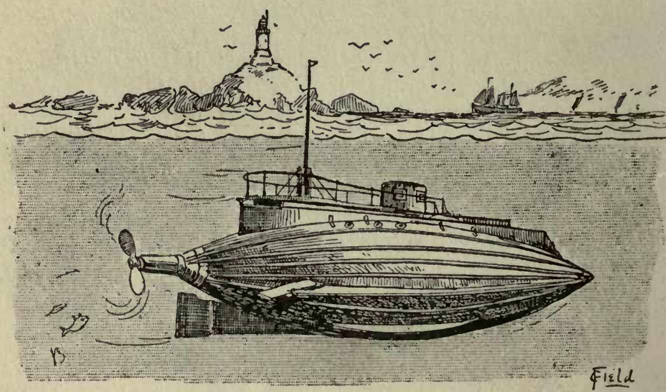
the "Y" by M. Bertin, a retired naval constructor, the "Z" by M. Maugas, and the *Oméga* by M. Bertin. The "X" is of 168 tons displacement, 128 feet long, using a petrol engine at the surface; the "Y" of 213 tons, 144 feet long, using compressed air engines; the "Z" of 202 tons, 136 feet long, with paraffin engines; and the *Oméga* of 301 tons, 160 feet long, having steam as her motive power when above water. All these four are of greater tonnage when submerged, and in this condition are propelled by electricity carried in accumulators.

The most promising of the boats seems to have been the *Oméga.* In 1903 six improved and larger boats of somewhat the same description, known as the *Émeraude* class, were begun. They are big affairs 147 feet long with a displacement of 400 tons apiece at the surface. They have eight-cylinder petrol engines, and, of course, accumulators for driving the electric motors used when submerged. They carry a complement of 22 men. Another pair of boats somewhat similar to the *Farfadets*, known as the *Guêpe* class, were begun at Cherbourg in 1904 and launched three



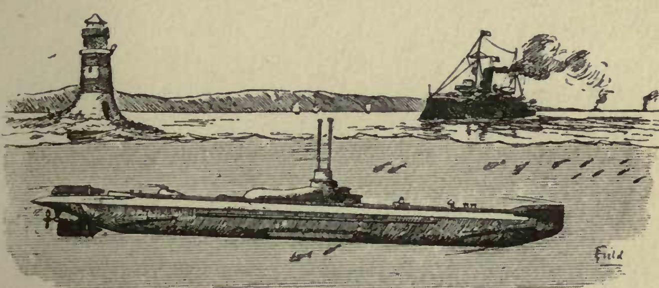
THE FRENCH SUBMARINE "VENTOSE."

years later. Their principal designer is M. Petithomme, a naval constructor, who also is responsible for two very large boats of about 400 tons displacement which were begun at the same port in the same year, but their construction has been suspended. M. Labeuf, the designer of the *Narval*, is responsible for two more boats which were to be built in 1904. These are the *Circe* and *Calypso*, also large 350-ton submersibles, while towards the end of 1905 eighteen still larger boats designed by him were commenced at the various dockyards, several of which have now been completed. Before quitting our brief notice of France's submarine fleet we may just mention that the Marquis de Dion, the well-known constructor of automobiles, has designed a little boat something after the style of the "Goubets," which is intended to be carried on board ship. This little submarine has a displacement of 21 tons only, so it must be quite a diminutive affair as submarines now go. Finally we have to record that a boat invented by a M. Thuau —which seems to be almost an exact copy of the *Goubet* (externally at any rate)—went through what are said to have been very successful trials at Saint-Malo in September 1904; but here her achievements would appear to have stopped short, as we hear no more of her.




GERMAN "HOWALT" SUBMARINE.

Germany.—This country, as we have seen, has made a belated appearance in the sphere of submarine construction. We have noticed the two boats of the "Nordenfeldt" type with which she carried out her early and secret experiments, and now we find her slowly going ahead again in 1901 with a little submarine built by Messrs. Howalt of Kiel. She was not quite 50 feet long, with a little over six feet beam. She was electrically propelled, and fitted with a single torpedo tube at the extreme bow of her cigar-like hull. She was tried, but with very mediocre results, in 1902. The Germans, always watching the progress of British naval affairs, now considered that they might do worse than follow our example in experimenting with the "Holland" type. One of these, of 120 tons displacement, said to very much resemble our own early "Hollands," was launched at Kiel in 1902, and has since been experimented with, though, of course, the Germans have not allowed any of her performances to leak out. They then set to work and built a still larger boat, 128 feet long, and with 180 tons displacement. No particulars as to her launch or trials are procurable, but it is certain that she was a boat of



THE "D'EQUEVILLEY" OR "GERMANIA" SUBMARINE.

a new class designed by a Spanish engineer of the name of d'Equevilley. This vessel, which in form is not very unlike an ordinary torpedo-boat, was built from his designs in the Germania Yard at Kiel, and was followed by three similar ones. D'Equevilley had previously built a similar boat at this yard for the Russian Government, and it is probable that her trials so favourably impressed the German naval critics that they determined to try the type for themselves. The new boat is said to contain some very striking improvements in submarine navigation, but few, if any, details are available. Four additional ones are to be ready by the end of 1909.

As Germany is also said to have placed an order for four

"Lake" submarines at Baltimore, it is evident that though "last," she does not intend to be "least" among the Great Powers in the race for submarine predominance. These boats will doubtless be improved *Protectors* similar to those ordered by the Russian Government.[1]

[1] *Vide* p. 184, Chapter XIV., for description.

# CHAPTER XIV

## SUBMARINES OF TO-DAY (*continued*).

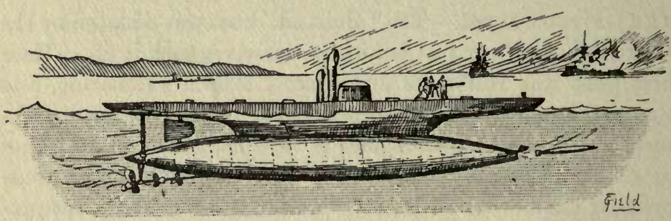
# CHAPTER XIV

## SUBMARINES OF TO-DAY (*continued*)

**The submarines of the United States, Russian, Italian, Japanese and some minor Navies.**

THE UNITED STATES.—The "Holland" boat was adopted by the United States Navy just before we ourselves took it up. Their first boat was Holland's ninth experimental submarine, and was purchased by the Government for 150,000 dollars. Submerged she has a displacement of 74 tons, is 53 feet 10 inches long, and 11 feet in diameter. She is fitted with petrol four-cylinder engines for surface work, and uses electricity for propulsion when below water. In other respects she is very much like *Holland No. VIII* described in Chapter XII.

Seven "Hollands" of the *Adder* type, practically identical with our first five submarines, followed, and then their designer built a very similar trial vessel with which to carry out further experiments on his own account. She was called the *Fulton*, and in the autumn of 1901 this boat, with seven officers and men on board, remained at the bottom of Peconie Bay for fifteen hours without renewing her air supply even from the flasks of compressed air taken down for the purpose. During all this time a perfect gale was raging at the surface. Her diving qualities were so satisfactory that it is said she could plunge quickly enough to avoid a shell fired at not too close a range. He followed up the *Fulton* by the *Plunger*, a very similar vessel which differs in appearance from other "Hollands" on account of having a queer cupola-like conning-tower quite different from those of her elder sisters. But while carefully watching these experimental boats and at the same time carrying out extensive trials with one of Simon Lake's *Protectors*,[1] the United States Government ordered the construction of four peculiar "semi-submersibles" invented by Mr. Clarence C. Burger. The well-known French naval journal *Le Yacht* claims that M. Drzewiecki had a hand in this design, but this is probably a mistake. Burger's boat has practically two hulls. Underneath and well out of harm's way is the cigar-shaped submarine, containing engines, accumulators, and torpedoes, while above, and connected only by a species of




BURGER'S SEMI-SUBMARINE.

hollow keel and the armoured conning-tower, is a flat hull packed with cellulose, minutely subdivided into small water-tight compartments, and very difficult to hit or destroy. The torpedo tube is right forward in the lower hull; the three propellers—all on one shaft—are placed below the after end, while the rudder is pivoted between the upper and lower portions of the vessel. A considerable speed is expected to be realised by these queer craft.

Another extremely small submarine, the invention of Mr. T. J. Moriarty, a mechanical expert in Government employ, is also said to have been experimented with. It is only 10 feet long, 3 feet deep, and 5 feet wide. It seems

[1] A special board of officers reported favourably on this boat in 1904 and recommended that five should be purchased.

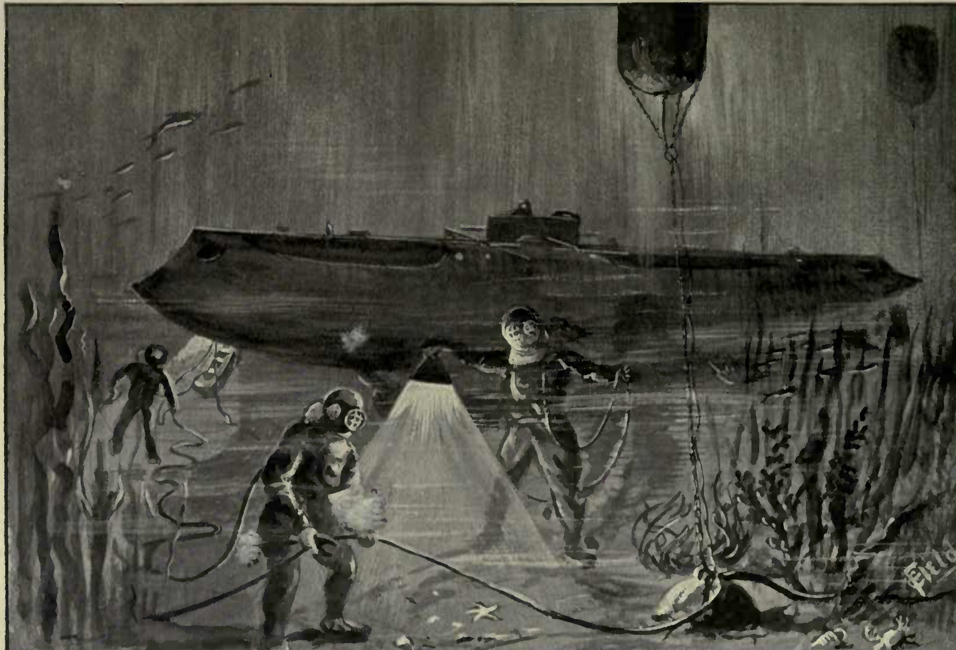
not very unlike Holland's first boat, and, like that little submarine, is propelled by pedalling. Judging by the general tendency of submarines to increase in size as more is learnt about their capabilities and requirements in the long course of experiments which have been carried out in Europe and America, it does not appear likely that this microbe will displace the submarine monsters already built.

Finally we must not omit to mention the *Octopus* and *Cuttlefish*, two big submarines which were launched at Quincey, Massachusetts, about the end of last year. Absolute secrecy is being maintained as to their interior arrangements, but externally they bear a strong resemblance to the "Holland" boats. The American spread-eagle press claims for them that they are the largest submarines in the world; but this is absurdly incorrect, as the *Octopus*, the bigger of the two, is only 106 feet long with a displacement of 278 tons, while the other is but 80 feet 6 inches long with a displacement of 170 tons only. Two others of the *Cuttlefish* class are said to be under construction as well as one of the Lake *Protectors*, eight others of this type being projected.

Russia.—It is impossible to give any very accurate and succinct account of the rise of the Russian submarine flotilla as, owing doubtless to strict censorship on the part of the authorities, very little reliable information seems to have leaked out. The consequence is that no two authorities are in anything like agreement. As an instance, one well-known publication gives the submarine *Forel* as a Lake boat of the *Protector* class. Another authority says that the *Forel* is a sister boat to the *Petr Kotcha*, quite a different type; while according to a French Service journal the *Forel* is the name given to the first of the d'Equevilley boats built at Kiel for the Russian Government.

One thing is certain, and that is that the Russian Admiralty have had a leaning towards submarine warfare ever since the Crimean War, and as we have seen in some earlier chapters, have experimented rather largely with submarine boats from time to time. Not with any great amount of success, however, for the Russian, except on a few occasions when he has been commanded by English or Scots officers, has always proved a poor sailor-man. It is therefore quite natural that he should not shine in submarine navigation, which requires care, nerve, and quickness of resource in a very high degree. Several modern submarines were available in the Far East at the time of the war with Japan, but the navy made no use of them whatever, and probably spoilt more than one. At the present time Russia appears to have a considerable number of submarines of one sort and another, as will be seen by the list in Appendix II. The best of these are probably the d'Equevilley boats, some of which are described under the heading of "Germany." Then there are said to be half a dozen "Hollands" which ought to be effective vessels, and lastly, but by no means least, the Russian Navy is in possession of a number of the very successful Lake boats of the *Protector* class, including the original *Protector* herself.

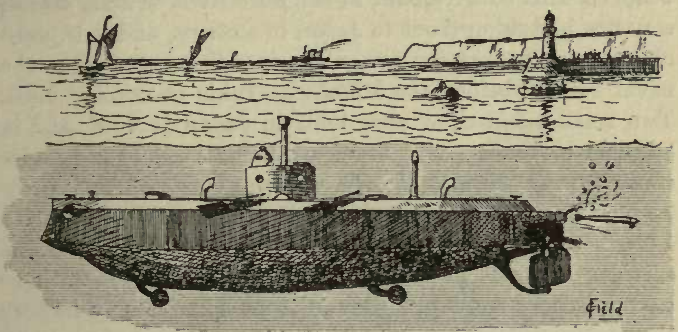
This type of boat, which has recently been considerably improved, has probably a great future before it. Direct descendants of the *Argonaut*, they possess advantages which are practically unique. They can not only swim but travel along the bottom on wheels. The crew need not fear being buried alive, like the unfortunates in the *Lutin* when she foundered off Biserta, because ingress and egress when under water is perfectly practicable and easy. The *Protectors*, instead of being cigar-shaped like most submarines, are very much the same shape as an ordinary ship's hull with a ram bow (some of the Russian boats have a straight cutwater). The original *Protector* is about 70 feet long, 11 feet beam, and has a submerged displacement of 170 tons. She has a flat upper deck, in the centre of which rises an elliptical conning-tower with perpendicular walls of bronze, above which rises an armoured sighting hood. The motive power is furnished




DIVERS FROM A MODERN "LAKE" SUBMARINE CUTTING MINE CABLES.—See p. 185.

p. 184]

by gasoline engines actuating twin screws when running awash or at the surface, and by means of storage batteries when submerged; 11 knots has been realised when in the former position and seven when under water. Tanks of air under high compression can supply enough air for six men for sixty hours. The *Protector* is armed with three torpedo tubes, one aft and one on either bow, firing 18-inch Whiteheads. Like several other submarines, when about to dive she obtains an equilibrium in the water by filling ballast tanks with

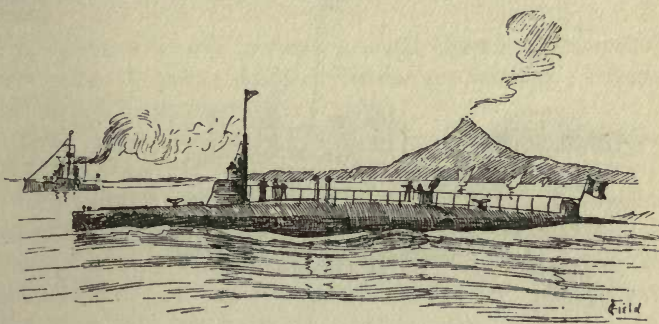


THE RUSSIAN SUBMARINE "OSSETYR" (*ex* "PROTECTOR").

water, and then overcomes her reserve buoyancy by using "hydroplanes," which in her case are situated amidships at the edge of the upper deck. A unique feature of the *Protector* is that she is able to travel on the sea-floor, being equipped with two large steel wheels which are fitted on the keel line, one in advance of the other, and which may be raised or lowered at will by means of hydraulic pistons. The propellers continue to push the vessel forward when she is resting upon her wheels just as they do when she is water-borne. When raised, the wheels fold back into recesses in the bottom of the ship. Right forward she has a diving compartment which allows divers to enter and leave her below water, and from which the bottom can be examined through a thick sheet of glass.

Japan.—As we know that Russia had at least a few submarines in the Far East at the time of the Japanese War, and it was also reported that Japan obtained five of the "Holland" type from the United States about that period, it seems strange that we should have heard absolutely nothing of any attempt to make an offensive use of them by either one side or the other. However, there it is. The five Japanese boats referred to were built at the Fore River Works, Massachusetts, and shipped out to Japan in sections, and it is probable that these were the five submarines that appeared at the naval review before the Mikado at Tokio in October 1905. Two small submarines were built in Japan in 1906, and in addition to these, six or seven newer submarines are under construction, two of which have been completed at Barrow by Messrs. Vickers, Sons & Maxim and been shipped out to Japan. These are big vessels of over 300 tons displacement carrying a couple of torpedo tubes apiece, and intended to have a surface speed of 14 knots an hour. We may be sure that, having adopted the submarine torpedo-boat, Japan will not rest till her submarine flotilla is as formidable in proportion as the rest of her fine fleet; in fact it has been stated that she hopes to have no less than 50 effective submarines by 1915.

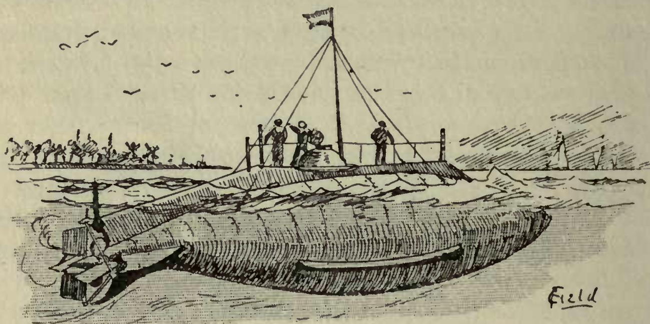
Italy.—We have already referred to the *Pullino* or *Delfino*, an Italian submarine launched in 1892 and improved in 1894. The *Italia Militaire e Marina* of 1904, however, referred to it as a new vessel which had only completed her trials at Spezzia on August 30 in that year. The hull of this *Delfino* is constructed of steel plates and is in the form of a cigar. Her displacement varies, according to her immersion, from 95 to 107 tons. Her engines are worked solely by electricity furnished by 300 accumulators. She has three propellers: one aft for movement ahead or astern, and the other two above for the work of submersion and bringing her to the surface again. The *Tritone* is another smaller Italian submarine invented by Captain Ferrari, a naval officer, and launched at Spezzia in 1902. She is nearly 59 feet long, has a single screw, and has a speed of 8 knots above and 5 below water. She carries a crew of five men. Further details of her construction are not obtainable. But the most important Italian submarines are the set of five *Glaucos*, invented by M. Cesare Laurenti, constructed between 1903 and 1905. These boats, which were built at Venice, are fitted



THE ITALIAN SUBMARINE "NARVALO."

with F.I.A.T. petrol twelve-cylinder engines for surface work, which are said to drive them at 14 knots an hour. Below-water propulsion is by electricity, the rate of progress falling to 9·9 knots. They each carry a single torpedo tube. There is a boat, the *Foca*, just launched which will have a displacement of 175 to 220 tons, be 130 feet long, and have a speed—it is hoped—of 15 knots.

Sweden.—This country has a couple of submarines, but one only—the *Hajen*—is supposed to belong to the Royal Navy. This vessel, built at Stockholm in 1904, is a boat of a modified "Holland" type. She is of about 120 tons displacement, steams 10 knots above and 7 below water. She has the now usual petrol engines and electric accumulators, carries one torpedo tube and a crew of six men. The other submarine to which reference has been made is built from the designs of Herr Enroth, and appears to be, generally speaking, a modernised "Nordenfeldt." The inventor claims that she will steam at 12 knots above and only half a knot less below water. She is a biggish vessel of over 140 tons displacement, 82 feet long with a beam of 14 feet. She carries torpedo tubes both at bow and stern. Two improved *Hajens* are projected.



THE DUTCH SUBMARINE "LUCTOR ET EMERGO."

AUSTRIA has two submarines building at Barrow, probably "Hollands," four *Protectors* in her own dockyards, and three "d'Equevilley" boats at Kiel.

NORWAY.—The Norwegian Navy only possesses one submarine at present, which is a "Holland," probably of the *Fulton* type. She does not intend to rest content with this single specimen, as Admiral Borresen has demanded of Parliament a considerable sum for further submarine construction, and both a F.I.A.T. and a "d'Equevilley" boat are ordered.

HOLLAND.—Holland, like Norway, has only one submarine. This is the *Luctor et Emergo*, a "Holland" boat, probably of the *Plunger* type.

PORTUGAL.—In addition to the *Plongeur* already mentioned,[1] Portugal is experimenting with another submarine, the *Fontes III*, designed by the same naval officer—Lieutenant Fontes—who is responsible for the earlier boat.

SPAIN has the *Peral*, probably not now of any use at all.

BRAZIL has two "Goubet" boats, the *Mello Marques* and *Jacinto Gomez.* Launched about 1903, they have a displacement of about 25 tons and are said to have a speed of 6 knots when on the surface. It is reported that the Brazilian Government are about to purchase five of the "Holland" boats.

ARGENTINA is said to have a small electrically propelled submarine of native design. Details are wanting. Several "Hollands" are projected.

CHILI also is reported to have a small electric submarine under construction. Its name is the *Urzua Curat.*

This concludes the enumeration of the submarine flotillas belonging to the navies of the present day. No mention is made of Turkey and Greece which, as we have seen, used to be in possession of "Nordenfeldt" submarines. If they have these now, they can be worth nothing more than scrap-iron. The nations that have not been noticed have as yet evinced no tendency to build up a submarine squadron. They prefer to await further developments in under-water navigation and warfare.

[1] *Vide* Chapter XII.

# CHAPTER XV

## Submarine Weapons

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## SUBMARINE WEAPONS

Automatic Submarines—The Whitehead torpedo—The "Schwartzkopf" torpedo—The Howell, Peck, Hall and Berdan torpedoes—Brennan's Wire-controlled torpedo—Other similar devices—The Orling-Armstrong "Actinaut" torpedo and "Armorl" boat.

"A TORPEDO may be defined as an explosive case, which may be fired either automatically by concussion, or at the will of the user, and which is stationary under water or travels through the water. Some travelling torpedoes are moved by being towed, others by the working of independent machinery concealed within them, others by being carried at a boat's bow, or pushed; and yet others by a controlling power worked from the shore or from some other fixed station." [1]

This definition of the various types of torpedoes, written some years ago, is a very good and concise one, but nowadays those which are stationary are generally called mines, those which were "pushed"—that is to say, spar-torpedoes—are practically obsolete, and the word "torpedo" is now generally understood to refer only to those which "travel through the water."

Such torpedoes, to all intents and purposes, are small automatic or semi-automatic submarine boats, without a pilot or crew, and as such may be considered to come within

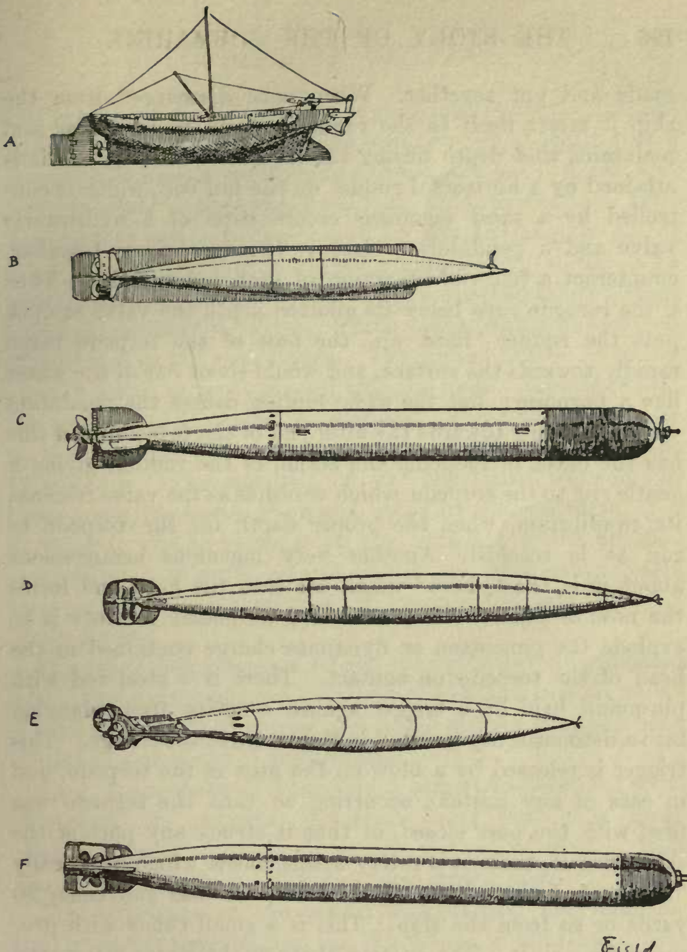
[1] "All About the Royal Navy," p. 55. Laird Clowes.

the range of our subject. In any case they are so intimately connected with it, as being the only weapons carried by modern submarine vessels, that some description of their various types cannot but be of interest.

By far the most important is the Whitehead Automobile Torpedo, from its efficiency and from its almost universal adoption. Mr. Whitehead was an English civil engineer settled in Austria. There is nothing to show that he had ever given any attention to torpedo warfare before he was consulted by a certain Captain Lupuis with reference to an idea which he had for a species of fireship or surface torpedo. This was in 1864. The proposed weapon was a crude affair, much like an ordinary small boat in shape, its propeller driven by clockwork, and its steering effected by means of ropes from the shore. The forepart was to be filled with powder which was to be exploded by a pistol whose trigger was connected with small vertical and horizontal spars which protruded from the bow and would come in contact with the side of the ship to be attacked. The idea was a very rough and ready one, not of much value in itself; but it set Mr. Whitehead's brain to work, and in two years he produced his first fish-torpedo. From this point Lupuis and his fireship go out of the story, but there is no doubt that this was the germ from which has been evolved the automobile torpedo of to-day with its wonderful mechanism, long range, and heavy charge of high explosive. Whitehead's first torpedo was made of boiler-plate, carried 18 lb. of dynamite, and had a speed of 6 knots for a very short distance. Compare this with the latest type in use in our Navy, which has a speed of 35 knots for 1000 yards, is efficacious at 3000, and carries a charge of about 200 lb. of guncotton.[1]

"This torpedo is a wonderful piece of mechanism, beautifully

[1] With the compressed air which drives it, heated by the new apparatus which has been invented for the purpose, it is capable of a speed of 43 knots for 1000 yards and 30 for 4000.




**AUTOMATIC TORQEDOES.**

A. Lupuis' Automatic Fireship, 1864, from which the first Whitehead was evolved.
B. Early Whitehead, 1870. Speed, 8 knots. Range, 400 yards. Charge, 76 lb. Guncotton.
C. Modern Whitehead (18-inch). Speed, 35 knots for 1000 yards; 20 knots for 4000. With Heated Air, 43 knots for 1000 yards, 30 knots for 4000. Charge, 200 lb. explosive.
D. Modern "Schwartzkopf" (18-inch). Speed about 32 knots. Range, 3000 yards. Charge, 210 lb. explosive.
E. Howell Torpedo (13·3-inch). Speed, 24 knots for 600 yards. Range, 1000 yards. Charge, 70 lb. explosive.
F. Bliss-Leavitt Torpedo (21-inch). Speed, 36 knots for 1200 yards; 28 knots for 3500 yards. Turbine engines. Charge, 133 lb. explosive.

made and put together. When once discharged from the ship it steers itself to the required depth under water and maintains that depth during the time it is running. This is attained by a horizontal rudder on the tail end, which is controlled by a most ingenious combination of a hydrostatic valve and a pendulum weight. These, working together, counteract a too violent action of each individually. Thus if the torpedo runs below its allotted depth the valve at once puts the rudder 'hard up,' the nose of the torpedo turns rapidly towards the surface, and would shoot out of the water like a porpoise; but the same motion causes the pendulum weight to swing towards the after end of the torpedo, and this has the effect of reducing the action of the rudder, giving a gentle rise to the torpedo, which vanishes as the valve resumes its equilibrium, when the proper depth for the torpedo to run at is reached. Another very ingenious arrangement about it is the 'pistol' which fits into the head and forms the nose or point. When attacking an enemy its duty is to explode the guncotton or dynamite charge contained in the head of the torpedo on contact. There is a steel rod with pin-point, held by a trigger against a spring from plunging into a detonator cap inserted in the centre of the charge. This trigger is released by a blow on the nose of the torpedo, and in case of any mistake occurring so that the torpedo was fired with the port closed, or that it struck any part of the ship firing it, there is a safety arrangement which practically 'half-cocks' the pistol till the torpedo has run some 30 yards or so from the ship. This is a small collar with propeller fans on it. The motion through the water causes the fans to turn and so works the collar off to the danger position." [1]

British torpedoes are in addition fitted with a net-cutting apparatus so as to be able to go through the steel nets which a ship at anchor may use to protect herself from their attack.

[1] Lieutenant Fenton, R.N., in "Navy and Army Illustrated," vol. vi. p. 188.

The propellers of a Whitehead are close together at the extreme end of the torpedo, the outer one being on a shaft which passes through the hollow one to which the inner one is affixed, and both revolve in opposite directions at a tremendous rate. The motive power is compresed air and the engines are of the "brotherhood" type, three cylinders being placed at an equal distance apart like the spokes of a wheel and their pistons working towards the centre. These will probably be replaced by turbines in the near future. The United States Navy has already begun to provide itself with the huge "Bliss-Leavitt" fish-torpedoes, 21 inches in diameter, which are driven by turbine engines and can maintain a speed of 36 knots for 1200 yards. The accuracy of the Whitehead torpedo has been much improved of recent years by the adoption of a gyroscope, which, running at the immense speed of 2200 revolutions a minute, greatly assists the hydrostatic valve and pendulum in their work of keeping the weapon on a direct course.

The latest improvement which is now being experimented with, is an arrangement for heating the compressed air which is used to drive the engines, and which greatly increases both the speed and range of the torpedo.

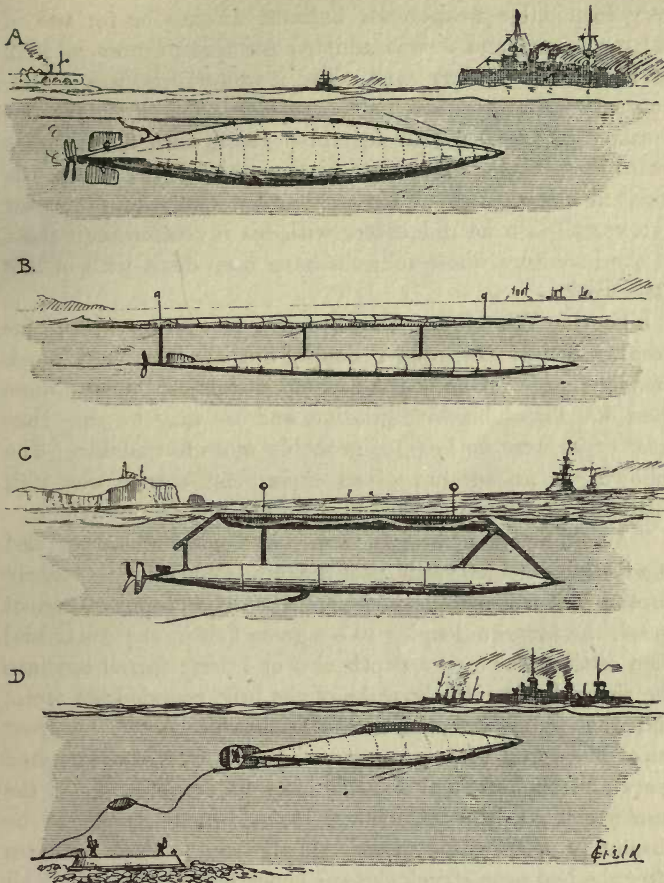
The "Schwartzkopf"[1] torpedo is almost identical with the Whitehead, its principal difference being that it is made almost entirely of phoshpor-bronze instead of steel. It is used by the German Navy and some minor ones.

The Americans at one period thought that they had got hold of an improvement on the Whitehead in the Howell fish-torpedo, which is propelled by setting a heavy flywheel in motion which gears directly on to the shafts of two twin screws, one on either side of the rudder. The range claimed for this torpedo was 1000 yards, which was more than that of the Whitehead at this period; but 500 was about as much as could be depended upon, and the rival torpedo has since made such

[1] *i.e.* "Black head."

gigantic strides in efficiency that the Howell, though still in use, will not improbably be superseded by it. Three other automobile torpedoes have been experimented with, but as none of them has been adopted by a Naval Power, a passing notice will be sufficient. These are the Peck and Hall, which were intended to be propelled by steam, and the Berdan, an ingenious invention of the Russian General of that name. It really consisted of two fish-torpedoes, one of which towed the other. On the first one coming in contact with a ship's defensive net, the one in tow dived down and came up inside, against the bottom of the ship. The same officer patented another somewhat similar notion for evading the net defence. This was a torpedo-boat fitted with a species of long buffer at the bow and two vertical torpedo tubes, one on each side, near the stern. When the buffer touched the side of the ship to be attacked the torpedoes were discharged, and, each connected by a rope to a protruding peg or bar near the bows of the boat, swung downwards under the net and upwards against the enemy's side. The old spar-torpedo was simpler and at least as efficacious, without being any more dangerous to the attacking boat.

Besides the absolutely automatic class of torpedo which we have just described, there have been several kinds which, while sharing in the general resemblance to a submarine boat, have yet relied on operators stationed on shore for guidance, direction, and in some cases motive force. The one which has had the most successful career, so far, is the Brennan, a big fish-like affair that is driven and steered by means of strong piano-wire coiled on drums connected with its two propeller-shafts. The shore ends of these wires are wound on other drums driven by a steam-engine. The faster they are wound up the faster runs the torpedo; if one wire is wound faster than the other it is obvious that one propeller will revolve faster than the other and the direction of the Brennan be altered. In this way it can be guided to the right or left within a radius




WIRE-CONTROLLED TORPEDOES.

A. The "Brennan." C. The "Sims-Edison."
B. The "Automobile." D. The "Victoria."

of 40 degrees, and so can follow or intercept an enemy's ship that comes within range although she herself may change her direction time after time. The Brennan is therefore a very formidable weapon for harbour defence or for use in narrow waters, and it was adopted for this purpose in 1882 by the British Government. The inventor, who was a Melbourne watchmaker, was paid a retaining fee of £5,000 and a salary of £2000 a year for three years, with all expenses incurred in the perfection of his invention. He afterwards received a lump sum of £110,000 and a salary of £1500 for five years.[1] So he did better with his invention than most of the inventors whose schemes have been dealt with in this little work.

Like the Whitehead, the Brennan has an apparatus for keeping her at the proper depth, but she carries a much heavier charge. One of the earliest models contained no less than 300 lb. of blasting gelatine, and we may be sure that later types were no less but probably more formidable. The following is an account of an experiment carried out with a Brennan mounted at Cliff End Fort in the Isle of Wight:

"An old merchant brig was towed at a speed of 9 knots, and at a distance of 1200 yards, past the fort. When she was nearly abreast of it a Brennan was launched. At an immense rate of speed, the torpedo, leaping like a great fish in the water and then settling down to a depth of 6 or 7 feet, darted out into the channel, got into the wake of the brig, rounded her stern, and went plump into her on the starboard quarter. A great jet of black and white smoke, a violent upheaval of smashed spars and timbers, and a dull report followed; and, as the smoke cleared, the unfortunate brig, which seemed to be absolutely shaken to pieces, slowly sank. Four minutes after she had been struck she was beneath the water, which all around was covered with her wreckage." [2]

But after a career of something like five-and-twenty years, the manufacture of the Brennans has been suspended. Probably the incidents of the Russo-Japanese War have induced

[1] A. H. Burgoyne, "Submarine Navigation."

[2] "All About the Royal Navy," p. 58. Laird Clowes.


"OBSERVING HER HANDIWORK"—A SUBMARINE COMING UP AFTER TORPEDOING A BATTLESHIP.

p. 200]

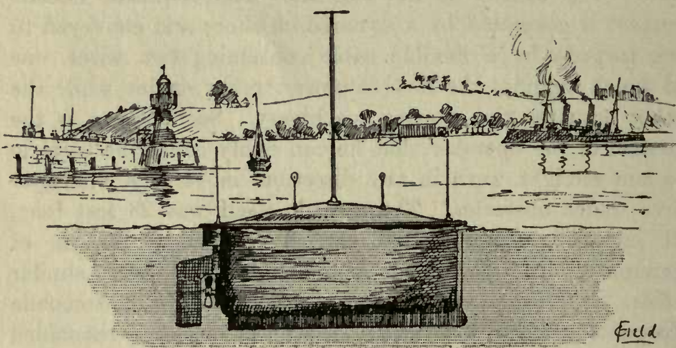
the authorities to consider that some other form of harbour defence is preferable, or that the heavy gun is sufficient to keep ironclads at a distance from shore defences.

Among other shore-controlled torpedoes we may mention the Lay, Nordenfeldt, and Sims-Edison torpedoes. The latter is a long cigar-shaped torpedo suspended by a rigid framework from a boat-shaped float upon which are two vertical rods carrying coloured flags by day and screened lamps by night. By means of these the operator on shore can observe and follow the course of his torpedo. The requisite electric current is generated by a dynamo on shore and conveyed to the torpedo by a flexible cable containing two wires, one of which supplies the motive power to the engine while the other actuates the steering machinery. So complete is the control of the operator that he can easily cause the torpedo to run straight, turn in any direction, move in a circle, or dive under obstacles. The torpedo itself was 28 feet long, 21 inches in diameter, and carried very nearly 400 lb. of dynamite. The Lay and Nordenfeldt were very similar affairs, and there was also the "Controllable Automobile Torpedo," another American invention, which closely resembled the Sims-Edison except that it carried its own motive power, its engines being driven by carbonic-acid gas which became liquefied under a pressure of forty atmospheres. "The liquid gas is carried in a small tank within the torpedo, and on its passage to the engines, through a coiled copper tube, is highly expanded by an intense heat produced by the chemical action of dilute sulphuric acid and quicklime." [1] This was a very ingenious idea for under-water propulsion, and was said to give the torpedo a speed of twenty miles an hour for one mile.

The "Victoria" torpedo, like the Brennan, an Australian invention, was something between the latter weapon and the Whitehead, *i.e.* was guided from the shore by an electric

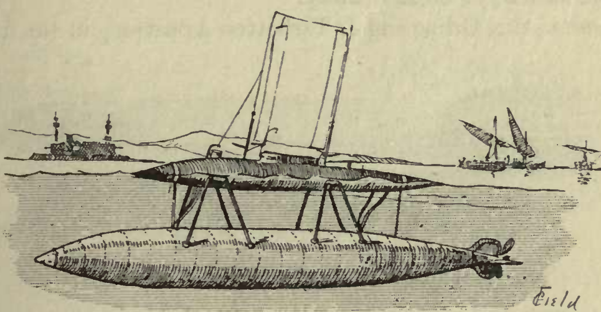
[1] Lieutenant Hughes, U.S.N., in *Scribner* for April 1887.

wire, but carried its motive power within itself—compressed air, as in the Whitehead. Preferably it was discharged from a species of flat stand provided with a couple of clips for holding the torpedo, and from which it could be released by an electric wire which communicated with the shore. These and the dynamo were portable, and could instantly be placed in position at low water at any threatened point of the coast. Though well reported on, this torpedo never achieved any permanent success.



NIKOLA TESLA'S "WIRELESS" BOAT.

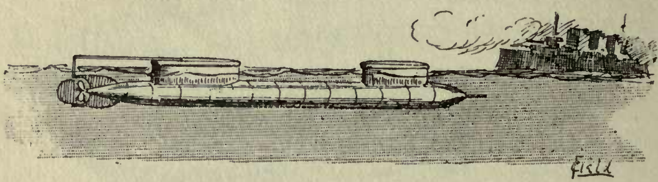
But recent science has put into the hands of inventors a method by which they can control their boats and torpedoes without having to hamper them with yards and yards of electric cable. It is, in fact, the application of wireless telegraphy to the direction of a torpedo, or even an under-water automatic boat so large that it may well be called a submarine. The same force that is used to move the telegraphic instruments hundreds and thousands of miles away, although there is no material communication, and so send messages through space, can well be utilised to steer a torpedo at a distance of as many yards. The first boat designed to be steered in this way was a queer little surface craft invented by Nikola Tesla in 1898. It was built of wood with a domed metal top, and might have been able to take a torpedo alongside an enemy if not seen and destroyed before it got there. A young Englishman, of Spanish descent, Varicas by name, invented a somewhat similar apparatus for boat-steering by wireless waves about the same period, and made several successful experiments with a model. Quite recently a Frenchman, M. Lalande, produced an automatic submarine which is very like the Sims-Edison torpedo in appearance. The Lalande has no



LALANDE'S "WIRELESS" TORPEDO.

material connection with ship or shore, and is an actual submarine from which torpedoes may be discharged. She—that is to say, the boat proper—is suspended at a depth of about 5 feet below the float or upper portion of the contrivance, which is a little over 2 feet in diameter. The boat itself has a diameter of 4 feet and is furnished with a torpedo tube from which a Whitehead can be discharged at the will of the operator on shore; in the centre are her electric engines and accumulators, while aft is the special apparatus which steers and in fact acts as the brain of the vessel, manœuvring it in obedience to the various impulses passed down from the light poles which rise above the surface and serve as receivers for the Hertzian waves. They fulfil a further useful purpose in enabling the operator to observe and direct the course of the submarine. It is evident that here we have an apparatus which might form a most formidable engine of war. Its principal disability would seem to be the necessity for using an above-water float which might be observed by the enemy and possibly destroyed. But there is another "wireless" contrivance in the field which may possibly revolutionise naval warfare. This is the Orling-Armstrong torpedo, which runs completely under water and has nothing at the surface to be shot away.

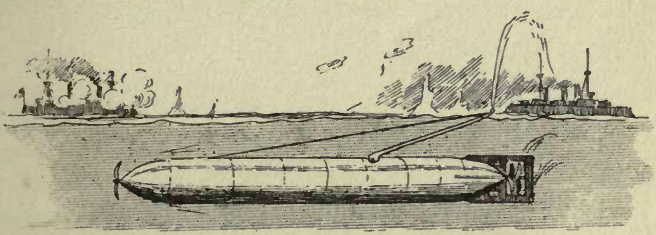
Messrs. Axel Orling and J. Tarbotton Armstrong in the first



THE ORLING-ARMSTRONG "ARMORL" BOAT.

place designed a submarine boat which was free from the disabilities of all other submarines which have to rely for their direction on the periscope compass bearings or occasional visits to the surface. The "Armorl" boat, as it was called, could steer almost directly for her objective because her commander would be in constant communication by wireless telephone with another officer on board ship or on shore who could see the enemy and continually indicate her position to him. This boat does not seem to have advanced beyond the model stage, probably because her inventors thought they might just as well apply the idea directly to a torpedo, which would be in many ways preferable to the bulky and expensive submarine. In point of fact the "Actinaut," as they term their new torpedo, promises to be less costly than the

Whitehead. "It is just dropped or slipped into the water,"[1] said Mr. Armstrong, "and is then, without any connecting wires, entirely subject to my control, either from the bridge of a ship or a room on shore. There is a receiving apparatus on board the torpedo which by ingenious mechanism acts upon an arm the movement of which causes the screws to turn. Every quarter-turn of this arm causes the screws to revolve differently, and consequently makes the torpedo take up a new position. Of course it was necessary to have some mark to show the position of the torpedo in the water.



THE ORLING-ARMSTRONG "ACTINAUT."
By favour of the *Illustrated London News*.

I used a flag at first, but the Admiralty asked me if I could not devise something which could not possibly be shot down by an enemy. One night I dreamed the way to get over the difficulty, and now we have an air-pressure tank in the torpedo which sucks in salt water and sends it out again like the blow of a whale. They may fire at that for ever without doing any harm. The spray of water at the same time serves as an indestructible receiver for the electric waves. On encountering a warship the torpedo first travels towards the netting which surrounds it as a protection against torpedoes of all kinds. After it has struck the net it goes back, sinks, goes forward again and upward, and then blows up the vessel."

[1] In the *Illustrated London News*, June 13, 1903.

When this invention is perfected it seems quite possible that all submarine boats and most torpedoes will have to be relegated to the scrap-heap. But to be perfect it must carry a very heavy charge, for if the events of the Russo-Japanese war go to prove anything it is that even a series of Whiteheads striking the same ship will not do damage comparable to that inflicted by a mine filled with a big charge of high explosive. The torpedoes damaged and even disabled a battleship, the mine destroyed it totally.

# CHAPTER XVI

## SEMI-SUBMARINES

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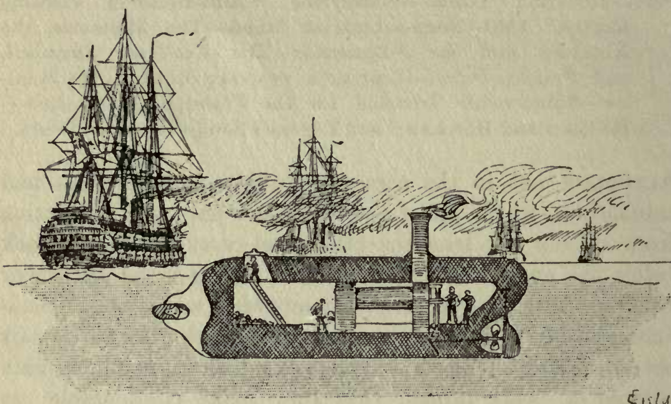
### Semi-submarines

Semi-submarine Vessels—Nasmyth's "Anti-Invasion Floating Mortar," 1853—Semi-submarine Rams—The *Manassas*, the *Katahdin*, and the *Polyphemus*—The *Keo-Kuk*, *Stromboli*, and *Spuyten-Duivel*—Legrand's proposed Submersible Monitor—Submersible Ironclad for the Prussian Government—Berkeley and Hotchkiss' and Lagane's Semi-submarine Boats.

Although not in the same category as submersibles and submarines, which utilise the water not only as a protection from fire but also from detection, and carry out their attack below the enemy's waterline whether acting at the surface or below it, there have been a good many what we may call "semi-submersibles" built from time to time, of which a few particulars are of interest. These vessels have this in common with submarine boats proper, that they make considerable use of the water in which they float to protect themselves from gun-fire both by covering a great portion of their hull and by offering a smaller target, since in action as much of them as possible is beneath the surface. We have had occasion to refer to one of these in Chapter XIV., but this (the American Burger boat) approaches so nearly to a submarine proper that it is perhaps excusable to have reckoned it in the list of United States submarines.

Most of the semi-submarines that have been constructed have been much larger craft than the real submarines have ever been, most in fact being actually ships. Leaving on one side the "catamarans" used at Boulogne in 1804, and the " torpedo pilots " to which we have already had occasion to refer in tracing the earlier phases of the evolution of under-water attack, we have first to describe an invention which attracted some attention about the year 1853. This was Nasmyth's Submarine Mortar, a curious vessel built of poplar wood at least 10 feet thick, so as to be impervious to any of the round cannon-balls of the period. It was about 80 feet long over all with a beam of 30 feet, and was propelled by a steam-engine driving a single screw. Nothing appeared



SECTION OF NASMYTH'S FLOATING MORTAR, 1853.

above water but the rounded top of the mass of timber forming the upper deck of the vessel, the funnel, and a little dome over the head of the steersman, who was ensconced in a small chamber cut in the thickness of the upper side of the vessel near the bow. The cross-section of the vessel was a flattened circle like that of an orange, so that she was very nearly cylindrical in form. The most remarkable point about the " Anti-Invasion Floating Mortar "—to give her the title bestowed on her by the inventor, James Nasmyth, better known as the inventor of the steam hammer—was the mortar itself. This was an enormous casting of brass fitting like a cap over the whole of the forepart of the vessel. It was 8 or 10 feet thick in the central part, which protruded like a kind of snout, and in this, in line with the longer axis of the boat, a chamber was bored out. Into this fitted a huge conical projectile with a hollow base. This contained a charge of powder, which with the projectile itself was enclosed in a hermetically closed brass case having a percussion arrangement at the end of it and a species of protruding flange round the centre. This big shell was fitted tightly into the mortar down to the flange, and was always to be carried in this position. Although no great speed was expected from this weird vessel, the impetus with which the point of the shell would be driven against the flank of an enemy's ship would be sufficient, it was considered, to cause the flange to be sheared away and the percussion cap at the end of the powder charge driven against the base of the mortar, which would then be discharged and drive a big hole through the enemy below water.

It was an ingenious idea, but does not seem to have "caught on."[1] It had obviously a good many weak points, and passive defence on our own coasts has always been a policy opposed to the better judgment of the nation, as was aptly pointed out at the time. "The fear of an invasion," remarked the *Illustrated London News*, "has been very strong in the minds of the people of Britain ever since Louis Napoleon became President of France, and at present the excitement, we can perceive, is approaching fever heat. . . . We must say that England seems afraid now of trusting in her wooden walls, and, instead of terrifying her foes by keeping watch and ward on their coasts, as she once did, she is keeping a sharp look-out for the defence of her own coasts by such water-hogs as this of Mr. Nasmyth. Prudence, no doubt, is the better

[1] In a very recent issue of the *Scientific American* there is a description of a novel automobile torpedo invented by a Mr. Davis which carries a small loaded cannon in front like Nasmyth's boat.

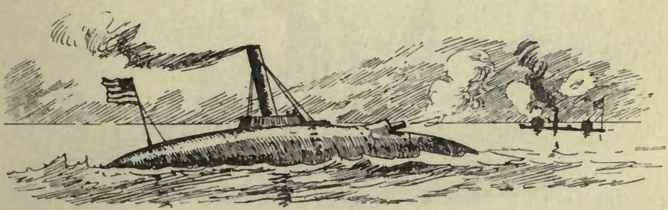
part of valour, but we apprehend that this vessel could very easily be taken prisoner by a few boats before it was permitted to drive its snout against the side of an invading warship."

Mr. Tétar van Elven, of Amsterdam, in 1859 patented a design for an ironclad which was to fight in an "awash" position, armed with the time-honoured "auger"—in this case driven by steam. Its most interesting peculiarity was a kind of "periscope" or "optical tube."

We come now to a class of vessels which are very similar to Nasmyth's except that they were more modern, were built of iron and steel instead of wood, and relied on their rams instead of a submarine projectile. But the method of attack was really the same. Protected by a horizontal cuirass and difficult to hit on account of lying so low in the water, they were intended to charge straight up to the enemy unchecked by the fiercest storm of projectiles that could be directed upon them. They, too, were "water-hogs."

Like many another innovation in naval and military material, their earliest types date from the American Civil War, where both sides set to work to produce the most novel and destructive weapons they could fabricate out of the means at their disposal. Ramming attack dates from the days of the ancient Greeks and Romans, and was very usual in the Middle Ages, where long oar-propelled war-vessels were used, as, for instance, when Richard Lion-Heart's galleys rammed and sank the huge Turkish dromon off Beyrout. The advent of sail-power put the ram in the background for a time, but the invention of steam propulsion brought it once more to the front. An almost solid mass of timber propelled by paddle-wheels was advocated by the American Commodore Barron about 1821, while in 1841 Congress voted 250,000 dollars to Robert Stevens for the construction of an armour-plated ram which he proposed; but this does not appear ever to have become part of the United States Navy. But among the various extraordinary craft the Confederates built and improvised on the outbreak of the Civil War, they had a regular steam ram which took part in many of the engagements with the Northern squadrons.

This was the *Manassas*, a cigar-like affair lying very low in the water, only showing the hump of her back (which was a foot thick and covered with 1½ inches of bar iron), her funnel, and the muzzle of a 68-pounder gun sticking out of a porthole a little way in front of it. In October 1861, only six months after the declaration of war, this little "water-hog" drove the whole of the Mississippi blockading squadron out of that river. This formidable vessel had a displacement

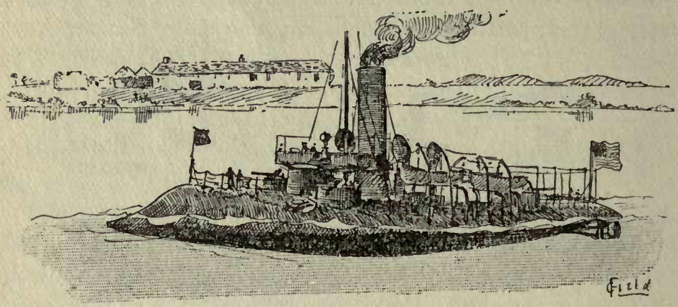


THE "MANASSAS" RAM, 1861.

of 387 tons and was 128 feet long, her bow being built solid for a length of 20 feet and plated with iron.

The "defence ram" *Katahdin*, designed by the American Admiral Ammen and launched in the early 'nineties, was a very similar vessel. All of her hull that appears above water is a curved turtle-backed deck varying in thickness from 2 to 6 inches, and sloping down to 6 inches below the waterline. From the lower edge of this armour deck the ship's sides slope suddenly inwards to meet the narrow flat bottom of the vessel. The hull is further protected by a 3- to 6-inch armour belt just below the edge of the protective deck. All that is to be seen on the *Katahdin's* deck is an armoured conning-tower, a funnel, her ventilators, and two low barbettes in which are mounted four light guns for driving off torpedo-boats.

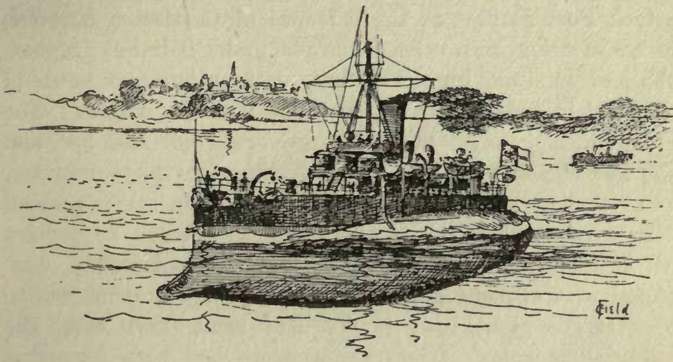
The *Polyphemus*, built in this country and launched at Chatham in 1881, was a similar type of vessel, but as she has a much more elaborate superstructure she looks very much like a small gunboat. Yet the hull itself is really a cigar-like affair heavily plated on the sloping upper surface and lying almost entirely under water. The *Polyphemus* is much bigger, therefore, than she looks, and has a displacement of 2640 tons. She is 240 feet long and 40 feet wide amidships, and carries



THE "KATAHDIN" RAM, 1893.

five submerged torpedo tubes. She served several commissions in the Mediterranean and took part in some of the earlier Naval Manœuvres, when she distinguished herself by breaking the defence boom laid out in Bantry Bay. The boom was constructed of heavy spars secured by a 5-inch wire hawser, but the *Polyphemus*, after dodging several torpedoes fired at her by the defending boats, struck the boom at right angles and went through it as if it were packthread, without the slightest shock being experienced on board. No more ships of her kind were built, and she is not now on the effective list of the Navy.

We have noticed the variety of warship types which owe their creation to the American Civil War, and among these was the submersible monitor built by the Federals. She was an attempt to improve on the monitor proper, which proved such a formidable instrument in dealing with the improvised ironclads of the Southerners, by providing her with an arrangement which allowed her to sink the whole of her hull under water except her turrets and funnels, or "smoke stacks," as the Yankees preferred to call them.



THE "POLYPHEMUS" RAM, 1881.

This was the *Keo-Kuk*, whose hull, were it not for the ram and rudder, had very much the shape of a cigar. She was 160 feet long over all and 36 feet wide. She was provided with twin screws, and under ordinary circumstances only drew eight and a half feet of water. When in fighting trim, however, with her tanks filled, she only showed her turrets and funnel above water. The turrets were built solidly on the deck so that no water could leak in underneath them. As, therefore, they could not revolve, each was provided with three ports fitted with swinging lids so that the 11-inch gun inside could be trained on either beam and ahead or astern, as the case might be. The *Keo-Kuk* was built of iron and strongly supported for ramming by longitudinal girders. Her tanks took forty minutes to fill and a quarter of an hour to empty. Her projectiles weighed 180 lb. each, and she carried a crew of a hundred officers and men. She was plated with two inches of iron, and had an inner skin nearly an inch in thickness.

This unique warship had a very short fighting career, and her power of immersion—if indeed she made use of it—did not preserve her from serious injury. Being ordered to attack Fort Sumter at the entrance of Charleston harbour, in conjunction with other ironclads under Admiral Dupont, she had to stand in within three or four hundred yards of this fort in order to avoid a collision with the *Nahant*. The Confederate gunners at this range could not miss her, and she was struck nearly a hundred times in thirty minutes. Some of the projectiles went clean through her, others pierced her turrets, the 2-inch plating being insufficient to protect her from direct impact. In short, she was knocked completely out of time and had to haul off. It came on to blow in the night, and the *Keo-Kuk* went down early the following morning. Great expectations had been formed as to her capabilities, and after so signally disappointing them it can hardly be wondered that no more "submersible monitors" were built. It may be remarked that the ordinary monitors which had been in action at the same time suffered very little damage in comparison.

But the Federals still thought there was something in the idea, and turned their attention to submersible torpedo-craft. They built two of these, the *Spuyten-Duivel* and the *Stromboli*. The first of these was constructed of wood, and was indeed a curiosity in appearance with her rounded deck, funnel right aft as well as amidships, bell-topped conning-tower, and three bare pole-masts. She was just over 82 feet long and 20 feet wide, was covered over with 1-inch armour, and had a displacement of 207 tons. Under ordinary circum-


THE "KEO-KUK" OVERWHELMED BY FORT SUMTER.

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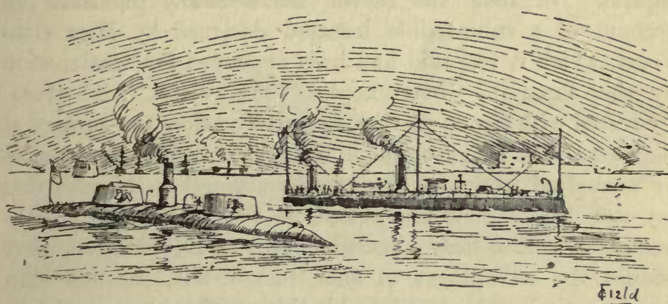
stances the *Spuyten-Duivel* only showed about 3 feet of her hull above water, and when in this trim could steam between 9 and 10 knots. When, however, she was going into action she filled up her tanks, and then her speed came down to 4 knots and only a foot of her hull could be seen above the surface. She was armed with a torpedo attached to the end of a long heavy spar which could be pushed out below water at the bow by means of special gearing provided for the purpose. She arrived in the James River in 1865, just too late to take any part in the hostilities which were about to terminate.



THE SEMI-SUBMERSIBLES "KEO-KUK" AND "SPUYTEN-DUIVEL," 1865.

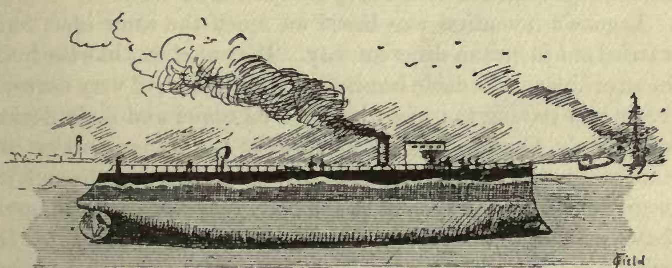
She was made useful afterwards in blowing up the various obstructions which the contending forces had placed in the River.

The *Stromboli* was an earlier edition of the *Spuyten-Duivel* by the same designer, Mr. William Wood. She was 84 feet long and twenty feet wide, and armed, like the latter vessel, with a spar-torpedo. Mr. John Lay, better known later on as the inventor of the Lay torpedo, and who also had a hand in the designing of the *Spuyten-Duivel*, was put in command of her, and in November 1864 she was sent to attack the Confederate ironclads off Charleston. She got there, but as regards her exploits, if any, history is silent.

But not only in America were certain inventors' minds turned towards submersible, or rather semi-submersible fighting ships. A French naval engineer, M. Legrand, designed a submersible monitor for coast defence in 1862, a model of which is to be seen in Paris. In appearance it is like a shallow boat with twin screws, in the centre of which rises a kind of armoured mound surmounted by three turrets. In action this is all that would have been visible of the vessel. Another model of a single-turreted monitor intended to fight in an "awash" position is also to be seen in the French capital. In 1869 the *Berlin Borsenzeitung* published an account of a submersible ironclad designed by Herr Otto Vogel, which it was said had been approved for construction by the Prussian Government. "The vessel," it wrote, "covered with strong plating, is entirely below the surface of the water, with the exception of the deck, which is surmounted by a vaulted iron roof of immense strength. Beneath this covering heavy guns are placed, so that the whole greatly resembles a first-class ironclad. It is said, however, that besides the advantages of such men-of-war, the new ship may be entirely submerged, and in this position is so completely under command that it can outweather a storm or attack an enemy with submarine cannon or torpedoes. Mr. Vogel is now making a 24-foot model."

Whether the model was completed is unknown, but it is practically certain that the Prussian Navy never numbered this remarkable warship among its effective units. Two turret-ships, the *Abyssinia* and *Magdala*, were built for the defence of Bombay harbour in 1870, and these ships, it is said, could be submerged up to the armoured breastwork on which their turrets stood.

Admiral Porter, an American officer who designed more than one queer craft in his time, is responsible for the "semi-submersible" called by his name which was launched about 1873 or 1874. Two quite different accounts are given of this vessel. According to one[1] it was built with an enormous armoured turret equipped with guns, which, with the pilot tower and funnel, was all that remained visible when in fighting trim. Another agrees with the former in saying that she had a torpedo fixed on a spar protruding from her ram, but makes no mention of the gun-turret. Both agree as to her dimensions. In all probability the *Porter* never had a turret, though her inventor may have contemplated one before he finished working out his design; and by the addition of upper-works the original semi-submersible was altered and enlarged in the



LAGANE'S SEMI-SUBMERSIBLE, 1880.

*Alarm*, a ram exactly like the description of the *Porter* forward with its armoured snout sticking out a long way ahead under water, finished off with a spar-torpedo and carrying a heavy gun in the bows.

Two other "semi-submersibles" remain to be noticed, that invented by Messrs. Berkeley and Hotchkiss, the latter of whom became famous on account of his quick-firing and machine guns, and that designed by M. Lagane about 1880. The first mentioned was in itself a regular cigar-shaped submarine in appearance, but it was not in reality anything of the sort. It was heavier than the water it displaced, and so, if left to itself, would have sunk to the bottom. But it was suspended

[1] Pesce, "La Navigation Sous-marine."

between two long cylindrical floats in such a way that when they were close alongside the whole affair floated at the surface. When, however, they were pushed outwards and upwards by means of a peculiarly jointed series of levers, the boat itself sank so low in the water that only the top of the conning-tower, the funnel, and a ventilator were left above it. The floats, which were minutely subdivided and filled with cork, partially protected it from fire on the broadside, as they themselves would take a deal of knocking about before they could be destroyed. The vessel was propelled by an ordinary steam-engine and carried a torpedo tube in her bow.

Lagane's invention was based on much the same idea, but carried out in quite a different way. His vessel was like the hull of an ordinary broadside ironclad of that period, of very narrow beam and having the space between its upper and main decks completely filled in with wood. Only the upper portion of this mass of timber appeared above the water, and through it were cut shafts for the conning-tower, funnel, coal-shoot, and hatchway, in the centre of which was a ventilating-cowl. It will be obvious that the crew down in the lower portion of the vessel were fairly well out of harm's way. The boat was built of steel with bullet-proof plating on those parts appearing above the deck, and was armed with a tube for the ejection of Whitehead torpedoes right down at the point of her ram bow, and a spar-torpedo carried forward on her upper deck. She was nearly 100 feet long but only 10 feet wide, and 13 feet deep. It is interesting to note that Lagane's idea is practically the same as that perfected in Burger's new American "submersibles."

# CHAPTER XVII

## Submarine Working Boats

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### Submarine Working Boats

Submarine Workers and Diving Boats—Newton's Boat—Dr. Payerne's Submarines—Lambert's Weird Diving-boat, 1852 —Raeber's and Merriam's Boats—Pozzo's Spherical Submarine Worker *La France*—The *Audace*—Simon Lake's *Argonaut I* and *Argonaut II*—Experiences on Board—Pino's Submarine Worker and the *Bou-Korn*.

While not, perhaps, precisely within the scope of our subject, which is principally limited to submarine navigation in connection with its application to under-water warfare, there have been a certain number of submarines designed especially for the more peaceful work connected with salvage and under-water construction, which have been so well thought-out and practically successful that they can hardly be passed over in silence. The most noteworthy example of this is the series of *Argonauts* or submarine wrecking boats invented by Simon Lake, from which has been directly evolved the submarine torpedo-boat *Protector*, which, in the opinion of many experts, is about the most perfect vessel of her class that has ever been built.

All kinds of contrivances have been constructed or imagined for carrying on under-water work, some of the earliest of which have been briefly referred to in the beginning of this book; and since those there have been all possible kinds of diving-bells, diving-suits, caissons, tubes and cylinders produced for this purpose. Our business lies with none of these, but only with such apparatus of the sort that may be truly considered as submarine boats. And about the earliest of these is the diving-boat for which William Newton, an indefatigable, though not highly successful inventor, took out various patents between the years 1838 and 1856. It was in the shape of a lemon with sharp elongated ends, and was, in point of fact, a kind of subaqueous jaunting-car for the use of divers, who drew their supply of air from her interior. The boat carried two of these at a time, each seated on a seat on the outside. Two tubes leading to the surface kept the boat well supplied with the air which was necessary, not only for the divers she carried, but for the one or two men inside who turned her many-bladed propeller and steered her by means of a rudder and a species of oar which protruded from her bow.

Dr. Payerne, some slight reference to whose boats has already been made, having studied diving and made several descents during the operations on the wreck of the *Royal George* at Spithead, began by trying to improve on the diving-bells then in use, and afterwards turned his attention to submarine working boats. His first essay in this direction was what he termed a "Bateau-cloche" or diving-boat, and was produced in 1846. It was very much the shape of a modern heavy-gun projectile except that it tapered slightly towards the stern, which, instead of being flat like the base of a shell, was slightly convex. It was 35 feet long and about 10 feet at its greatest diameter. Inside it was divided into two parts by a convex bulkhead, the fore-part constituting the air reservoir and the after portion the room in which the propeller was turned by a hand-crank. The vessel steered by vertical and horizontal rudders, and the divers emerged into the water by means of an "air-lock" or small chamber in which the air was compressed till its pressure was sufficient to stop the inrush of water when the outer hatch was opened. The boat carried out some experiments on the Seine at Paris which seem to have been attended with fairly favourable results.

"SOWERS OF DEATH." MINE-LAYERS AT WORK.—See p. 279

By favour of the *Sphere*.

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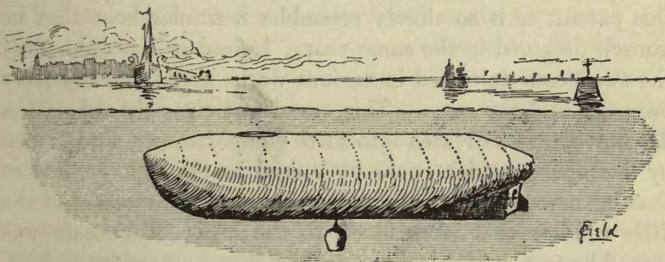
But the inventor was not satisfied. He thought he might still improve on his design, and in 1854 he took out another patent for a submarine which he termed a "Pyrhydrostat." In appearance it was something between a cylinder and an ordinary boat with a convex deck. It was divided by two vertical bulkheads into three compartments. The after one, which occupied half the length of the vessel, contained the engines, driven by steam generated by a sealed-up furnace burning coke, the tanks to be filled for immersion, and a heavy weight which could be lowered to act as an anchor. The



DR. PAYERNE'S "PYRHYDROSTAT," 1854.

centre one, divided horizontally by a deck with a manhole in it, formed the working chamber and the air-lock to give the diver egress, while the foremost one contained merely an extra supply of compressed air. It does not seem quite certain that this particular boat was actually built, but the former boat is said to have proved of great service in the construction of the famous breakwater at Cherbourg.

A Frenchman, Alexandre Lambert, built a weird diving-boat in America in the year 1852. It looked outside like a very long egg. In the middle was a big working chamber, which also formed an air-lock, so that divers could go outside the boat by a manhole in the lower part. The compartments at each end contained a number of cylinders of compressed air which could be pumped into the central compartment by eight pumps, four at each end, and so raise the air pressure sufficiently to exclude the water when the manhole was opened. In the upper side were a number of glass scuttles, and a hatch for entrance into the vessel. This extraordinary affair hardly deserves the name of a boat, as it had no means of propulsion. Whether its trials—if they ever came off—proved its efficiency or otherwise does not seem to be recorded.

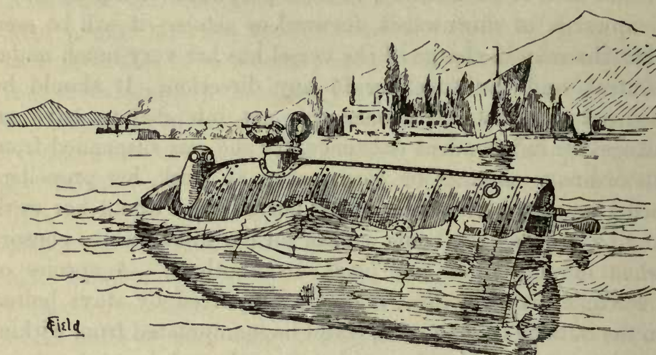
Another diving-boat was designed by Raeber of Newark, near New York, in 1866. There seems to be an idea that a Frenchman named Merriam must have had something to do with this patent, as it so closely resembles a similar boat that he himself designed in the same year. Indeed it is possible that the two boats described in various works may in reality have been one and the same. This vessel was cigar-shaped with a flat bottom, was divided into three compartments, and driven by a propeller which could be turned to the right or left so that it answered also for a rudder, or at any rate assisted the little rudders that were fitted to the boat. The shaft was turned by two hand-winches, to which it was geared by pinions. Some miles of wire were carried on drums so that directions could be telegraphed from the shore if considered advisable. To enable the water tanks to be emptied almost immediately on an emergency, a peculiar method was adopted. Cylinders containing air at a very high degree of compression were so placed that the air could be turned into the ballast tanks, the effect being that the water they contained would be blown out almost instantaneously. Raeber designed a second boat for war purposes, but it was not built.

We now come to a queer spherical submarine worker built by an Italian—M. Piatti del Pozzo—about 1897. It was constructed on the Seine and carried out its trials in that river. *La France*, as it was called, was very strongly built of steel, strengthened by vertical and horizontal ribs. As the sides of this spherical boat are very nearly 3 inches thick, it offers a tremendous resistance to the pressure of the water, and it is claimed that by its means work on wrecks, reefs, etc., can be carried on at depths far beyond those at which it is possible for a diver or a diving-bell to work. Complete with its working arms and other paraphernalia it weighs no less than six tons. It is fitted with three screw propellers driven by electricity. One of these works in a recess cut out of the rudder, which is very large, reaching nearly from top to bottom of the boat; the remaining two are placed one at each side, and as they can be turned so as to direct their powers of propulsion in any direction —upwards or downwards, forward or astern—it will be seen that the man in charge of the vessel has her very much under control, and can turn her in any direction. It should be pointed out that *La France* was not intended to have an altogether independent existence, for she was suspended from an ordinary steamer or barge when at work, her propellers being merely intended to enable her to move about her work and to prevent her being a drag on her above-water consort when moving from one place to another. A species of telescopic arm or crane, strongly supported by stays bolted to the outside of the vessel, could be manipulated from within, as also could a big claw-ended wrench and large bowls or baskets for carrying or removing stone or any heavy materials.

The crew—who enter by a trapdoor at the top—are enabled to see by means of specially constructed windows at the side, and by the aid of an electric light suspended from the ship to which the machine is attached. Heavy cases of ballast are used to sink the "worker," which in case of accident can be released from the inside, on which the Pozzo boat will at once bob up to the surface.

A very similar contrivance was patented by a M. Rigaud in 1899 under the name of the "Hydrophilos," but was never built. The principal difference between it and *La France* was that instead of being spherical it was just the shape of a large egg. Four legs were fitted to its larger end, and between them there was space for a big horizontal propeller to assist in raising and sinking the quaint-looking vessel.

Degli Abbati, an Italian engineer, also produced an extremely odd-looking diving-boat in 1892, which he christened the *Audace.* Looked at sideways its general outline was not very unlike that of a projectile intended for a large gun, but then it was not cylindrical but inclined to be flat, like a half-filled Gladstone bag. It was 28 feet 6 inches long, 7 feet wide, 11 feet 6 inches high, and built of two thicknesses of steel



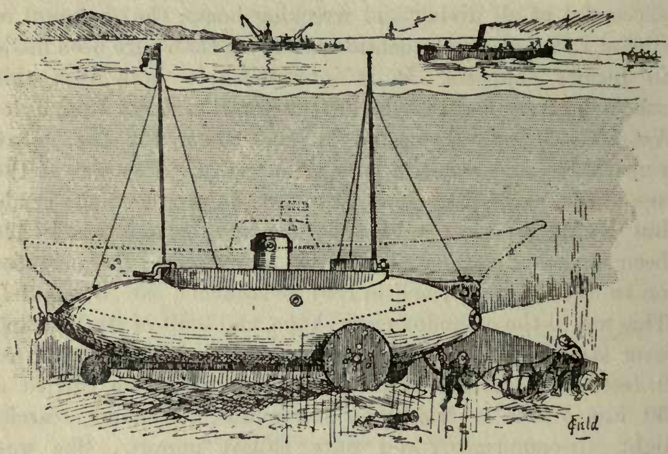
"L'AUDACE," SUBMARINE WORKER, 1892.

so as to be able to withstand the enormous pressure of water at the depth of 300 feet, to which it was intended to descend. As a matter of fact, it never went deeper than 53 feet during its trials at Civita-Vecchia. At that depth the *Audace* evinced great horizontal stability, moved easily through the water, and demonstrated that the arrangements for the supply of air to her crew of four men were almost perfect. She was lighted and driven by electricity, and there was an arrangement of lenses which enabled her to project three electric rays on either side to allow her divers, after quitting her by the door near her after end, to see what they were about. She had a single small propeller and two rudders, the lower one of the ordinary form. The other, placed just above it, was like the tail of a fish. Forward she had a small conning-tower and a manhole or scuttle giving access to her interior. Although she seems to have done well on her trials nothing more very remarkable has been heard about her, probably because want of funds prevented further experiments.

We now come to what may be fairly regarded as the most successful of all diving and wrecking boats, the *Argonaut* of Simon Lake, of which mention has more than once been made in former chapters. It is interesting to note that this successful inventor drew his first inspiration direct from Jules Verne's "Twenty Thousand Leagues under the Sea," that remarkable romance of a submarine vessel. This was at the age of ten, and a very few years later he produced the crude but highly practical submarine *Argonaut Junior*, which has been already described.[1] But this only spurred the inventor on to further efforts, and in 1897 he launched the *Argonaut I.* This was of the orthodox cigar shape, and built of steel plating over strong frames. She was 36 feet long with a beam of 9 feet, and was constructed in Baltimore. She carried a 30 h.p. White & Middleton gas engine, a dynamo, search-light, air-compressor, and water-ballast pumps. She was provided with a diving compartment, with geared wheels for movement along the sea-floor, and with a propeller for propulsion at the surface. Although so small in size, a crew of five men cruised over 2,000 miles in her in 1898, partly at the surface and partly submerged, in Chesapeake Bay and on the Atlantic coast. During this extended cruise she was put through every trial and experiment that could be devised, coming out triumphantly from almost all, and finally vindicated her surface seaworthiness by braving the terrible storms of November and December, in which over two hundred vessels were wrecked. Here are a few extracts from the inventor's

[1] *Vide* Chapter XII.

own account of the cruise.[1] "We have been in some pretty rough weather and found that she was perfectly seaworthy. Of course, being so small and of such weight, the seas at times would wash clear over her decks. This, however, caused no inconvenience to those below, as her stability was such that she would roll or pitch very little, even though the seas were breaking over her in great volume. We have been cruising



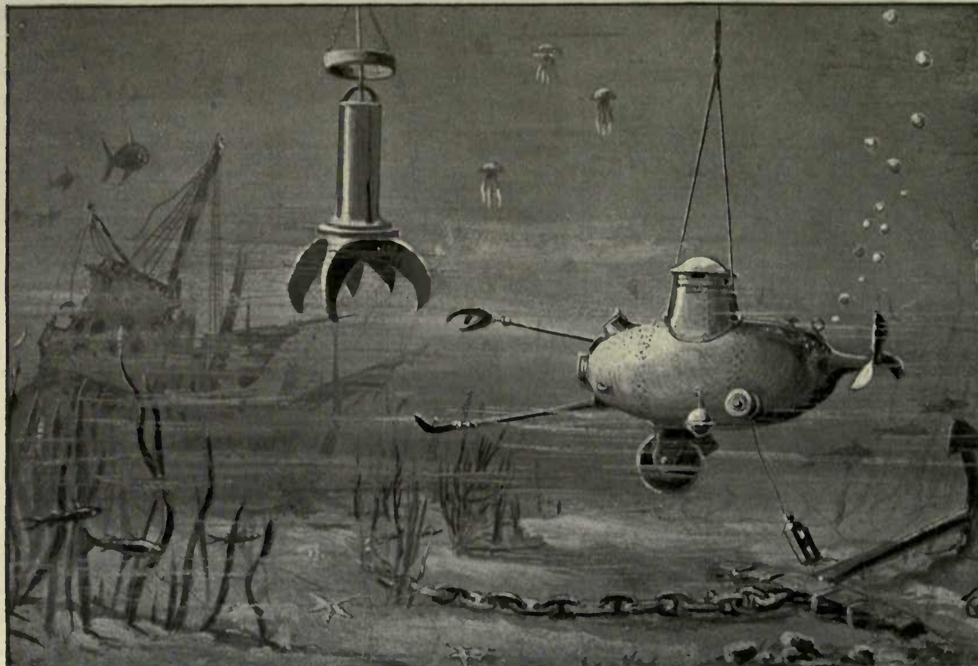
LAKE'S "ARGONAUT I AND II," 1897 AND 1900.
N.B.—The dotted line shows how No. I was improved into No. II.

on the bottom in rivers, in Chesapeake Bay and beneath the broad Atlantic. In the rivers we invariably found a muddy bed; in the bay we found bottoms of various kinds, in some places so soft that our divers would sink up to their knees, while in other places the ground would be hard, and at one place we ran across a bottom which was composed of loose gravel, resembling shelled corn. Out in the ocean, however, was found the ideal submarine course, consisting of a fine grey

[1] Quoted by Herbert Fyfe in "Submarine Warfare."

sand, almost as hard as a macadamised road, and very level and uniform. During this trip we investigated several sunken wrecks. We found one old wreck, said to have gone down some forty years ago near the mouth of the Patuxent River. . . . Toad-fish had evidently found this old wreck a congenial habitation, and when the diver's hand comes in contact with one of these horrible-looking, strong-jawed, big-mouthed fish, he pulls it back pretty quickly. We spent some hours with Hampton Roads as head-quarters, and made several descents in the waters adjacent thereto; we were desirous of making a search for the cables that connected with the mines guarding the entrance to the harbour, but could not obtain permission from the authorities, who were afraid we might accidentally sever them, which would, of course, make their entire system of defence useless. It was therefore necessary for us, in order to demonstrate the practicability of vessels of this type for this purpose, to lay a cable ourselves, which we did, across the channel leading into the Patuxent River. We then submerged, and, taking our bearings by the compass, ran over the bottom, with the door in our diving compartment open, until we came across the cable, which we hauled up into the compartment with a hook only about four and a half feet long, and we could not avoid the impression that it would be a very easy thing to destroy the efficiency of the present mine system. And how many lives might have been saved, and millions of dollars besides, had our Navy been provided with a craft of this type to lead the way into Santiago, Havana or San Juan, off which ports squadrons were compelled to lie for weeks and months owing to fear of the mines? On another trip we had a college professor on board, who could not understand exactly how our men could get out of the boat. I told him to come into the divers' compartment and I would explain it to him. Accordingly he, reluctantly, as I thought, entered the compartment, which in the *Argonaut* is a little room only 4 feet long and a little wider. After closing the door I noticed that the colour was leaving his face and a few beads of perspiration were standing out upon his forehead, and had he been any one else but a professor or, possibly, a newspaper man, I would not have gone any further with the experiment. The door, however, was closed and securely fastened. I then opened the valve a full turn, and the air began to rush in with a great noise. He grabbed hold of one of the frames and glanced with longing eyes at the door we had just entered. After getting the desired pressure I stooped down and commenced to unscrew the bolts, holding the door which leads out into the water. Our professor said, 'What are you doing now?' I answered, 'I am going to open this door so that you can see the bottom.' Throwing out his hands he said, 'No, no, don't do that. I would not put you to that trouble for the world.' However about that time the door dropped down, and as he saw the water did not come in, the colour returned to his face, and he exclaimed, 'Well, if I had not seen it, I never would have believed it.' "

But Mr. Lake found that the cigar shape, as has so often proved the case, did not give him quite as much horizontal stability as he would have liked, and so he set to work to reconstruct his boat, finally transforming her into the *Argonaut II.* When finished, about 1900, she had a cigar-shaped hull as before, but it was 20 feet longer and carried above a buoyant superstructure with a swan bow and overhanging stern, so that at the surface her hull looked very like that of an ordinary yacht. Her engines were by the same makers but were twice as powerful, and she carried a 4-h.p. auxiliary engine in addition. Her internal arrangements were very similar to those she had before alteration, and she proved as great a success as before, with the advantage of greater stability, seaworthiness and accommodation, for she could now carry a crew of eight men and had a cruising radius of 3,000 miles. From this improved *Argonaut* to the *Protector* was but one step. This powerful submarine torpedo-boat has been already

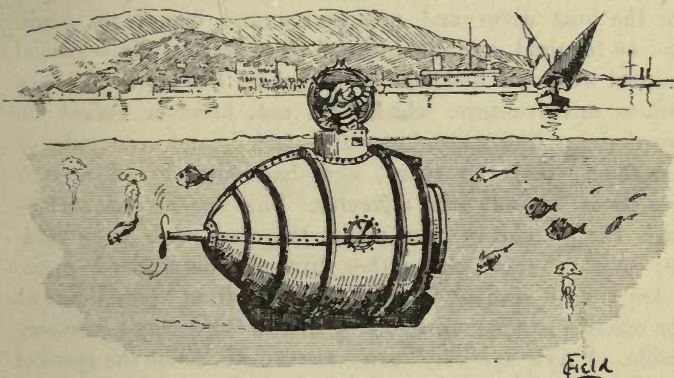


THE CHEVALIER PINO'S SUBMARINE AT WORK.—See p. 233.

p. 232]

described,[1] and it only remains to add that had the *A*1 and *Farfadet* been provided, as she and all the Lake boats are, with diving chambers, some, if not all of their crews might have escaped to the surface.

Two other diving-boats are worthy of mention, Pino's Submarine Worker and the *Bou-Korn*. The first mentioned is the invention of the Cavaliere Pino, an Italian, and is somewhat like a rather elongated egg, is only a little over



THE "BOU-KORN," 1903.

9 feet in diameter, and is able to resist the crushing pressure of the superincumbent water at a depth of 80 fathoms, or over 300 feet. Its crew of two men can lift and handle heavy weights with considerable facility by means of the long arms with claw-like attachments which protrude from the forepart of this strange vessel. Heavy objects having been placed in contact with an automatic grapnel, which is employed in conjunction with the submarine, they are clutched and hoisted to the surface. The crew can shift the position of their underwater ship by means of an electrically worked propeller and a

[1] *Vide* Chapter XIV.

wheel for moving on the bottom of the sea, while constant telephonic communication is kept up with the vessel from which the submarine grapnel is worked.

The *Bou-Korn*, a remarkably successful little vessel in its way, was invented, not by an engineer but by a priest, the Abbé Raoul of Tunis Cathedral, and was designed to enable the sponge fishery on the North African coast to be carried out with less danger to the divers. The inventor seems to have succeeded almost beyond his expectations, for the boat dives and manœuvres and comes up again just as required, and manipulates most successfully a special grapnel which he designed for it. The *Bou-Korn* had one serious misadventure, which does not, however, reflect on her design. The Abbé himself, a friend, and a couple of fishermen were on board, and had carried out one or two dives without any difficulty. She was at the surface with the hatchway open whilst the crew made their mid-day meal, after which another dive was determined upon. "Are you all ready ?" asked the Abbé from his position at the opening to the man who attended to the diving machinery inside. "Aye, aye, Sir," came the answer ; but the speaker acted too quickly, and down she went before the Abbé could close the hatch. Luckily all hands kept their presence of mind, and one after the other contrived to slip out of the man-hole and shoot up to the surface, where they were rescued by the tug in attendance. The *Bou-Korn*, which, by the way, is named after a mountain in the Bay of Carthage, was built at Goletta of metal sheathed with wood, for the double purpose of protecting her from corrosion and collision. She is about 16 feet long, and is equipped with three screws, one of which, at the stern, propels her, while the other two, situated one on either side, enable her to turn in her own length. She is a very queerly shaped craft not unlike a huge lemon, and having been got up again from the bottom after the mishap just related, is said to be still "going strong."

# CHAPTER XVIII

## Some Projected Submarines which have never been Built

## CHAPTER XVIII

### A Few Proposed Submarines

Some Projects for Submarines—Montgéry's *L'Invisible*, 1825—Castèra's Designs for Submarines—Althabegöity's "Hydroscaphe"—Bauer's "Brûleur des Côtes"—Hubault's Submarine—Lieutenant Hovgaard's Plans for a Submarine Vessel—Apostoloff's and Lacavalerie's weird Revolving Submarines—Rogers' Telescopic Boat.

Since the early part of the nineteenth century it has been necessary to limit our "Story of the Submarine" to those boats which have been actually built. Had not this been done, the proposed limits of this little work would have been far exceeded. For one under-water boat that has been constructed at least three have been designed, planned, or suggested. Many of these have had their good points, very many have been mere chimeras, while a great number have been principally remarkable for their weird and grotesque design. It is proposed in the present and following chapter to describe a selection—a very small selection—of the very numerous list of embryo submarines.

The first to which we will direct our attention is *L'Invisible* of Captain Montgéry of the French Navy, which is principally remarkable on account of its ambitious nature. According to the elaborate plans and descriptions which its inventor, or rather projector, drew up about the year 1822, *L'Invisible* was to be a regular under-water battleship armed with four big "colombiads," or under-water cannon, to be fired through ports fitted with special water-tight stoppers, eight carronades on the upper deck, a hundred torpedoes, the same number of rockets, a ram, and last, and perhaps not least, a species of force-pump or big syringe through which an explosive composition [1] could be squirted upon the enemy something in the same way that the ancients used to propel Greek fire through their siphons. The hull was to be very much like that of an ordinary above-water vessel except that it was to be rather shallower than was generally usual; it had a deck with low bulwarks just like any other craft. According to the inventor, it was to be built principally of iron, and to be 112 feet long, 28 feet wide, and 16 feet deep. A domed conning-tower rose three feet above the bulwarks, which, like the dome itself, were plated with armour 6 inches thick, as was also the deck and the upper portion of the ship's sides. She was to be fitted with two masts which could be lowered and stowed behind the bulwarks. But these were only an auxiliary means of propulsion, as she relied principally on oars and a set of paddle-wheels, which last were to be actuated by a kind of explosion engine of which the motive power was derived from the gas of exploded gunpowder. This sounds like a risky machine to deal with, but Montgéry does not condescend to precise details of its construction. There is little doubt that the whole thing was merely an attempt to improve on the *Nautilus* and *Mute* of Fulton, without the provision of any very new or original features. Another, and modified edition of *L'Invisible* was suggested by Montgéry a year or two later, the principal difference from the first being that it was smaller.

A M. Castèra, who had devoted many years of his life to the study of submarine navigation, and who had been one of a committee appointed to report on Fulton's submarines, took out what is said to have been the first patent for a submarine

[1] The composition suggested was "three parts of naphtha or rectified petroleum and one of nitrate of potash reduced to a fine powder."

boat in 1827.[1] Its shape was evidently suggested by the *Nautilus*, but its inventor, unlike Fulton, did not quite fancy the idea of being cut off from the upper air altogether. He therefore proposed that his boat should be suspended from a float by two cords which could be reeled in or out from inside the boat and so assist her to ascend. From the middle of the float a flexible tube or hose led into the conning-tower so that the vessel was always supplied with air. Castèra's submarine was, in point of fact, a "wrecking boat" or "under-water worker" comparable in many respects to other more modern boats of the kind such as the *Argonauts*. Like them it had its air-lock, by means of which divers could descend into the water, it had scuttles in the bottom for the examination of the sea-floor, while long leathern gauntlets hung from its under-part by means of which objects could be grasped by men inside. She was to be propelled by oars, and to have a horizontal plane or rudder right forward and a heavy detachable leaden keel serving as a safety-weight.[2]

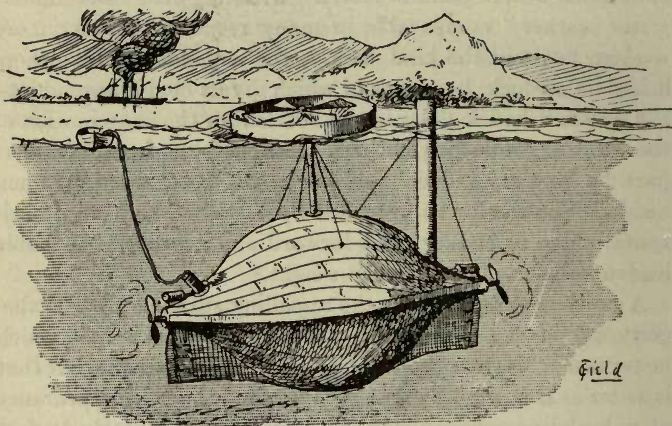
A gentleman rejoicing in the appalling surname of Althabegöity, proposed a weird-looking submarine vessel in 1856 which he termed a "Hydroscaphe." A model of it was made, but that is as far as it went. Looked at sideways it had the appearance of a brobdingnagian lemon, 82 feet long and nearly 40 feet in diameter. It was to be propelled by two screws—one at either end—actuated by a motor the nature of which is unknown, and was to be submerged by the admission of water and the action of a big horizontal propeller standing well up above the top of the hull. The Hydroscaphe was wood-built and maintained its connection with the air by means of a tall

[1] He had brought out a "project" for a submarine as far back as 1796.

[2] Another of Castèra's projects was to equip his boat with four wheels of large diameter which could be turned by cranks from inside and so move on the sea-bottom—an anticipation of Lake's idea.

funnel or cylinder containing a ladder leading down into the boat. The whole affair was much more funny than practical.

One of the last attempts to solve the problem of underwater attack made by Bauer, that clever but very unfortunate inventor, was with his design for a submarine which he termed "Le Brûleur des Côtes." This was in 1861, and under the auspices of *Die Gartenlaube* [1] a subscription was set on foot to provide the necessary funds for its construction. But not half the



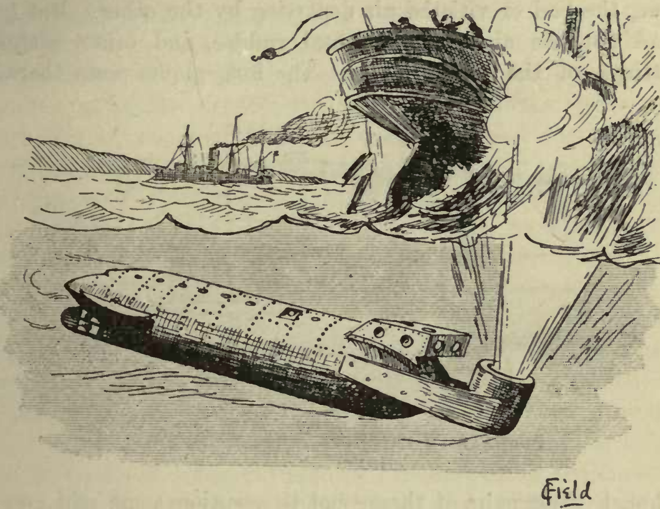
ALTHABEGÖITY'S PROPOSED SUBMARINE, 1856.

estimated cost was forthcoming, and the project had to be given up. The vessel may be best described in Bauer's own words: [2] "This coast-defence vessel is in the form of a whale. Its hull is of iron, and provided with engines of 100 h.p. which will enable it to travel and manœuvre at great speed at the surface of the water till it arrives within cannon-shot of the enemy's ships; thenceforward it dives to the depth of about 30 feet and then approaches them either on the bow or broad-

[1] A popular journal.

[2] Quoted by Pesce in "La Navigation Sous-marine."

sides, being careful to avoid touching the enemy's ship, to whom it should not give the least indication of its presence. Having arrived at its destination, the submarine fires its torpedo"—which, it should be said, was to be carried in a species of mortar like a gigantic pipe-bowl protruding from the bow—"by means of a channel of communication forward;



BAUER'S PROPOSED "BRÛLEUR DES CÔTES," 1861.

the explosion being vertical, would make a hole at least one and a half or two feet in diameter. After this operation, it rises to the surface in a parabolic curve by aid of its vertical means of propulsion, opens the portholes in its upper-works, profits by the consternation of the enemy's crew to run alongside and give him a broadside at point-blank range, and again disappears in the waves to avoid being boarded by the enemy. At this moment the marine colossus, seeing itself helpless and abandoned without assistance, will surrender to the pitiful

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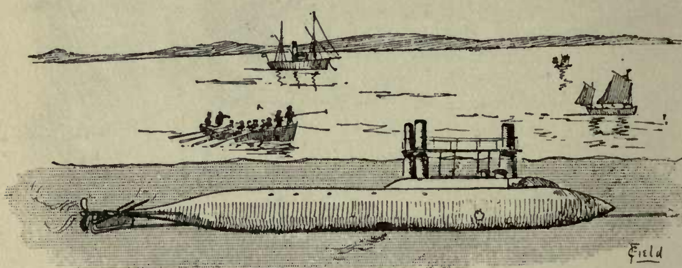
submarine with its double mode of propulsion, and they will say that the Goliath has been vanquished by David."

The queer oblong submarine patented by M. Hubault of Amiens in 1857 was not very unlike Castèra's in general design, but a rather more crude affair. It had the float, but with two tubes leading to it instead of one, the idea being that the good air was to come into the boat through one, the bad or vitiated air departing by the other. But it had not the air-lock, horizontal rudder, and other useful fittings of the older design. The long gloves were there,

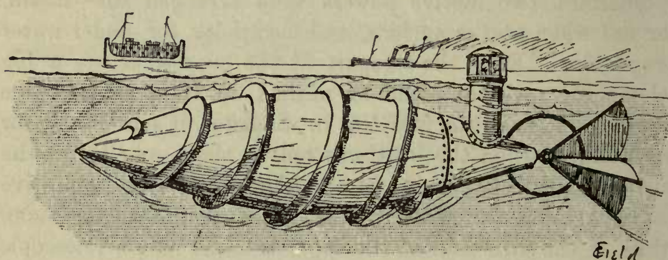



HOVGAARD'S PROPOSED SUBMARINE, 1887.

though—four pairs of them—not to mention some odd contrivances which enabled the crew to stick out their heads as well. She had a hand-turned propeller and a species of light-projector forward, though how the searchlight itself was provided does not appear. Her odd appearance is really the only excuse for mentioning Hubault's submarine.

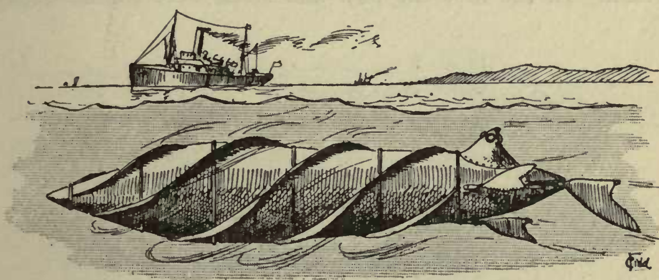
A very different affair was the under-water boat so carefully thought out and described by Lieutenant Hovgaard of the Royal Swedish Navy in a little pamphlet he published in 1887. His proposed submarine was to be of the usual cigar shape, but it was not round in cross-section but oval, being nearly twice as wide as deep. Its bows were inclined to bluffness, but it fined away very much aft. Near the forepart was a kind of excrescence or superstructure which held a detachable safety-boat to enable the crew to escape in case of accident. It was carried in a species of dock just as was the similar boat in Bourgeois' *Plongeur*. The total displacement of Hovgaard's ideal boat was 740 tons, so that it would have been a submarine of the very largest kind. Like Nordenfeldt's and Waddington's boats, she was to have horizontal propellers for vertical movement to aid in ascent and descent. These were placed in recesses almost amidships. A single screw served for forward propulsion, and, as in most of the very latest submarines, two motive powers were arranged for—steam, for use when at the surface, and electricity for under-water progression. From the forepart of the superstructure a big telescopic ventilator could be pushed up to a considerable height, and, as it was four feet in diameter, it served also for a hatchway when the boat was only a short way below the surface. Just abaft this and on either side was a diminutive conning-tower, the steering-room being just beneath them, while at the after end of the superstructure was a telescopic funnel. When the boat was at the surface and both funnel and ventilator were raised, a light bridge or hurricane deck could be fitted between them for convenience in navigating. As armament the proposed submarine was to carry four Whitehead torpedo tubes, two being placed side by side at the bow and the remaining pair in the steering-room, one on either broadside. In addition to these, provision was made for running out a torpedo at the end of a long telescopic spar at the bows. Altogether Hovgaard's submarine would seem to have been one of the most practical designs that had been produced, and it seems a pity that plans so well and carefully worked out should not have resulted in the construction of what bid fair to be a really practical and efficient war-vessel. As such it serves very well as a foil for the next boat to be described, which is no other than the fantastic revolving submarine imagined by M. Apostoloff, a Russian student of electrical science.

Now if there is one thing more than another that has been clearly proved by every trial of every submarine that has taken place, it is that, the power of propulsion being equal, the speed under water, when the whole boat is submerged, falls very much below that at the surface, even though the lines of a submarine are specially designed for the former conditions and not for the latter. In spite of this, there are and have been a great number of persons, some of them really students of navigation both above and below water,



APOSTOLOFF'S PROPOSED SUBMARINE, 1889.

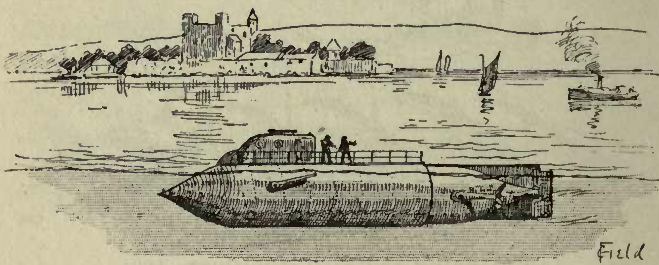
who cannot get rid of the idea that a boat can be built to travel under water at a speed which cannot be approached by any above-water craft that ever floated. Among these must be reckoned M. Apostoloff (though by this time he surely must have disabused his mind of the idea), for the weird submarine he designed in 1889 was to be capable, he alleged, of crossing the Atlantic in no more than 28 hours!! In order, as he thought, to overcome the frictional resistance of the water which so seriously retards a submarine vessel,—for the simple reason that the whole of the hull is submerged instead of about a third, as is the case in an ordinary boat,—M. Apostoloff adopted in the design of his boat the principle of a boring screw. Its entire body is itself a screw which bores or worms its way through the water. The revolving portion of the hull, however, finishes just before a little conning-tower which is placed close to the stern, which is finished off by a species of cross-shaped rudder like the paper "feathers" which schoolboys fix into the end of a penholder to transform it into a dart. Working on a kind of universal joint, it is supposed to be able to deflect the boat up or down, right or left, or in fact in any direction whatever. The part of the boat that revolves in the water is of course only the outside shell, which works on an axle running the whole length of



LACAVALERIE'S PROPOSED SUBMARINE, 1894.

the submarine, and around it is fixed a screw flange converting about three-quarters of the boat into a huge propelling screw which was to be driven by electric motors. Possibly to meet the views of intending passengers, who, while taken with the idea of crossing the stormy Atlantic at lightning speed, hesitated to book passages in the interior of a vessel which added to the ordinary risks attendant on submarine navigation a chance of a jam in the machinery which might turn the saloon into a huge merry-go-round, Apostoloff suggested a modification of his first scheme. The submarine was to be there just as before, but lofty pillars at bow and stern were to support between them a big swinging upper hull something like an ordinary decked boat, but hanging in the air clear of the waves. So far as is known, neither in one form nor the other has the *Apostoloff* crossed the Herring Pond up to this day.

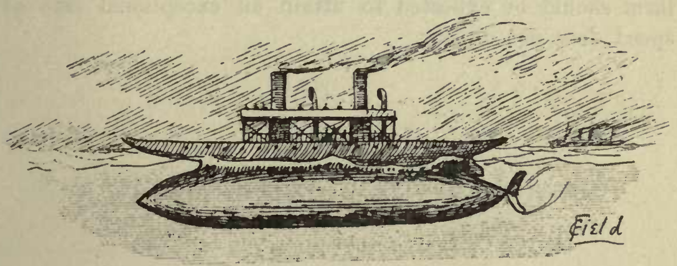
A South American, living at Colon, Lacavalerie by name and a dentist by profession, made elaborate plans for a somewhat similar vessel in 1894. Whether he cribbed the idea from Apostoloff's published designs, or whether it was suggested to him by his boring operations in the teeth of his patients, is not known. Anyway he designed two kinds of submarines propelled in exactly the same way as Apostoloff's proposed vessel. In the first the bow and stern were connected by




ROGERS' PROPOSED SUBMARINE, 1894.

a strong keel and the revolving portion hung between them, the flanges on it only making a very gradual turn. In his later design the revolving portion was almost exactly similar to that of Apostoloff's design, the main external difference between the two boats being in the rudders, which in Lacavalerie's boat were four in number, each like half a fish's tail. This boat has not crossed the Atlantic either. It may be noted in passing, that though hitherto unattended with success, this form of propulsion seems to possess a fascination for a number of inventors not only of submarines, but of surface vessels. We may mention Bluemel of San Francisco, Gresham of Brooklyn, and a Canadian inventor, all of whom have patented designs for such ships or boats, to say nothing of the water velocipedes and cycles invented by Breyer and Moxon.

Silas and George Rogers of Brighton carried out an ingenious application of the method of sinking and rising by means of alteration in displacement in the design for a submarine which they patented in 1894. Instead of effecting this by means of a series of cylinders as in the Campbell and Ash boat, their idea was to make the boat itself telescopic. The foremost three-quarters of the vessel—which was cylindrical with pointed ends—was made a shade larger than the afterpart,




VOGT'S SEMI-SUBMARINE, 1898.

which fitted into it, the joint being made water-tight by circular rings of packing. When the boat was required to go below water her displacement was reduced by drawing in the afterpart by means of a big screw and hydraulic apparatus. This operation was reversed when it was desired to come up again. Rogers' boat was to be propelled by twin screws actuated by electricity, and was expected to attain a speed of from 12 to 14 knots. Another peculiarity about this telescopic submarine was that her conning-tower was designed, so to speak, to be a boat in itself. Should any untoward accident befall the vessel while in the depths, all the captain and his crew (who would be with him in the conning-tower) would have to do would be to follow the example of the rats who proverbially " leave a sinking ship." They would be able to disengage the tower from the foundering submarine and " bob up serenely from below." Somehow or other this rather plausible submarine has not " caught on " nor even been built.

Though not a true submarine, the " high-speed semi-submersible " patented by Vogt in 1898 is worthy of mention. The lower and principal portion of her hull was exactly like a cigar-shaped submarine, but attached to it was an above-water superstructure like a shallow boat carrying a species of flying-deck between the funnels. Why a vessel of this form should be expected to attain an exceptional rate of speed does not appear.

# CHAPTER XIX

## More Inventors' Ideas for Submarine Vessels

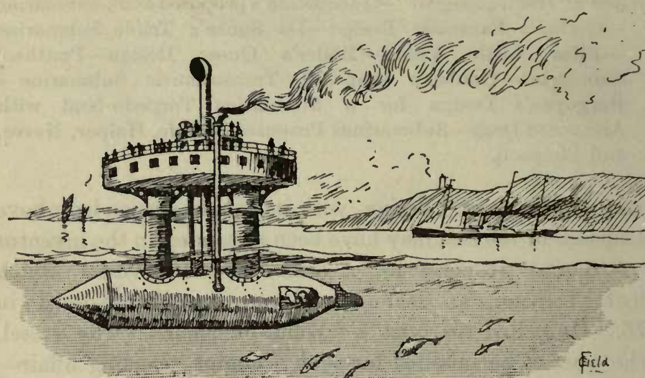
# CHAPTER XIX

## MORE INVENTORS' IDEAS FOR SUBMARINE VESSELS

**Tomassi's "Hemi-plongeur"—Jacquemin's proposed Semi-submarine —Gerber's Fantastic Design—De Souza's Triple Submarine —Elias' Little Vessel—Möller's Queer Design—Ponthus' Submarine—Goubet's proposed Transatlantic Submarine— Burgoyne's Design for a Submarine Torpedo-boat with Armoured Deck—Submarines Proposed by Fife, Haipar, Neves, and Simpson.**

APOSTOLOFF'S second design, with its saloon suspended above the surface of the sea, may have been suggested to the inventor by a quaint proposal for a semi-submarine vessel which Donati Tomassi, an Italian engineer, brought forward in 1876. He called his boat a "Hemi-plongeur." The vessel, if the word is permissible for such a quaint seagoing affair— consisted of two parts, a cylindrical submarine with coned ends and a circular platform supported on a pair of big round colums which raised it some way above the surface. These columns were of considerable diameter, so that, being hollow, they were available as hatchways for both passengers and cargo. They were also made telescopic so that the submarine portion of the contrivance could sink to a greater depth below the surface when rough weather came on and so be less affected by the waves. But the inventor can hardly have had any sea-experience, or he would have perceived that such an arrangement might well lead to the destruction of his boat. A big wave breaking below the platform would in all probability tear it from its supports, the water would rush in and sink the submarine in an instant, and the platform would not be very long in following it to the bottom. Yet Tomassi was so pleased with his idea that he suggested that it might be found useful in war as well as in commerce, if gun-turrets were mounted upon the upper platform.

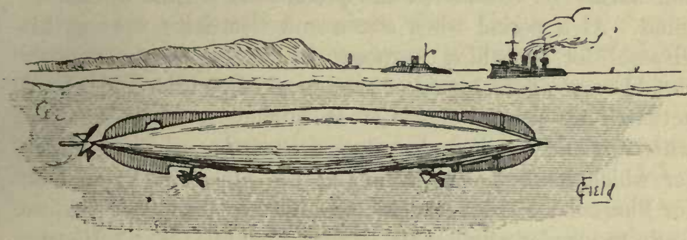
A Frenchman, M. Delavaque, produced a model of a submarine in 1874 which is interesting on account of the two horizontal propellers for sinking and ascending. They were placed under the boat one at either end, and possibly furnished



TOMASSI'S "HEMI-PLONGEUR," 1876.

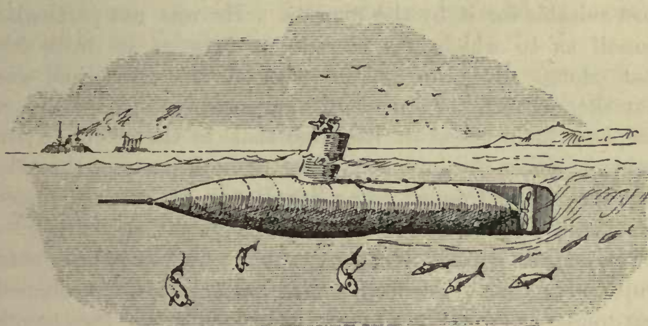
the germ of the idea perfected by Nordenfeldt, Waddington, and later inventors.

Another queer idea for a semi-submarine was suggested in 1884 by one Jacquemin, a dockyard employee at Ciotat. His vessel was to be of the ordinary cigar shape, but it was only intended to travel at a very short distance below the surface. A high, narrow hatchway stood up above the centre of the boat and projected above the surface, thus affording a copious supply of air to the crew and forming a kind of look-out place for the captain. She was fitted with all kinds of apparatus for the use of divers, including air-locks for their ingress and egress and leather arms and hoods by means of which they were supposed to be able to lean out of the boat below water and use their hands for under-water work. The most curious



DELAVAQUE'S PROPOSED SUBMARINE, 1874.

part about the idea is that, the boat having to keep so close to the surface, it offered no particular facility for diving purposes. It did not take the divers appreciably nearer their objective than a surface boat would have done. She was to be fitted



JACQUEMIN'S PROPOSED SUBMARINE, 1884.

with an escape boat like that carried by Bourgeois and Brun's *Plongeur* [1] and in Hovgaard's [2] proposed submarine.

The submarine vessel which was proposed by Mr. Gerber

[1] *Vide* Chapter VIII. [2] *Vide* Chapter XVIII.

of San Francisco in 1887 is one of the most crude and extraordinary affairs—if the inventor's diagram is anything like his real idea—that were ever conceived—so much so that it can hardly be considered the product of a sane or serious mind. At a period when steam and electricity were at his disposal for propelling purposes, to suggest that his vessel should move about by aid of hand-worked paddles and wheels actuated by twisted elastic is an obvious anachronism, and when we find the inventor stating that the principal object for which he wishes to construct his submarine is to look for Pharaoh's chariot-wheels at the bottom of the Red Sea, we begin to wonder whether Mr. Gerber should be taken seriously.

A Brazilian, M. Virissimo Barboza de Souza, had a rather ingenious idea for a submarine in 1891, if it should have proved workable. But as it was never built, this question has not yet been decided. His scheme provided for a long cylindrical vessel with coned ends, its engines being driven by whatever motive power should eventually be considered most suitable for it by the experts. He was not particular himself as to which was chosen, as long as it drove his boat along. But the unique part of the invention was that the central portion of his proposed submarine was a complete little vessel in itself, so that in the event of an accident, either the foremost, after, or both parts of the submarine could be dropped, like a lizard's tail, and the remainder would still be able to get along comfortably " on its own."

Two rather curious ideas for submarine navigation were projected in 1898. The first of these was a little lemon-shaped four-tonner proposed by Castello y Elias, only just big enough to carry one man and one torpedo, which almost filled a tube that ran right along through the axis of the little vessel. The whole of the hull above this tube was packed solid with cork except for a small central compartment for the "operator," who was intended to wear a diving suit and helmet, while below were a number of cylindrical reservoirs containing compressed air for working the engines and for supplying the diver. A small cylinder of highly compressed air was placed in the central tube—behind the torpedo for its ejection.

In the same year, an inventor named Möller brought out a design for a submarine worker, whose shape it is almost impossible to describe. It can only be vaguely hinted at as an ovoid bent askew. In the diagram that the designer has produced, the interior of the boat presents the appearance of a piece of a factory with a good deal of brickwork and a large glazed window, though possibly what look like window-panes and bricks may be intended to represent something very different. The boat has no visible means of propulsion, although there is an engine with a big cylinder and a flywheel. The captain of this boat is supposed to act in a rôle similar to that of the commander of Tuck's first submarine.[1] He wears a diver's suit and takes his stand in a sort of sentry-box, which can be pushed out of the top of the vessel by machinery arranged for the purpose. He stands facing aft, and ready to release a buoyant torpedo which reposes in a little well beside him.

A M. Ponthus, a Frenchman, who may be described as an inveterate inventor of submarine apparatus, had a very novel—albeit probably impossible—idea for increasing the speed of a submarine which he projected in 1901. He imagined that her propellers, of which she had three,—one at each end and a third underneath amidships,—would revolve so rapidly that they would create a species of vacuum around them and so prevent them exerting their full driving power on the water. To get over this imaginary difficulty he hit upon the expedient of blowing the water back on the screws by means of jets of compressed air.

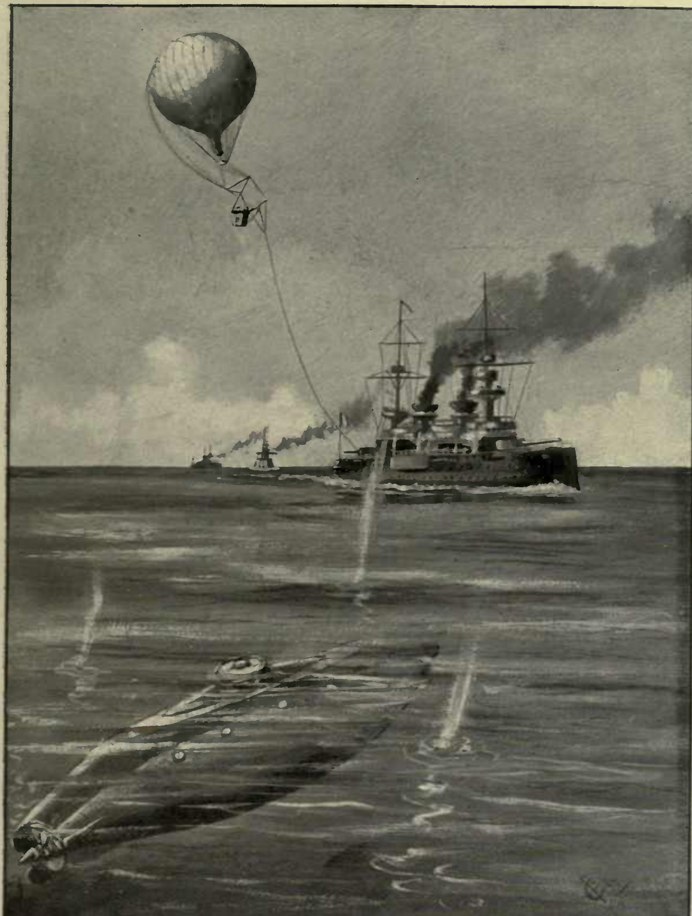
He estimated that, aided in this way, they would be able to drive his boat through the water at the enormous speed of 40 miles an hour. The submarine herself was in the form

[1] *Vide* Chapter XI.

of a short, fat cigar, with a conning-tower and hatch amidships. The four rudders—two horizontal and two vertical—were placed just abaft the conning-tower. She was equipped with four external and detachable weights and an arrangement for projecting an electric ray in front of her. The central screw, besides assisting to drive her forward, was expected, in some unexplained way, to add considerably to her stability.

A submarine of large size, and so differing considerably from his other boats, was designed at one time by the eminent, though financially unsuccessful, Goubet. Like Apostoloff's nightmare of a boat, it was intended to revolutionise trans-atlantic travel. The following are extracts from a general description published in 1902.[1] Exact details are not procurable. "The marvellous craft which he [M. Goubet] has perfected will cross the Atlantic, and remain under water half the journey—3000 miles. Should the Goubet trans-atlantic arrive off New York at night in a tremendous storm, she need not waste time and money in beating on and off, or anchoring outside the harbour. She can approach under water, announcing her coming by signal fuses, until, arriving in the channel, she can arise if she pleases and proceed to Quarantine's tranquil water. It requires no expert to appreciate some of the advantages such a vessel as Goubet's has over the greatest transatlantic liners. The *Nautilus* of the twentieth century can have no fear of the mightiest storm that ever strewed its path with drifting hulks. For, watching the barometer, the captain of Goubet's electrer —will that name fit a steamer driven by electricity?—will fill the water reservoirs for immersion, and on the near approach of a storm will take a header down below. There, far under the tremendous waves that are curling over the funnels of the surface boats, Goubet's vessel will keep on her quiet way until the storm spends its force. The Goubet boat will have eyes and the sharpest kind of ears. Its eyes will

[1] In the *Illustrated Mail.*



BALLOON LOOKING FOR SUBMARINES.—See p. 282.

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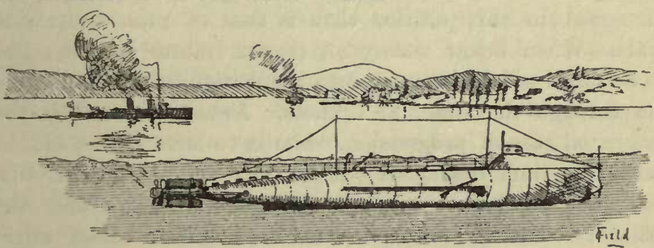
By favour of the *Sphere*.

not only be electric searchlights to illuminate its submarine path, but, being under water, it will be able to see above water—this by means of the new French cleptoscope, an instrument composed of mirrors and prisms and telescoping tubes, of which the top one projects above the surface of the water. . . . When heavy fog's impenetrable wall shuts out sea and sky, the Goubet boat can be quickly submerged and safely pursue its way. So, until submarine boats become as numerous as fishes, any one of them is entirely safe from collision." . . . And so forth. And yet we still brave the Atlantic in above-water vessels!



BURGOYNE'S PROPOSED ARMOURED SUBMERSIBLE, 1904.

Mr. Allan Burgoyne, the author of that very interesting and compendious work "Submarine Navigation, Past and Present," has designed an armoured submersible in which are to be found many of the best points for which the most successful and well-designed submarines are remarkable. "According to the plans,[1] the boat would be 140 feet long, with a beam of 12 feet. She would have a somewhat peculiar shape, her forepart being very like that of a torpedo-boat or a destroyer, while her after-portion would be of the familiar cigar shape usual in submarines. The conning-tower—which is armoured—is so designed that it could be raised to a considerable height above its normal position, so that when the boat is lying close under the surface it could be pushed up to

[1] *Daily Graphic.*

reconnoitre without any other part being exposed, and quickly lowered below water again. Provision is made for the escape of the crew should any damage or accident prevent the boat from coming to the surface. A closed cylinder fits into a recess immediately abaft the conning-tower, in which escape is effected. The armament of the proposed submersible is to consist of three torpedo tubes. Of these, one is placed forward and the other two—one above the other—right aft. . . . She will have a 24-cylinder oil engine of 500 h.p. for surface propulsion, when a speed of from 14 to 15 knots is expected, her shape forward being much more suited for speed in this position than is that of most submarine craft. When below water, an electric motor of from 250 to 300 h.p. will be brought into requisition, which will drive her through the water at 7 knots. Awash, 8 knots is the estimated rate of progression. She is to have twin 4-bladed propellers, well bracketed out to port and starboard. She will have three keels, one in the usual position, and the other two—which perhaps should be rather called bilge-pieces—one on each side, so that rolling and pitching should be reduced to a minimum. The forepart of these side-keels terminates in a horizontal rudder, which, together with those which are placed right aft, serve to guide the vessel up or down when submerged and keep her at the required level. For this purpose balance cylinders are also provided, forward and aft, so arranged that as water is drawn into one an equal amount is expelled from the other. In short, the boat will have every appliance that the most exacting submarine could require, even to an electric-light projector which comes up through a specially constructed hatch in front of the conning-tower." Finally it must be mentioned that the whole portion of the boat that would appear above water in an awash position is well protected by armour plating.

Another recent submarine design is that of Mr. C. W. Fife of Brighton, a young man who has devoted four years' study and experiment to it. "In shape[1] the craft is not dissimilar to the type now in use in our Navy, but it is with added inventions that he claims his success. First and foremost among the advantages claimed for the new submarine is that while travelling submerged, if by accident it should come in contact with a rock, or a sunken wreck, even should a hole have been made in the craft, she will at once rise automatically to the surface. On the other hand, should she be run down by a passing vessel while being partially submerged, she would remain on the surface, thus rendering impossible such a disaster as that which befell the *A*1. It is the boast of the inventor also that his boat will be able to remain submerged with the full necessary crew on board for as lengthy a period as ten days without in any way communicating with the surface of the sea. Enough fresh air will be generated during that time to supply those aboard, and it will be possible practically to regulate the temperature of the boat at will. . . . The boats when constructed will, according to size, carry three or five torpedoes and a submarine gun, and by means of a special engine and propeller and the enormous force used, Mr. Fife declares that a speed of 20 knots on the surface and 18 knots when fully submerged will be easily attained." These are, after all, generalities, and are rather suggestive of the sanguine temperament of youth. The account from which the above description is taken states further that the model was to be experimented with by the Admiralty, but if it was approved it has since been kept such a dead secret that the fact that there are any such boats under construction has not leaked out.

Two or three more descriptions of the more recent fancies in the way of submarine vessels and we must leave the consideration of the craft that have never really existed, except on paper, and to which perhaps more space has already been devoted than they are worth.

[1] *Illustrated Mail.*

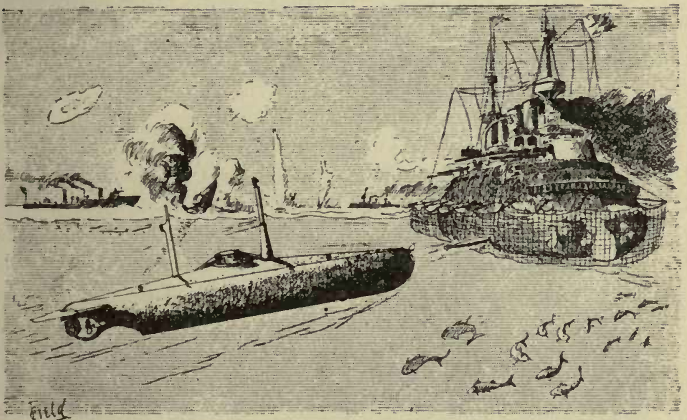
Lieutenant Haipar, of the United States Navy, is responsible for what we may term "a very queer fish." His proposed boat, which is much the shape of an oval pocket-flask, looks very much like a short, podgy fish, the big rudder taking the place of the tail. The shape is probably designed with a view to giving the boat the maximum amount of horizontal stability. The propellers, of which there are two, revolve in recesses cut out of the rudder, and, unlike most twin screws, are placed not side by side, but one above the other. She has the usual conning-tower amidships and carries no less than four Whitehead torpedoes, which are placed two on either side of her, one over the other, suspended in clips or frames fixed to the outside of her hull.

Another American has been ingenious enough to evolve a submarine of a unique shape, a feat which one would think almost impossible when one considers the immense numbers of weird under-water vessels that have been either designed or built. This inventor, Mr. Thomas Wheless of New York, suggests that his boat should be built on very much the same lines as an ordinary racing yacht's hull, with a sharp spoon bow and an overhanging stern. Strictly speaking this vessel ought to be called a submersible rather than a submarine, for though intended to move on the surface it can yet be submerged at will. She is fitted with a single screw, a pivoted rudder, and is steadied by a heavy weight amidships.

A Chilian gentleman, Don Santiago Neves of Valparaiso, has not long since designed a submarine working boat which may possibly prove a useful vessel—if ever constructed. It is very much in the form of a long sugar-cone, the stern, with its propellers and rudder, being the smaller end. At the other is the conning-tower, and in front of the boat a most powerful pair of claws or levers opening and closing by hydraulic power. The vessel, like Pozzo's *La France*,[1] is intended

[1] *Vide* Chapter XVII.

to work suspended from an above-water craft by a chain, but her propellers—aided by six others placed at various parts of her hull—enable her to move very freely about her work and place her in the entire control of her captain. Forward she has a whole array of specially constructed bull's-eye scuttles and an electric-light projector, so that her occupants will have no difficulty in seeing what they are about. Her



SIMPSON'S PROPOSED SUBMARINE, 1906.

inventor states that he has specially designed her for raising weights and for the heavier kinds of under-water work.

In conclusion we may mention a somewhat "neat-looking" submarine for which a Mr. George Simpson took out a patent in 1906. Among her peculiarities may be noted a long overhanging stern which serves to protect her rudder and propeller, a big horizontal rudder made in one piece, and a queer ventilator which acts both as a downtake for fresh air and an outlet for foul. She is to fire her torpedoes from a bow tube, and is strengthened externally by a series of longitudinal plates which form a species of keel.

# CHAPTER XX

## Recent Submarine Disasters and Accidents

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### Recent Submarine Disasters and Accidents

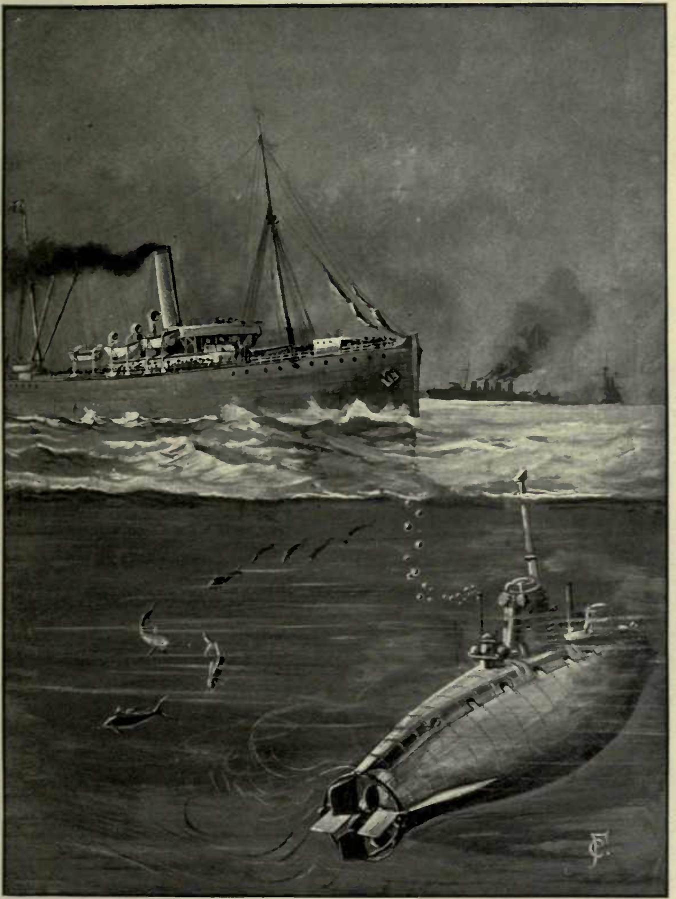
Loss of the *A*1—Explosion on Board the *A*5—Sinking of the *A*8—Foundering of the Russian Submarine *Delphin*—Loss of the *Farfadet*—Sinking of the *Lutin*—Slighter Mishaps.

The deep has taken heavy toll of lives of the pioneers of submarine navigation, as we have recorded in previous chapters. Many inventors and many who have trusted themselves to their inventions, have looked their last on the sky when their submarine craft has dived below the surface. There was Day, who with his submarine contrivance disappeared in the depths of Plymouth Sound in 1773; Cervo, crushed in his hollow wooden ball in 1831; Dr. Petit, who suffered the same fate at Saint-Valery three years later; and the Yankee shoemaker, Lodner D. Philips, who met his death at the bottom of Lake Erie early in the 'fifties. More recently, as boats were generally built larger, the number of lives lost in accidents to submarine craft grows heavier. There was the Confederate *David*, which time after time drowned her crews during her trials, finishing up by drowning all hands when she blew up the *Housatonic*. We have seen, too, how the too sanguine inventor Herr Flach lost not only his own life but those of his son and six other unfortunates in Valparaiso harbour. All these casualties occurred during what we have termed the experimental period of the evolution of the submarine. But there have been a good many others since the submarine boat has become a recognised naval unit, which will be fresh in the minds of most readers. We may briefly refer to some of the most recent.

There was a mishap on board the United States submarine *Fulton* in April 1902. She was on her way from New York to Washington, having on board, besides the stored electricity for her under-water trials, several hundred gallons of gasoline for her surface engines. Just after she had reached Delaware Breakwater there was an explosion of hydrogen gas, which is stated to have been caused by the spilling of acid from the storage batteries. The boat herself was not seriously damaged and was able to continue her trials, but her commander, several of her crew, and an Austrian naval officer who was on board, were more or less seriously injured.

The next disaster to be chronicled is a very much more dreadful affair, in which many of our gallant sailors lost their lives. It is almost superfluous to say that it is the sad loss of the submarine *A*1 at Spithead in 1904 that is referred to.

This boat was one of the newest and finest of the then novel submarine flotilla, and with others, in conjunction with gunboats and destroyers, was taking part in an extended series of manœuvres, in which their duty was to defend the approaches to Portsmouth Harbour against the attack of the Home Fleet of battleships and cruisers. In the course of the proceedings it became the task of *A*1 submarine to mount guard over the Eastern Channel into Spithead not far from the Nab Lightship. One of the enemy's cruisers had been sighted in that neighbourhood, and the unfortunate submarine lay awaiting her advent with only the top of her periscope showing above water. It was a misty afternoon, and, the "eye" of the periscope being probably turned seaward, the approach of the liner *Berwick Castle* coming up from the direction of Southampton was not observed. Neither did the watch on board the steamer catch sight of the diminutive top of the periscope, which in the nature of things was made as small and unobtrusive as was compatible with efficiency in



HOW THE "A1" WAS LOST.

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order to avoid the prying eyes of the look-outs on board an enemy's ships of war. The *Berwick Castle* then, not dreaming of the proximity of the submarine, passed right over the spot where lay the doomed *A*1, which unfortunately for herself had —unlike the earlier "Hollands"—a very lofty conning-tower.

From the reports of the divers who afterwards examined the wreck, it is evident that the liner struck her at the top of this tower, breaking the lid and letting in the water which carried swift death to the devoted crew who—as Admiral Sir John Fisher aptly pointed out in his general orders—"as truly lost their lives for their country as if they had fallen in action with its enemies." The captain of the *Berwick Castle* felt that she had touched something, and signalled the fact to the nearest men-of-war. He told them that he thought it must have been a practice torpedo, so slight was the shock. This signal was remembered later on at the rendezvous when the *A*1 failed to appear, and instant and careful search revealed her whereabouts. Two officers, Lieutenant Mansergh and Sub-Lieutenant J. P. Churchill, together with nine men, lost their lives in this terrible catastrophe. The boat was discovered lying in 42 feet of water, and owing to the depth and the strong tideway, great difficulty was experienced in getting her to the surface; but thanks to the unremitting exertions of the naval officers and men employed on the work and the assistance rendered by the salvage steamer *Belos*, she was eventually lifted from her resting-place and brought into dock at Portsmouth for repair. The bodies of the victims of the disaster were transferred from their iron tomb to the consecrated ground of Haslar Cemetery.

Another of the same series of boats, the *A*5, was the scene of the next fatality. On the morning of February 16, 1905, she was at Queenstown and alongside the *Hazard*, a gun-vessel which was acting as a tender to submarines, filling her petrol tanks from the supply tank on the deck of the latter vessel. Nearly two hours had elapsed after she had filled up, during which time her crew was busily employed in getting the boat ready to go out of harbour, when an explosion occurred on board. It is supposed that petrol vapour had leaked out, mingled with air, and that this highly inflammable mixture was ignited by sparking from an electric switch. Whatever the cause, the results were most serious. Her commander, Lieutenant Skinner, and five men were killed or afterwards died of their injuries, and every man on board was incapacitated. While the crew of the *Hazard* were engaged in removing them from the submarine, a second explosion occurred immediately below the conning-tower, which, while not so disastrous as the first one, was yet responsible for further injuries. White mice were afterwards kept in the British submarines, which act as danger indicators, for they begin to squeak the moment there is the slightest hint of escaping petrol vapour.

But the explosion on board *A*5 does not end the tale of mishaps to the "A" Class. Only a few months later—on June 8, to be exact—the *A*8 went down just outside Plymouth Breakwater with eighteen men on board, four only of whom were saved. The following is abridged from the report made by the *Times* Plymouth correspondent:

"*A*7 and *A*8 went out yesterday morning about 9 o'clock accompanied by torpedo-boat No. 80, for evolutions. It was a dull grey morning with rain falling at intervals, but the weather was tolerably clear. The two submarines were taken to the western end of the Breakwater for instructional purposes. Torpedo-boat No. 80 carried extra ratings to be put through the methods of diving and to become accustomed to under-water navigation. All the men wore regulation dress, special oilskins and sea boots. Each of the submarines dived twice for the specified length of time. About half-past ten both submarines came up, each to exchange three of her crew for a similar number of ratings from the torpedo-boat. The conning-towers were opened and the other prescribed regulations carried out. The new ratings had stepped on board

THE SEARCH FOR THE "A1."—See p. 267.

By favour of the *Sphere*.

the sloping deck, and the three men to be exchanged were in the act of coming up, when the bow of the vessel was seen to dip heavily, causing her to ship a huge quantity of water through the conning-tower. Then, to the great consternation of those watching, she began instantly to settle down before it was possible to close the conning-tower. Lieutenant Candy, it was noticed, leaped forward, whilst the other three on deck were washed off. With all speed boats were lowered from the *Commonwealth*, the *Forth* and the torpedo-boat, and rowed to the scene of the disaster. A dinghy from a passing ketch was also lowered and picked up one survivor. The others were rescued by the other craft and placed on board the torpedo-boat, which then hurried under full steam to land, carrying tidings of the disaster. The only ray of hope being that, owing to the length of time the submarine took to disappear from view she could not have been quickly flooded, the rescue parties worked with desperate energy on this forlorn chance. Two buoys marked the spot, and Government tugs patrolled for some distance around to preserve a clear space for the operations of the divers. About 1 o'clock an explosion was heard and wreckage was flung up, including the two hatches of the *A*8. A second explosion followed, eddying bubbles disturbed the surface of the water, and the hope of rescuing the imprisoned men became extremely faint."

As a matter of fact, all was over with the unfortunate crew of the *A*8. She was found lying in 20 fathoms of water between Penlee Point and the western end of the Breakwater, her conning-tower open and the glass scuttles let into the deck broken, though otherwise she does not seem to have sustained any structural damage; and having been brought to the surface and taken into dock, is again in her place in the Submarine Flotilla.

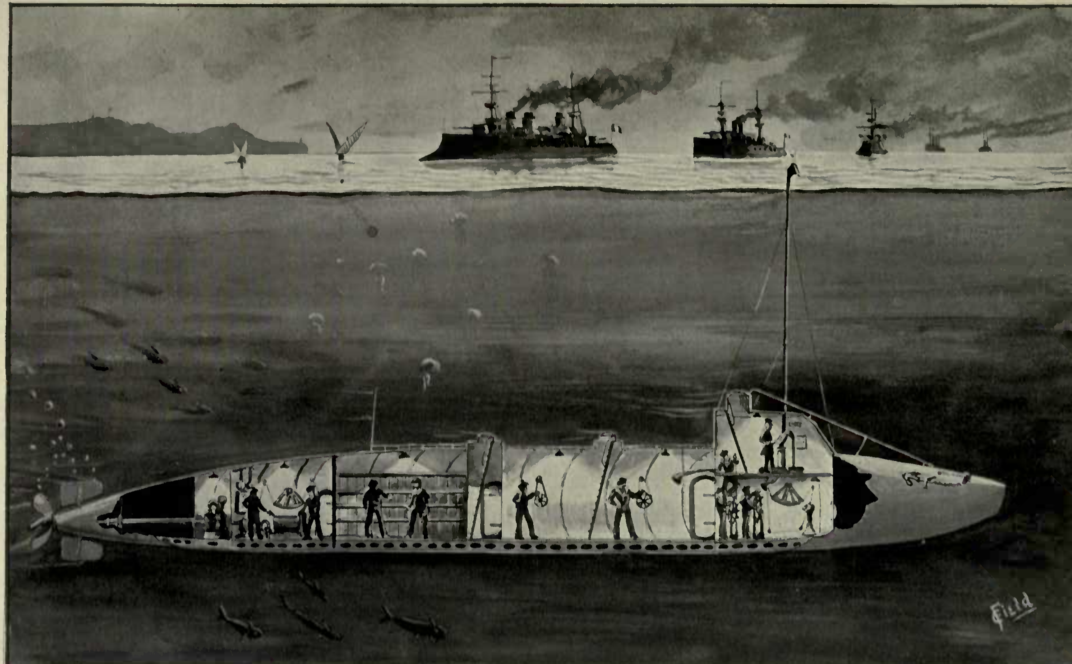
But the British Submarine Service had not a monopoly of such accidents. The *Delphin*, a Russian submarine of 175 tons, sank at Cronstadt on June 20, 1904, being swamped by the wash of a passing steamer. Two officers and twenty-four men were drowned. Again, the foundering of our own *A*8 was pretty quickly followed by the similar fate which overtook the French submarine *Farfadet* at Bizerta on July 6 of the same year. The unfortunate boat was carrying out her diving exercises about 8.30 a.m., when at the close of some surface manœuvre she began to dive before the lid of the conning-tower had been properly fastened. The water poured into the vessel, compressing the air contained within it. This blew out the commander and two other men from the conning-tower, who thus miraculously escaped the fate of their fourteen unhappy comrades who went down in the submarine. In spite of the almost superhuman efforts that were made day after day by the officers and sailors of the French Navy stationed at Bizerta, they were unable to save from death—and a terrible lingering death—the unfortunate men imprisoned in the metal sarcophagus which the *Farfadet* had become. For it was known that they, or at any rate a portion of them, were alive for some days, as they responded to the knocks made by the divers on the outside of the hull. Indeed at one time hopes were entertained of their rescue, for the after-part of the boat was raised to the surface. But the crane broke, down she went again, and then all hope was over. For it was not till ten days had elapsed that the *Farfadet* was eventually brought to the surface and taken into the dockyard. This, as far as is known, seems to have been the most dreadful submarine catastrophe on record. The victims of the earlier accidents, and of those which befell our "A" class submarines, suffered a comparatively merciful death, as they must have been drowned almost instantaneously, but the gallant fellows on board the ill-fated *Farfadet* must have undergone mental and bodily tortures which one shudders to think of.

France had not to wait very long before she had again to mourn the crew of the sister submarine *Lutin*, which on

October 16, 1906, also went down off Bizerta. She left harbour in company with a convoying vessel which had officers on board to watch her performances. She made three successful dives, but when a fourth descent was carried out, it was noted that instead of the *Lutin* reappearing in a horizontal position, she came to the surface considerably down by the stern, about 20 feet of the forepart showing above the water. After remaining in this position for nearly two minutes, she slowly disappeared, and did not rise again. The behaviour of the vessel clearly seemed to indicate the entry of water into her afterpart. Assistance was immediately rendered. Salvage operations could not at once be undertaken, the sea being rather rough at the time, but the bottom was dragged and the position of the boat located in 110 feet of water. A telegram was sent to Malta asking for any assistance that could be rendered, and the battleship *Implacable*, with the destroyer *Albatross*, was immediately despatched by Lord Charles Beresford to Bizerta. They brought with them certain diving stores and salvage appliances which had been requisitioned, and on their arrival operations were immediately resumed with the assistance of a Danish salvage steamer that was lying in the port. Much difficulty was experienced owing to the great depth of water in which the *Lutin* was lying, but she was eventually got into a small floating dock. When the dock was pumped out it was found that the vessel had several leaks in her sides, one near the stern, one on a level with the water-ballast tanks, one on the port side, also near the stern, and another near the after rudder. The rudder itself was bent, and the horizontal rudders were in position for ascent to the surface. The cover of the forward conning-tower was found only half closed, and it is believed that an attempt was made to open the hatch for the purpose of escaping, after the bow of the vessel appeared above water, as soon as the crew realised that she was foundering; but the operation could not be completed in time, and only resulted in admitting much more water into the interior. The *Lutin* was commanded by Lieutenant Fepoux and was manned by a crew of one other officer and twelve men. All perished.

This is the last serious catastrophe that has so far overtaken a submarine boat, but there have been a few minor ones that may just be mentioned in conclusion. The *Gymnote*, for instance, was the scene of an explosion of hydrogen gas on October 15, 1905, as she was lying on a barge in the Mourillon Arsenal. Two petty officers who were working on board were seriously burnt, several of the accumulators were destroyed, and the fore-hatch blown up. Otherwise the old submarine—the doyen of the French under-water flotilla—escaped injury.

Then again, early in 1906, the French submersible *Bonite* was only saved from destruction by the presence of mind of her commander, Lieutenant Maurras, during some manœuvres in which she was taking part. She had just made a successful attack on the armourclad *Jena*, and dived again to pass under the rest of the squadron and torpedo a ship at the rear of the column in which it was moving. While she was under water the battleships altered course, and when she came again to the surface she found herself close to the flagship, the battleship *Suffren*. A collision was unavoidable, and the little submarine would have been utterly smashed against the thick armour-belt of the ironclad had not her commander, with commendable presence of mind, given the order to dive at once. He thought that scraping under the big leviathan he would stand a better chance of escape than running right into her belt. His pluck and resource brought their reward. Though bumping the *Suffren* so heavily that his crew were thrown down and his boat damaged, he got past her, and, letting go his heavy lead emergency-weights, came up on the other side. The *Suffren* also sustained considerable damage, and, as she was making water, had to go into dock for repairs.




THE LOSS OF THE "LUTIN." HER INTERIOR.—See p. 271.

By favour of the *Sphere*.

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A somewhat similar accident befell the *A*9 at Plymouth a very short time later whilst she was carrying out an attack on the *Theseus*. She was run into by the steamer *Coath*, which she had not seen coming up, and which had not seen her. There was a terrible shock, the periscope was shorn off, the conning-tower badly damaged, and the crew of the submarine thrown one upon another. But Lieutenant Fraser, who was in command, rose to the occasion, let drop his safety-weights, and brought her at once to the surface.

# CHAPTER XXI

## The Future of the Submarine

## Conclusion

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### Conclusion

Can Submarines Fight Each Other ?—Submarines *versus* Mines—Disabilities of the Submarine—Her "blindness" Under Water—Periscopes, Omniscopes, Optical Tubes, etc.—Captain Mahan's Opinion on the Submarine—How can Submarines be Attacked ?—Experiments at Portsmouth—Motor Boat to "run down" Submarines—What has the Automobile Torpedo done as yet ?—The Submarine an Untried Weapon—Future of Working and Passenger Submarines—Conclusion.

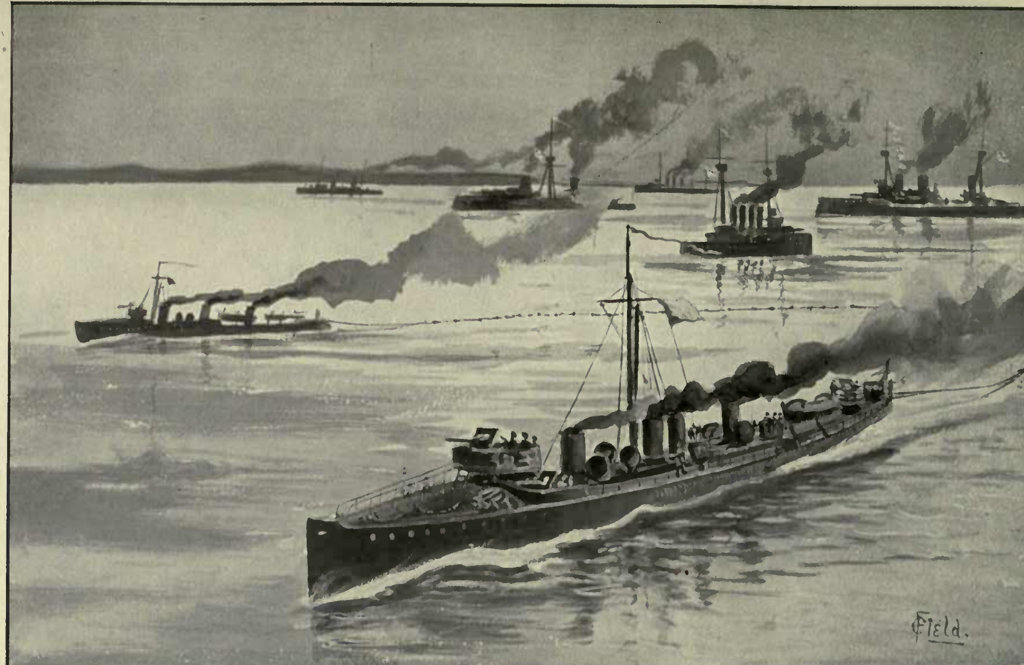
Having now—necessarily in a more or less sketchy manner—traced the evolution of the submarine from the earliest conceptions of under-water attack down to the perfected submarine and submersible torpedo-boats which are being yearly added to the principal navies of the world, it is perhaps fitting that in conclusion we should endeavour to formulate some opinion as to the future of this recently approved method of modern sea warfare.

The French, as we have seen, have for many years made up their minds that a very great future lies before the submarine. We ourselves, after spending the best part of a century in "crabbing" the idea of submarine navigation as a method of naval attack, have now taken it up more or less enthusiastically. When the alleged successes of the French submarines produced in this country something like an agitation for the provision of similar craft, Mr. Goschen aptly remarked in Parliament that "We cannot fight submarines with other submarines."

This view was supported by a good many more or less expert critics, though one, a Russian signing himself "X," chose to take an opposite view. This is what he says:[1] "It is said, 'Submarines cannot fight each other.' It is not true; they can and they will. That they are blind is nothing. Suppose a great hall quite dark, and in it twelve men in two parties hostile to each other. They attack and defend with such weapons as they have. Friend or foe cannot be distinguished, but will not each side have a password? And so I see in the future the fight of the submarines. Each may be fitted with some attachment so that, meeting another, it may seize and hold it—whether by electricity affecting the engines of the one held or by grappling claws, like many fish have, it matters not. The one that seizes makes signals to the seized by the Morse code, tapping the hull. If the seized is a friend, the proper answer—the countersign—will be given; if an enemy, it cannot be given. In the one case the seized is released; in the other, it is held and made prisoner, or else destroyed if means exist."

This fantastic glimpse into the future bears with it its own refutation; the whole idea in the writer's mind seems to be to suggest a possibility and put it forward as a probability. There is nothing in his theory to show that submarines are the *best* weapons with which to tackle other submarines. If one of the hostile parties in his parable of the fight in the dark hall were *outside* at the beginning, is it not likely that they would find a better means of disposing of their six opponents than by putting themselves on an equality with them in their blindness? Still, whatever our naval authorities really thought at the time, they bought five submarines, experimented with them, and have since continued to experiment and construct boat after boat until we have now quite a numerous flotilla of them and a great many others building or in contemplation. So

[1] *Vide* "Fighting Ships, 1906–7." F. T. Jane.




DESTROYERS TRYING TO "NET" A SUBMARINE.—See p. 283.

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that there is no doubt that they have formed the opinion that submarines have their uses, though probably for other purposes than to fight other submarines. If any further proof is needed as to their attitude it is to be found in the almost total abandonment of the system of submarine mining, on which till recently we relied to protect our ports from an enemy's ships, and the suspension of the construction of the Brennan torpedo, which at some of them formed a valuable adjunct to the mine defence. It is evident that they are of opinion that the perfected submarine is capable of advantageously replacing them, and the "Mine Layers," ships recently fitted for strewing mines, may, of course, be also destined for this duty.

The mine has often demonstrated its efficiency in naval warfare, and never more than in the recent naval campaign between Russia and Japan, in which, by the way, the torpedo proved far less dangerous than used to be imagined, while, so far as is generally known, the submarine was not tried at all, though both sides had such boats at their disposal.

As regards the latter, despite all the attempts which, as we have seen, have been made to use it in warfare, it is an unproved weapon, for no submarine acting as such—that is to say, in a submerged position—has ever damaged an enemy's ship. The *David* that sank the *Housatonic* and went down with her, attacked as a surface boat: the crew refused to have the hatches closed. Spain and the United States had a boat or two intended to attack under water when they went to war about Cuba, but neither belligerent attempted to use them either above or below water. The fact is that despite the numerous improvements due to the advance of scientific discovery, which have removed a very large number of the disabilities which formerly beset submarine navigation, there still remain two very serious ones: first the submarine's blindness when under water, and secondly its slow speed. Even at the surface it is a snail as compared to other craft; while totally submerged it is very much worse. An attempt, and, under favourable circumstances, a partially successful one, has been made to get over the "blindness" by the use of "Periscopes," "Omniscopes," Optical Tubes, "Cleptoscopes," and "Hydroscopes," which are all varieties of practically the same thing, that is to say, a series of telescopic tubes fitted with mirrors at the upper end which can be pushed up above water, and which, after the manner of the camera obscura, reflect down images of objects on the surface of the sea to a suitable screen or eye-piece in the conning-tower of the submarine. There are varieties of mirrors and in the modes in which the images they reflect are transmitted to the eye of the steersmen under water, but the main principle is the same, though some produce a diminutive panorama which has to be magnified, and others that, while reflecting a larger image, can only deal with a small portion of the horizon at once, so that the upper mirror has to be continually revolved. Excellent as these contrivances may be, they cannot give the freedom of sight and facility for judging distance that are the attributes of direct vision, and it is obvious that in rough weather they would be all but useless on account of the limitation of their horizon by the waves and the continual incrustation of salt upon the surfaces of their upper reflectors. It must be remembered, too, that, small as is the object presented by the upper end of a periscope, it still stands a chance of being detected by the vigilant eyes of the enemy's look-outs; and although the submarine may escape damage by gun-fire or by other means of attack, it will be quite possible for her quarry to quickly put a very considerable distance between them if under way, so very much faster would she be.

It is doubtless the consideration of these facts that induced the well-known critic Captain Mahan, of the United States Navy, to write, "I should be interested to see some demonstration that the submarine boat will not find a practically insuperable difficulty in discerning her prey—in seeking it, I should rather say."[1] The word "seeking" is just the right one, for it not only refers to the difficulty the submarine has in seeing, but also to her second disability, that slowness which renders it difficult for her to get at the enemy. As long ago as the time of Fulton, when oars and sails were the motive powers afloat, slow speed was one of the objections raised to his big submarine the *Mute*. And in these days of 30-knot destroyers, the submarine, despite her petrol and electrical engines, is proportionately still farther behind in the matter of speed. This, combined with the time certain types of submarines take to disappear from the surface, is their most vulnerable point, or rather that which gives their enemies their best chance of destroying them. A slow-diving boat—though these are becoming rare, thanks to recent improvements—having come up for observation may be "spotted" by a destroyer on the look-out, and even if at several hundreds of yards distance may be attacked by a spar-torpedo before she is deep enough down to be safe, so swiftly can her opponent tear through the water compared to herself. If she is merely located by a peep at her periscope, almost immediately withdrawn, it is quite on the cards that a destroyer may make for the spot so quickly that she may be able to get at her in the same way. At any rate, this is one of the methods of dealing with submarines that have been experimented with and tried, it is said, with a considerable amount of success. Some of these were made a few years ago at Portsmouth, a barrel representing a submarine being sunk 10 feet below the surface and attacked by the destroyer *Starfish*, which was specially equipped for the purpose. She was strengthened on the starboard bow to take the weight of a forty-foot spar, on the outer end of which was fastened a charge of 32 pounds of guncotton, and a crutch in which the spar worked. As the *Starfish* neared her target the spar was run out and the end

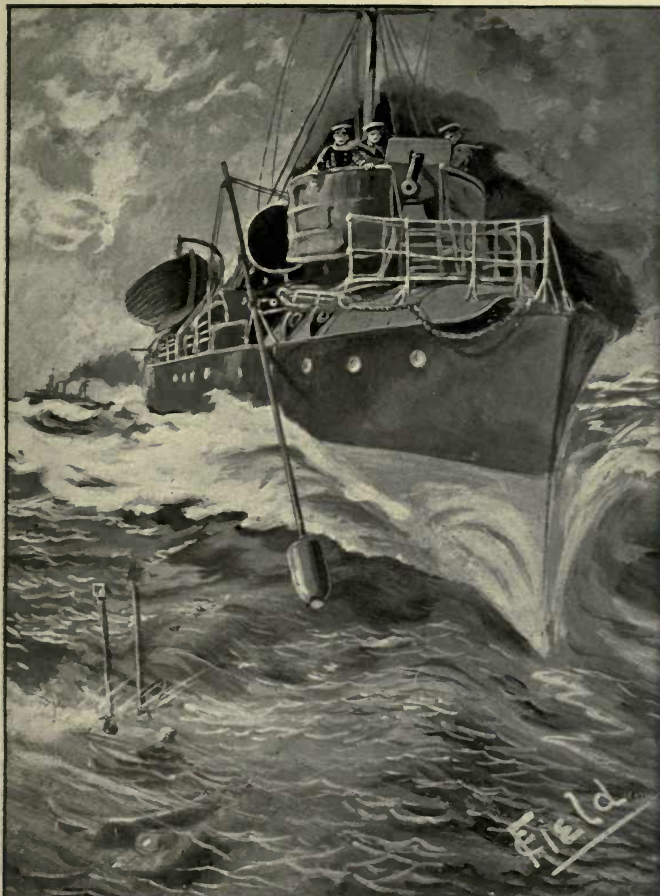
[1] In "Fighting Ships, 1901." F. T. Jane.

carrying the explosive charge dropped into the water as she passed it. As it swung aft it was fired by electrical contact, blowing the barrel to pieces. As for the destroyer, the speed at which she was travelling carried her clear of the effects of the explosion. Had her target been a real submarine there is little doubt that a hole would have been blown in her which would have been quite enough to sink her. As a method of locating a submarine which does not give herself away by coming to the surface, or even by using her periscope, the French advocate the employment of captive balloons, or at any rate they did do so a few years ago. The theory is that from the car of a balloon quite a large area of water is visible to a considerable depth which is invisible to observers on board a ship because their line of sight strikes the surface of the water at such a flat angle that further vision is arrested. But an attendant balloon might very well be able, under favourable circumstances, to detect the stealthy advance of a submarine assailant and telephone her whereabouts to the menaced ship.

Besides the spar-torpedo, various other methods have been advocated and experimented with for coping with the submarine. The quick-firing gun in the hands of expert gunners may very likely be able to give a good account of a submarine if caught at or close to the surface, and it is possible that fairly big charges of high explosive thrown in her path with special fuses set to explode on reaching a certain depth might destroy an under-water boat. "The radius of such an explosion must be great under water," says a French writer.[1] "It is a lesson taught by the English fish poacher, who thus kills fish by shock of explosive.[2] It will kill submarines. It is the fortune of war." The officers in charge

[1] "La Verité," in "Fighting Ships, 1901." F. T. Jane.

[2] This form of fishing is not confined to the English poacher. Twenty years ago it had been adopted by the natives of the Solomon Islands.




A DESTROYER ATTACKING A SUBMARINE WITH A SPAR-TORPEDO.

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of the *Starfish* experiments reckoned that their 32-pound case of guncotton would have smashed any submarine within a radius of 60 feet. It certainly would seem that a submarine completely surrounded by wat r which is exerting pressure on her from every direction, and with her comparatively slight structure and low buoyancy, ought to be much more vulnerable to a given charge of explosive than an above-water ship. That which would only damage the latter ought to crumple the former up. But it is possible that this theory is wrong, for, if we may believe the following, the French have already partially demonstrated the conclusion drawn from the *Starfish* experiments to be a fallacy. "Some sheep were placed in the *Naiade* (a submarine of the *Perle* class), and torpedoes exploded at from 98 to 150 feet distant: the sheep were uninjured and the vessel suffered no damage." But we do not know the weight of the explosive used, and there is a considerable difference between 98 feet and 60 feet. Still, we have not altogether pinned our faith to this method of settling with submarines. Another dodge that has been tried is to catch them in a net hung between a couple of destroyers steaming abreast; and, supposing the submarine to have been successfully located, it seems possible that she would find this method of attack very embarrassing, to say the least of it.

If proved to be practicable, the little automatic submarine torpedo controlled by "wireless" telegraphy, invented by Mr. Gardner of London in 1902, ought to be still more effective. This weapon, like the Orling-Armstrong torpedo, is claimed by its inventor to be so completely under control of the operator on board the ship which carries it that on being launched and its propelling machinery started, it can be made to literally hunt down the submarine, being so much faster in speed. As it carries a couple of hundred pounds of guncotton, which can be exploded by the "wireless" waves, it is practically sure to annihilate the under-water enemy if it gets anywhere near it. The weak point about this invention seems to be the omission of the inventor to let us know how the operator can follow the course of the submarine after she has dived. The advent of the motor-boat has suggested to an American ex-naval officer its applicability as a submarine-destroyer. His patent motor-boat is to be a light, strongly built craft small enough to be carried by any man-of-war of ordinary size, and capable of travelling at 21 knots an hour—not an exceptional speed as above-water craft go, but possibly sufficient for the purpose intended. Like the *Starfish*, she is intended to run down a submarine as soon as its presence is known or suspected, but instead of attacking it with a spar-torpedo she discharges a special kind of torpedo through a vertical tube straight down upon the slower moving enemy. This certainly seems a more practical method than Mr. Gardner's. But in this, as in every other case, you must "first find your submarine." Its invisibility is its strongest card. And despite the two capital shortcomings to which attention has been drawn, there is no doubt that in a future war between nations who have really made a study of under-water attack, its moral effect will probably be at least as formidable as any material damage it may do, and possibly may alone be sufficient to influence the course of the campaign. But all this depends not on the submarine alone, but on the automobile torpedo, for unless this, *its only weapon*, is an efficient one, it is powerless.

The Whitehead torpedo has now been invented a great number of years and has been continually improved in range accuracy and general efficiency, yet what has it done to justify the prophecies which have again and again been made as to its terrible destructiveness and far-reaching effect on naval tactics and strategy? Did it produce any very striking results in the Spanish-American War, or in the Chino-Japanese War, or, lastly, in the recent war between Russia and Japan? "Was it generally accepted before the war," writes a distinguished naval critic,[1] "that the Whitehead torpedo could do so little damage to a battleship that she could be easily repaired? That a port could be blockaded in spite of the presence of torpedo-boats inside it? . . . And is not the Whitehead torpedo decreasing in value? Neither is the untried submarine likely to prove more effective than the torpedo boat and destroyer. Nothing is more to be deprecated than the attempt that has been made to enhance unduly its importance by playing on the credulity of the public, to whom the unknown is always terrible. The new instrument of war has, no doubt, a value, but that it is anything more than an auxiliary with limited and special uses it is difficult to believe."

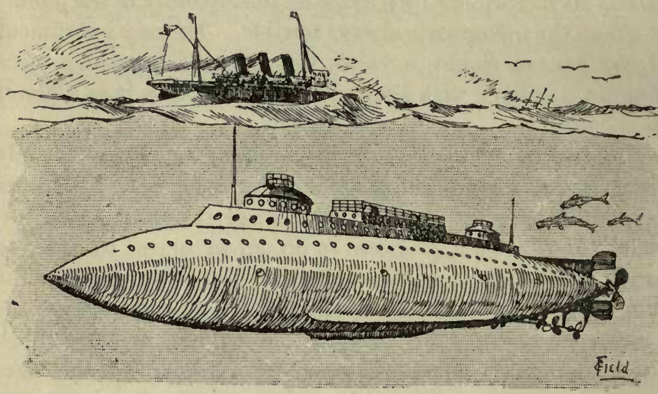
Here we may finally leave the militant submarine, merely observing in conclusion that it is evident that its future depends in a great measure on that of the automobile torpedo. If this, as it promises to do, grows bigger in order to carry a heavier and more effective explosive charge, the submarine must also be increased in size to carry the heavier and larger torpedoes. The advent of very much larger submarine boats will open up a whole host of other questions in connection with their use. It does not seem altogether impossible that the submarine proper may one day be supplanted by the semi-submersible torpedo-boat. Such a vessel, having its conning-tower and a portion of its upper surface sufficiently armoured to defy projectiles of moderate size, would be a formidable assailant, as it would travel faster than a submarine proper and would not, like the latter, suffer from "blindness."

As for submarine diving and working boats, they seem likely to prove much superior to the diving-bell, and they have already been so far perfected that we may look to see them frequently and effectively employed on under-water undertakings, such as the building of breakwaters, the blowing

[1] "Naval Policy," by "Barfleur."

up of wrecks, the search for sunken treasure, and other work of a similar kind.

The third class of submarines, those intended for passenger transport, will probably never exist, save in the imaginations of their ingenious and sanguine designers. There are as yet no indications that the travellers of the immediate future are likely to prefer the sombre depths of the ocean to the



A TRANSATLANTIC SUBMARINE LINER IN THE YEAR —?
Adapted from a picture in the *Illustrated Mail.*

brightness and fresh air of its upper surface; or that the submarine, with its hermetically sealed and stuffy interior, slowly boring along beneath the waves, will hold more attractions for them than the swift and luxuriously equipped liner rushing forward under the boundless canopy of heaven at the full speed of her mighty turbine engines.

Sea-sickness doubtless has its terrors, but even they, in most people's opinion, would be endurable when compared with the alternative of a prolonged confinement in a sub-aquatic iron dungeon.

# APPENDIX I

**CHRONOLOGICAL LIST OF THE PRINCIPAL SUBMARINE AND SEMI-SUBMARINE VESSELS EITHER BUILT OR PROPOSED FROM THE EARLIEST TIMES TO A.D. 1900 INCLUSIVE.**

# APPENDIX I

## CHRONOLOGICAL LIST OF THE PRINCIPAL SUBMARINE AND SEMI-SUBMARINE VESSELS EITHER BUILT OR PROPOSED FROM THE EARLIEST TIMES TO A.D. 1900 INCLUSIVE.

### References to Abbreviations

*Propulsion*

O means Oars.
P ,, Paddle-wheels.
S ,, Screw propeller.
Sl ,, Sails.
W ,, Wheels moving on sea-floor.
Hy ,, Hydraulic propulsion.

*Motive Power*

H means Hand power.
S ,, Steam.
Ex ,, Explosives.
E ,, Electric.
CA ,, Carbonic Acid.
F ,, Foot-power—propellers, etc., worked by pedals.
G means Gas.
P ,, Petrol.
A ,, Compressed Air.

*Shape*

B means Boat-shaped.
F ,, Fish.
R ,, Rectangular.
S ,, Ship shaped.
Bl ,, Barrel shaped.
P ,, Porpoise ,,
Sp ,, Spherical ,,
C ,, Cigar ,,
Cy ,, Cylindrical shaped.
L ,, Lemon ,,
O ,, Ovoid ,,

Note.—The table shows the principal designs for Submarines that have from time to time been brought forward up to the end of 1900, from which date the era of the regular construction of such vessels for naval purposes may be said to have commenced. Those which have been *actually constructed* are denoted by the name of their Inventor being printed in CAPITAL LETTERS. The remainder are merely designs and proposals, some carefully and scientifically worked out, but most no more than suggestions which are sometimes illustrated by sketch plans. There are doubtless many more of these which could be found if any one had the time and opportunity of wading through the patents lists of every civilised country, but those noted are the ones which, for one reason or another, appear to be the most deserving of mention.

| Date. | Inventor. | Propul-sion. | Motive Power. | Shape. | Remarks. |
|---|---|---|---|---|---|
| 1190? | .. .. .. .. | .. | .. | .. | *V.* p. 6, ch. i. |
| 1472 | .. .. .. .. | .. | .. | .. | Fr. *Valturius.* *V.* p. 16, ch. i., note. |
| 1505 | Gruntland Pirates .. | .. | .. | .. | Fr. *Olaus Magnus.* *V.* p. 15, ch. i. |
| 1559 | Venetians .. .. | .. | .. | .. | A diving-boat. *V.* p. 16, ch. i.; p. 24, ch. ii., note. |
| 1578 | W. Bourne .. .. | .. | .. | .. | First British design. *V.* p. 20, ch. ii. |
| 1596 | Napier of Merchiston | .. | .. | .. | *V.* p. 23, ch. ii. |
| 1605 | M. Pegelius .. .. | .. | .. | .. | *V.* p. 23, ch. ii. |
| 1620 | VAN DREBBEL .. | O | H | B ? | *V.* p. 25, ch. ii. |
| 1626 | UNKNOWN .. (possibly Van Drebbel) | .. | .. | .. | Used at Isle of Rhé. *V.* p. 27, ch. ii. |
| 1634 | Mersenne .. .. | O | H | F | *V.* p. 29, ch. ii. |
| 1640 | Barrié .. .. | .. | .. | .. | Details unknown. *V.* p. 33, ch. iii. |
| 1648 | Bishop Wilkins .. | O | H | .. | An imaginary "Ark." *V.* p. 33, ch. iii. |
| 1653 | DE SON .. .. | P | ? | R | Oblong box, pyramidal ends. *V.* p. 35, ch. iii. |
| 1680 | Borelli .. .. | O | H | .. | *V.* p. 36, ch. iii. (Navis Urinator). |
| 1685 | Ciminius .. .. | .. | .. | .. | *V.* p. 39, ch. iii. |
| 1688 | Doligny .. .. | .. | .. | .. | *V.* p. 39, ch. iii. |
| 1691 | Evance .. .. | .. | .. | .. | *V.* p. 39, ch. iii. |
| 1692 | Papin.. .. .. | .. | .. | .. | A model of Drebbel's boat, *V.* p. 25, ch. ii. |
| 1693 | Stapleton .. .. | ? | ? | ? | "A machine to enable a man to travel under water." |
| 1729 | SYMONS .. .. | O | H | B | *V.* p. 37, ch. iii. |
| 1737 | Cambon .. .. | ? | ? | ? | "An engine analogous to the hull of a vessel." |
| 1772 | DIONIS .. .. | O | H | ? | *V.* p. 40, ch. iii. |
| 1773 | DAY .. .. .. | .. | .. | S | No propulsion. *V.* p. 40, ch. iii. |
| 1776 | BUSHNELL .. | S | H | .. | *V.* p. 51, ch. iv. |
| 1780 | S. de Valmer .. | O | H | Bl | *V.* p. 61, ch. v. |
| 1780 | Beaugenet .. .. | .. | .. | .. | Details unknown. *V.* p. 61, ch. v. |
| 1795 | Armand-Maizière .. | O | S | ? | *V.* p. 61, ch. v. |
| 1796 | Castèra .. .. | O | H | ? | *V.* p. 61, ch. v. |
| 1796 | Fabre .. .. | .. | .. | .. | Like a "peach-stone." *V.* p 61, ch. v. |
| 1798 | Martner .. .. | O | H | .. | A "Coffer 200 ft. long and 20 to 22 high. To carry 4000 men." |
| 1799 | Thilorier .. .. | .. | .. | .. | A small Submarine to carry 4 men and cost 5000 francs. |
| 1800 | R. FULTON .. | Sl & S | H | P | The *Nautilus.* *V.* p. 62, ch. v. |
| 1800 | Schoepke .. .. | .. | .. | .. | Designed at Frankfort. To be 24 ft. long, 10 wide, and carry 12 men. |
| 1801 | HODGMAN .. | .. | .. | .. | Tried at Folkestone. Details unknown. *V.* p. 76, ch. vi. |
| 1801 | O'Reilly .. .. | W | H | ? | Wooden Submarine to be managed by 2 men. |
| 180? | B—— .. .. | W | H | ? | To run on wheels on sea-floor. Project by an anonymous correspondent of *L'Annales*, Paris. |
| 1809 | COUËSSIN Bros. .. | Sl & O | H | Bl | *V.* p. 77, ch. vi. |
| 1810 | Castéra .. .. | F | H | Bl | Proposed submarine like a "Tun with conical ends." |
| 1810 | D'Aubusson La Feuillade .. .. | F | H | .. .. | Copper almost in the form of an ellipse. |
| 1814 | FULTON .. .. | P | H | | *V.* p. 70, ch. v. *Mute.* |

| Date. | Inventor. | Propulsion. | Motive Power. | Shape. | Remarks. |
|---|---|---|---|---|---|
| 1814 | UNKNOWN .. | .. | .. | .. | Reported in *Naval Chronicle* as being built in England. *V.* p. 76, ch. vi. |
| 1821 | JOHNSON .. .. | Sl & O | H | ? | *V.* p. 77, ch. vi. |
| 1822 | Montgéry .. .. | Sl & P | H & Ex | S | *V.* p. 237, ch. xviii. |
| 1823 | SHULDHAM .. | .. | .. | .. | *V.* p. 79, ch. vi. |
| 1825 | D'Aubusson La Feuillade.. .. | Sl & O | H | ? | Armour-plated, 125 ft. long, 30 beam, 14 deep. Propelled by "Piston oars." To be armed with 10 "Colombiads." |
| 1826 | Boisserolles .. .. | O | H | .. | Imitation of Couëssins' boat. |
| 1827 | Castèra .. .. | O | H | P | Had float and diving chamber. *V.* p. 239, ch. xviii. Two other rather different boats, 1 with 3 wheels. |
| 1831 | CERVO .. .. | .. | .. | Sp. | A hollow wooden ball. *V.* p. 79, ch. vi. |
| 1832 | VILLEROI .. .. | O | H | .. | Spindle-shaped. V. p. 79, ch. vi. |
| 1834 | PETIT .. .. | O | H | C | *V.* p. 79, ch. vi. |
| 1838 | Newton .. .. | S | H | L | *V.* p. 224, ch. xvii. |
| 1840 | D'Aubusson La Feuillade | .. | H | S | 76 ft. long. Ship shape. Propelled by alternating cylinders. |
| 1846 | PAYERNE .. .. | S | H | Cy | Pointed bow, rounded stern. *V.* p. 79, ch. vi. ; p. 224, ch. xvii. |
| 1850 | BAUER .. .. | S | H | P | *Der Brandtaucher.* *V.* p. 86, ch. vii. |
| 1851 | PHILIPS .. .. | S | H | C | Two Boats. *V.* p. 80, ch. vi. |
| 1852 | LAMBERT .. .. | .. | .. | O | Submarine worker. No propulsion. *V.* p. 225, ch. xvii. |
| 1853 | Nasmyth .. .. | S | S | Cy | "Floating Mortar" semi-submersible. *V.* p. 210, ch. xvi. |
| 1854 | Marie-Davy .. .. | S | E | C | First proposal to use Electricity. An electrically driven auger and propeller. |
| 1854 | PAYERNE .. .. | S | H | C | Boat shape but with rounded top. *V.* p. 225, chap. xvii. |
| 1854 | Cambrez-Bassompierre | O | .. | .. | No details available. |
| 1854 | Unknown .. .. | S | H | O | Inventor a prisoner at Ajaccio. Just the shape of a lemon. |
| 1855 | Picot-Gueraud .. | ? | ? | ? | For cutting wires of mines. |
| 1855 | BAUER .. .. | S | P | P | *V.* p. 88, ch. vii. (*Le Diable Marin.*) |
| 1855 | Babbage .. .. | .. | .. | .. | An elongated diving-bell. *V.* p. 92, ch. vii. |
| 1855 | Spiridinoff .. .. | .. | CA | .. | Propelled by pistons. |
| 1855 | VILCOQ & DESCHAMPS .. .. | S | H | Cy | Short cylinder, cylindro conical bow, coned stern and big dome with leather gauntlets. *V.* p. 92, ch. vii. |
| 1855 | Felt .. .. .. | ? | ? | ? | Proposed to France. To carry 8 guns. |
| 1856 | Deschamps .. .. | S | H | .. | Much the same as former boat designed in conjunction with Vilcoq. |
| 1856 | SCOTT-RUSSELL .. | .. | .. | .. | Like Bauer's *Diable Marin.* *V.* p. 88, ch. vii. |
| 1856 | Althabegöity .. | S | ? | L | *V.* p. 239, ch. xviii. |
| 1857 | Conseil .. .. | ? | ? | L | Ellipsoidal in shape. No details. |
| 1857 | Hubault .. .. | S | H | .. | Nearly rectangular in shape. *V.* p. 242, ch. xviii. |
| 1857 | Scheltema-Beduin .. | PW | ? | ? | Invented in Batavia. |

| Date. | Inventor. | Propulsion. | Motive Power. | Shape. | Remarks. |
|---|---|---|---|---|---|
| 1859 | Masson .. .. | S | H | Cy | Carbonic-acid engine to empty tanks. |
| 1859 | CONSEIL .. .. | S | H | P | Also proposed a second boat with Turbine Motor. *V.* p. 92, ch. vii. |
| 1859 | Van Elven .. .. | S | S | ? | Armoured submersible Monitor fitted with a "Periscope." *V.* p. 212, ch. xvi. |
| 1859 | MONTURIOL .. | S | S | ? | *V.* p. 94, ch. vii. (*Ictineo.*) |
| 1860 | Riou .. .. .. | S | S & E | Cy | Two designs, one propelled by steam the other by electricity. Double hull. Coned ends. |
| 1861 | Bauer .. .. | S | S ? | P | Le Brûleur des Côtes. *V.* p. 240, ch. xviii. |
| 1861 | CONFEDERATES.. | S | S | C | *The Manassas*, semi-submersible. *V.* p. 213, ch. xvi. |
| 1861 | BARRIENS .. | O | H | Cy | Original *David.* Sunk to avoid capture by the Federals. |
| 1862 | VILLEROI | O | H | Cy | Pointed bow, rounded stern. *V.* p. 98, ch. viii. |
| 1862 | Legrand .. .. | S | S | .. | Submersible monitor. *V.* p. 218, ch. xvi. |
| 1863 | ALSTITT .. .. | S | S & E | S | *V.* p. 101, ch. viii. |
| 1863 | CONFEDERATES | S | H | Cy | *V.* p. 102, ch. viii. |
| 1863 | BOURGEOIS & BRUN | S | A | C | The *Plongeur*. *V.* p. 99, ch. viii. |
| 1864 | HUNLEY .. .. | S | H | Cy | Boat that sank the *Housatonic.* *V.* p. 105, ch. ix. |
| 1864 | WOOD .. .. | S | S | .. | Semi-submersible. *V.* p. 114, ch. ix.; p. 216, ch. xvi. (The *Stromboli.*) |
| 1864 | ? .. .. .. | S | S | .. | *Keo-Kuk*, semi-submersible monitor. *V.* p. 114, ch. ix.; p. 215, ch. xvi. |
| 1865 | WOOD & LAY .. | S | S | .. | *Spuyen-Duivel*, semi-submersible, *V.* p. 114, ch. ix.; p. 216, ch. xvi. |
| 1865 | NILLUS .. .. | S | S | C | Semi-submarine with speed of 15 knots. |
| 1866 | Merriam .. .. | S | H | C | *V.* p. 226, ch. xvii. |
| 1866 | RAEBER .. .. | S | H | C | Almost identical with Merriam's. *V.* p. 226, ch. xvii. |
| 1866 | FLACH .. .. | S | H | Cy | *V.* p. 115, ch. ix. |
| 1866 | HALSTEAD .. | S | H | P | Not actually built till 1872. *V.* p. 121, ch. x. *The Intelligent Whale.* |
| 1867 | Hallet .. .. | .. | .. | .. | Said to be very like Dr. Payerne's. |
| 1868 | ALEXANDROWSKI | S | A | .. | *V.* p. 117, chap. ix. |
| 1869 | Vogel .. .. | S | S | S | *V.* p. 218, ch. xvi. |
| 1869 | Barbour .. .. | S | CA | P | Propelled by carbonic-acid gas or by ammonia. |
| 1869 | Lacomme .. .. | S | A | C | To run on lines at the bottom of the sea. A kind of Submarine Railway. |
| 1870 | Constantin .. .. | S | H or A | .. | Like a big kettle with projecting cylinders fore and aft to alter displacement. |
| 1873 | Smith .. .. | S | E | Cy | Motive power drawn from shore by wires. |
| 1873 | PORTER .. .. | S | S | .. | Semi-submersible. *V.* p. 218, ch. xvi. |
| 1874 | Roy .. .. .. | S | .. | .. | To be driven by a kind of breech-loading gun. |
| 1874 | Delavaque .. .. | S | ? | C | Horizontal screws underneath for submersion. *V.* p. 252, ch. xix. |

| Date. | Inventor. | Propulsion. | Motive Power. | Shape. | Remarks. |
|---|---|---|---|---|---|
| 1875 | HOLLAND I .. | S | F | C | *V.* p. 123, ch. x. |
| 1876 | Tomassi .. .. | S | S | C | Semi-submersible. *V.* p. 251, ch. xix. |
| 1877 | Mortensen .. .. | S | A | C | First proposal to use bow Torpedo Tube. |
| 1877 | HOLLAND II .. | S | G | C | *V.* p. 125, ch. x. |
| 1877 | DRZEWIECKI I .. | S | F | .. | *V.* p. 124, ch. x. The *Podascophe.* |
| 1877 | Jones .. .. | .. | .. | .. | Submarine torpedo-boat. No details. Model tested at Liverpool. |
| 1877 | Olivier .. .. | .. | G | C | Propelled by gas from explosive like a rocket. Horizontal fins. |
| 1877 | Thompson .. .. | .. | .. | S | Semi-submersible design for turret ship. |
| 1878 | Watson & Woodhouse | S | .. | .. | Submersible ironclad with guns. |
| 1878 | Surman .. .. | S | .. | C | Suspended from air-bag and with glass observation chamber which could be floated up to the surface. |
| 1878 | GARRET I. .. | S | H | O | *V.* p. 122, ch. x. |
| 1879 | GARRET II. .. | S | S | C | The *Resurgam.* *V.* p. 124, ch. x. |
| 1879 | DRZEWIECKI II .. | S | F | P | *V.* p. 124, ch. x. |
| 1880 | Lagane .. .. | S | S | S | *V.* p. 220, ch. xvi. |
| 1880 | Lambert & Ivernau .. | S | A | Cy | Coned ends. |
| 1880 | Berkeley & Hotchkiss | S | S | C | Semi-submersible. *V.* p. 219, ch. xvi. |
| 1881 | HOLLAND III. .. | S | F | P | *V.* p. 125, ch. x. |
| 1881 | ALEXANDROWSKI II. | S | .. | .. | A failure. *V.* p. 135, ch. xi. |
| 1881 | BRITISH ADMIRALTY | S | S | C | The *Polyphemus.* *V.* p. 214, ch. xvi. |
| 1881 | NORDENFELDT I. | S | S | C | *V.* p. 126, ch. x. |
| 1881 | Woodhouse .. .. | S & P | A | Cy | Cylindrical with coned bow. Superstructure with gun, diving-bell. Paddles and screw propeller. |
| 1881 | Genoud .. .. | S | G | .. | Gas from iron scraps and sulphuric acid. |
| 1881 | Todorasco .. .. | .. | .. | .. | A Roumanian inventor. Details not available. |
| 1881 | DRZEWIECKI III | S | F | P | Much the same as No. 2, but with only one screw. *V.* p. 135, ch. xi. |
| 1883 | Davies .. .. | S | A | C | The *Demon.* Carried torpedo on its back. |
| 1883 | Telescheff .. .. | .. | .. | .. | Design for hull only. |
| 1884 | Blakesley .. .. | S | S | C | Much finer aft than forward. |
| 1884 | DRZEWIECKI IV | S | E | P | *V.* p. 135, ch. xi. |
| 1884 | TUCK .. .. | S | S | P | *V.* p. 137, ch. xi. The *Peacemaker.* |
| 1884 | Degener .. .. | .. | .. | .. | Bow cruciform. Ran on wheels. |
| 1884 | CAMPBELL & ASH | S | E | C | The *Nautilus.* *V.* p. 136, ch. xi. |
| 1884 | Jacquemin | S | ? | C | High conning-tower. *V.* p. 252, ch. xix. |
| 1884 | HOLLAND IV .. | S | G | P | V. p. 139, ch. xi. |
| 1885 | Boucher .. .. | O | .. | P | Telescopes, buffers, guns, and every possible sort of weird contraption. A chimera. |
| 1885 | Morhard .. .. | S | .. | .. | Salvage boat on rollers, air-tubes with floats. |
| 1885 | Welch .. .. | S | .. | C | A series of airtight cylinders strung on long tube ending in cones. |

| Date. | Inventor. | Propulsion. | Motive Power. | Shape | Remarks. |
|---|---|---|---|---|---|
| 1885 | WADDINGTON .. | S | E | C | The *Porpoise*. *V.* p. 141, ch. xi. |
| 1885 | HOLLAND V .. | .. | .. | .. | *V.* p. 139, ch. xi. |
| 1885 | TUCK .. .. | S | S | P | *V.* p. 138, ch. xi. |
| 1885 | Foure & Malé .. | S | E | ? | To go 14 knots below and 18 above water. |
| 1885 | Flais .. .. .. | S | G | Cy | Projecting bomb in cylinder below hull. |
| 1885 | D'Allest .. .. | S | P | C | Cigar-shaped with narrow compartment below for water-tanks. |
| 1885 | GOUBET I .. | S | E | P | *V.* p. 140, ch. xi. |
| 1886 | Toureau .. .. | .. | Hy | C | The "Hyponean." Hydraulic propulsion. |
| 1886 | Watkins .. .. | S | .. | Cy | Telescopic ends. Motive power not decided. |
| 1886 | Brin & Chapman .. | S | .. | Cy | Propelled by any suitable engine. |
| 1886 | Lecaudy .. .. | S | E | P | Model tried at Caen. |
| 1886 | Burgal .. .. | .. | .. | .. | The *Sombreur*—80 tons, 40 ft. long. |
| 1886 | Cazaux .. .. | S | E | C | 6 tons. Helmet-shaped conning-tower. |
| 1887 | NORDENFELDT II | S | S | C | *V.* p. 127, ch. x. |
| 1887 | Shepherd .. .. | S | P | P | Very much like the *Peacemaker*. |
| 1887 | PERAL .. .. | S | E | C | *V.* p. 144, ch. xi. |
| 1887 | Gerber .. .. | O | H | ? | An absurdity. *V.* p. 253, ch. xix. |
| 1887 | Hovgaard .. .. | S | S | C | *V.* p. 242, ch. xviii. |
| 1887 | Poore & Story .. | .. | .. | C | No mode of propulsion suggested. |
| 1887 | Noury .. .. | S | S | Cy | 15·7 tons. Model tried in Greece. |
| 1888 | Drzewiecki V .. | S | ? | ? | 150 tons. Particulars not available. |
| 1888 | GUSTAVE ZÉDÉ .. | S | E | C | The *Gymnote*. *V.* p. 142, ch. xi. |
| 1889 | Pool .. .. .. | S | S | Cy | Very short, wide cylinder with coned bow. To dive or FLY! |
| 1889 | GOUBET II .. | S | E | C | *V.* p. 153, ch. xii. |
| 1889 | Apostoloff .. .. | S | C A | C | *V.* p. 244, ch. xviii. |
| 1889 | NORDENFELDT III | S | S | Cy | *V.* p. 131, ch. x. |
| 1890 | MacDougal .. .. | S | S | .. | Submersible Whaleback. |
| 1890 | FONTES DE MELLO | .. | .. | Cy | No mode of propulsion. *V.* p. 156, ch. xii. |
| 1890 | Forest .. .. | S | P & E | C | Two boats. Elliptical in section. One much longer than the other. |
| 1890 | German NORDENFELDTS .. .. | S | S | C | *V.* p. 149, ch. xii. |
| 1891 | Middleton .. .. | S | S & E | ? | No shape specified. Detachable central compartment forming lifeboat. |
| 1891 | Thomas .. .. | S | E | C | Automatic boat, with float carrying a torpedo which dives under defence nets when bow of boat strikes an obstacle. |
| 1891 | De Souza .. .. | S | .. | Cy | Made in 3 separate parts which can be disconnected in case of accident, leaving a complete boat. *V.* p. 254, ch. xix. |
| 1892 | Sir G. Strickland .. | Hy | P | C | Protruding buffer below point of bow. |
| 1892 | MacDougal II .. | S | S | S | Armoured Whaleback. |
| 1892 | DEGLI ABBATI .. | S | E | ? | *L'Audace*. *V.* p. 228, ch. xvii. |
| 1892 | Auer .. .. .. | S | E | C | Cigar-shaped, but the central three-fifths of its length bulges below. |

| Date. | Inventor | Propulsion. | Motive Power | Shape. | Remarks. |
|---|---|---|---|---|---|
| 1892 | Goubet .. .. | .. | .. | C | The "Toueur," submarine ferry-boat moved by cable passing over three drums amidships. |
| 1892 | BAKER .. .. | S | S | O | *V.* p. 161, ch. xii. |
| 1892 | VAN WITTENS .. | S | .. | C | *V.* p. 150, ch. xii. |
| 1892 | DE PULLINO .. | S | E | C | *V.* p. 150, ch. xii. |
| 1892 | Sims .. .. .. | S | E | C | Drew power through cable from accumulators on shore. |
| 1892 | Holland VI .. .. | .. | .. | .. | Not built. *V.* p. 159, ch. xii. (*Plunger I.*) |
| 1892 | Schwann .. .. | Hy | P | ? | 65 tons. To travel 32 knots above and 15 below water. |
| 1892 | FONTES DE MELLO | ? | ? | ? | *V.* p. 156, ch. xii. |
| 1893 | Hayden .. .. | S | E | Cy | Conical ends. A Submarine Worker. |
| 1893 | AMMEN .. .. | S | S | .. | The *Katahdin.* *V.* p. 213, ch. xvi. |
| 1893 | ROMAZZOTTI .. | S | E | C | The *Gustave Zédé.* *V.* p. 151, ch. xii. |
| 1894 | Lacavalerie .. | S | E | C | *V.* p. 246, ch. xviii. |
| 1894 | Rogers .. .. | S | E | C | *V.* p. 247, ch. xviii. |
| 1894 | Piatti del Pozzo .. | S | ? | C | Formed of 7 separate spheres enclosed in a cigar-like outer cover. Central and largest one detachable to serve as lifeboat. |
| 1894 | Freese & Gawn .. | S | SE | C | Air supply through buoyed tube. |
| 1894 | Allen .. .. .. | S | E | C | Australian invention. Model tried at Sydney, N.S.W. |
| 1894 | LAKE .. .. | W | H | S | The *Argonaut Junior.* *V.* p. 157, ch. xii. |
| 1896 | Drzewiecki VI .. | S | SE | C | 190 tons. To go 15 knots above and 12 below water. |
| 1896 | Rutley .. .. | S | P & E | C | Dynamos driven by oil engines. Horizontal propellers in wells for immersion. |
| 1896 | Vassel .. .. | S | P | C | Bronze in 3 sections bolted together. Very like *Goubet.* |
| 1896 | ALVARY-TEMPLO | S | F | C | *V.* p. 156, ch. xii. (The "Aquapede.") |
| 1896 | Philippeau .. .. | S | P & E | P | Shaped rather like an elongated lemon. Double hull. |
| 1897 | PIATTI DEL POZZO | S | H & E | Sp | *La France.* *V.* p. 226, ch. xvii. |
| 1897 | LAKE .. .. | S | E | C | *Argonaut I.* *V.* p. 229, ch. xvii. Altered to II in 1900. |
| 1897 | Hinsdale .. .. | S | P & E | C | Suspended above a platform on the air-tube. A Submarine Worker. |
| 1897 | HOLLAND VII .. | S | S & E | C | Flattened cigar-shaped (*Plunger II*). *V.* p. 159, ch. xii. |
| 1897 | Romazzotti & Maugas | S | E | ? | Details not available. |
| 1898 | Möller (Carl).. .. | ? | ? | ? | Nondescript shape. Telescopic compartment for captain. Buoyant torpedoes as in Tuck's *Peacemaker.* *V.* p. 255, ch. xix. |
| 1898 | MacLaine .. .. | ? | ? | ? | Submersible battleship, 400 ft. long with 16 twelve-inch guns. |
| 1898 | Paul .. .. .. | S | ? | Cy | Short cylinder with spherical bow from which rises conning-tower. Displacement altered as in Rogers' submarine. |
| 1898 | Turc .. .. .. | .. | .. | C | French Naval Lieutenant's idea for a submersible. Cigar-shaped hull, heavily plated above water. |

| Date. | Inventor. | Propulsion. | Motive Power. | Shape. | Remarks. |
| --- | --- | --- | --- | --- | --- |
| 1898 | Urzua-Curat .. | Hy | ? | C | Fitted with bags like Borelli's boat. *V.* p. 189, ch. xiv. |
| 1898 | Elias .. .. .. | S | CA | C | The "Anthrotorpedo." *V.* p. 254, ch. xix. |
| 1898 | Homan .. .. | S | ? | C | Pivoted mast with look-out chamber at top. This can be folded down flat along upper surface of boat, and elevated by rack and pinion till the top appears at the surface to reconnoitre. |
| 1898 | GOUBET .. .. | S | E | C | For the Brazilian Navy. *V.* p. 156, ch. xii.; p. 189, ch. xiv. |
| 1898 | Vogt .. .. .. | S | S | C | High-speed semi-submersible. Cigar-shaped under water, with light hull above. Something like Burger's boat. *V.* p. 248, ch. xviii. |
| 1899 | Atkinson .. .. | ? | ? | ? | Model tried in Public Swimming Baths, Buckingham Palace Road. |
| 1899 | ROMAZZOTTI .. | S | E | C | The *Morse.* *V.* p. 171, ch. xiii. |
| 1899 | Rigaud .. .. | S | .. | O | The "Hydrophilos." Egg-shaped worker on 4 legs. *V.* p. 227, ch. xvii. |
| 1899 | Body .. .. | ? | ? | Cy | Conical ends. Made in 10 sections. Several torpedoes, one behind the other, in long central tube. |
| 1899 | Anonymous .. .. | S | E | P | English inventor. Double hull. |
| 1900 | Dobson .. .. | S | .. | P | Proposed fish-shaped submarine. Propellers arranged as in Baker's boat. |
| 1900 | Hoffman .. .. | .. | .. | .. | Invention of an Austrian officer. Details not available. |
| 1900 | Anonymous (J. R.) .. | S | S | S | Semi-submersible "Water-protected torpedo-boat." |
| 1900 | Hudson-Maxim .. | S | G | ? | To be driven by gas generated by the explosion of sticks of "Motorite" and to carry both submarine and aerial torpedoes. |
| 1900 | Argles .. .. | S | P & E | P | Oval in cross-section. Submersion by horizontal propeller. Rudder and screw below points of boat at each end. An Australian invention. |
| 1900 | Howard .. .. | ? | ? | ? | Invented by a Tasmanian. Model said to have been tried with good results. |
| 1900 | Drzewiecki VII .. | ? | ? | ? | A submersible. |

# APPENDIX II

**TABLE OF SUBMARINE TORPEDO-BOATS BUILT, BUILDING OR PROJECTED FOR THE NAVIES OF THE WORLD**

# APPENDIX II

## TABLE OF SUBMARINE TORPEDO-BOATS BUILT, BUILDING OR PROJECTED FOR THE NAVIES OF THE WORLD.

These tables have been compiled from the latest editions of Brassey's "Naval Annual," Jane's "Fighting Ships," from Burgoyne's and Pesce's works on Submarine Navigation, and from various naval and other journals. The British, French, Italian, and Japanese lists are probably approximately correct, and the United States tables as well. As regards the French, there seems to be some difference of opinion as to which boats are to be reckoned as "Submarines" and which as "Submersibles." Generally speaking, the table follows a list recently published in France as to this point.

The German and Russian lists are possibly not quite as accurate on account of the way in which these nations have prevented information leaking out to the press. The German submarine flotilla is very probably somewhat stronger than is here shown. In the Russian list Jane's "Fighting Ships"—generally particularly well informed as to naval matters in Russia—is pretty closely followed. The spelling of the Russian names must be accepted for what it is worth. Authorities differ widely as to this. Where figures are doubtful or unknown a query (?) is inserted.

| Name. | Date of Launch. | Tons. | Speed. | | Lgth. | Beam. | Crew. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| | | | Above | Below | | | | |
| British. | | | Knots | Knots | Ft. | Ft. | | |
| Holland 1 .. .. | 1901–3 | 120 submerged | 8 | 5 | 63·33 | 11·75 | 7 | Built Vickers. |
| Holland 2 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| Holland 3 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| Holland 4 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| Holland 5 .. .. | .. | .. | .. | .. | .. | .. | .. | Surface displacement of A1 rather less than 180 tons. Next 3 boats 200 tons when submerged. |
| A 1 .. .. | 1903–4 | 180 submerged | 11 | 7 | 100 | 10 | ? | |
| A 2 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| A 3 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| A 4 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| A 5 .. .. | 1904–5 | 200 submerged | 16 | 9 | 150 | 11·5 | .. | |

| Name. | Date of Launch. | Tons. | Speed. | | Lgth. | Beam. | Crew. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| | | | Above | Below | | | | |
| | | | Knots | Knots | Ft. | Ft. | | |
| A 6 .. .. | 1904–5 | 200 | 16 | 9 | 150 | 11·5 | .. | |
| A 7 .. .. | .. | submerged | .. | .. | .. | .. | .. | |
| A 8 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| A 9 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| A 10 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| A 11 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| A 12 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| A 13 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| B 1 .. .. | 1904–6 | 300 submerged | 13 | 9 | 150 | 13·5 | ? | |
| B 2 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| B 3 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| B 4 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| B 5 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| B 6 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| B 7 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| B 8 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| B 9 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| B 10 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| B 11 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| C 1 .. .. | 1906–7 | 314 submerged | 14 | 10 | 150 | 13·5 | ? | Two Screws. |
| C 2 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| C 3 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| C 4 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| C 5 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| C 6 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| C 7 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| C 8 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| C 9 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| C 10 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| C 11 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| C 12 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| C 13 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| C 14 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| C 15 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| C 16 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| C 17 .. .. | 1908 | .. | .. | .. | .. | .. | .. | |
| C 18 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| C 19 .. .. | Building | .. | .. | .. | .. | .. | .. | |
| C 20 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| C 21–C 30 .. | .. | .. | .. | .. | .. | .. | .. | |
| 13 Boats projected in Naval Programme for 1908–9 "D" Class. | | | | | | | | |
| FRENCH. | | | | | | | | |
| *Submarines.* | | | | | | | | |
| Gymnote .. .. | 1888 | 30 | 6 | 3 | 59·6 | 6 | 4 | |
| Gustave Zédé .. | 1893 | 270 | 10 | 5 | 160 | 12·5 | 8 | |
| Morse .. .. | 1899 | 146 | 12 | 8 | 118 | 9 | 9 | |
| Algerien .. .. | 1900 | 143 | 13 | .. | .. | .. | .. | |
| Français .. .. | .. | .. | .. | .. | .. | .. | .. | |
| Korrigan .. .. | 1901 | 185 | 12 | 8 | 135 | 9·5 | .. | |
| Gnôme .. .. | .. | .. | .. | .. | .. | .. | .. | |
| Lutin .. .. | .. | .. | .. | .. | .. | .. | .. | |
| Farfadet .. .. | .. | .. | .. | .. | .. | .. | .. | |
| Naïade .. .. | 1901–3 | 68 | 8 | 4·5 | 77 | 7·5 | .. | |
| Protée .. .. | .. | .. | .. | .. | .. | .. | .. | |
| Perle .. .. | .. | .. | .. | .. | .. | .. | .. | |
| Esturgeon .. | .. | .. | .. | .. | .. | .. | .. | |

| Name. | Date of Launch. | Tons. | Speed. | | Lgth. | Beam | Crew. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| | | | Above | Below. | | | | |
| | | | Knots | Knots | Ft. | Ft. | | |
| Bonite | 1901–3 | 68 | 8 | 4·5 | 77 | 7·5 | .. | |
| Thon | .. | .. | .. | .. | .. | .. | .. | |
| Souffleur | .. | .. | .. | .. | .. | .. | .. | |
| Dorade | .. | .. | .. | .. | .. | .. | .. | |
| Lynx | .. | .. | .. | .. | .. | .. | .. | |
| Ludion | .. | .. | .. | .. | .. | .. | .. | |
| Loutre | .. | .. | .. | .. | .. | .. | .. | |
| Castor | .. | .. | .. | .. | .. | .. | .. | |
| Phoque | .. | .. | .. | .. | .. | .. | .. | |
| Otarie | .. | .. | .. | .. | .. | .. | .. | |
| Méduse | .. | .. | .. | .. | .. | .. | .. | |
| Oursin | .. | .. | .. | .. | .. | .. | .. | |
| Grondin | .. | .. | .. | .. | .. | .. | .. | |
| Anguille | .. | .. | .. | .. | .. | .. | .. | |
| Alose | .. | .. | .. | .. | .. | .. | .. | |
| Truite | .. | .. | .. | .. | .. | .. | .. | |
| Emeraude | 1906 | 400 | 12 | 8 | 147 | 13 | 22 | |
| Opale | 1907 | .. | .. | .. | .. | .. | .. | According to some authorities these are Submersibles |
| Rubis | 1908 | .. | .. | .. | .. | .. | .. | |
| Saphir | .. | .. | .. | .. | .. | .. | .. | |
| Topaze | 1908 | .. | .. | .. | .. | .. | .. | |
| Turquoise | .. | .. | .. | .. | .. | .. | .. | |
| Guèpe 1 | 1907 | 44 | 9 | 5 | 70 | 7·5 | 4 | |
| Guèpe 2 | .. | .. | .. | .. | .. | .. | .. | |
| Q 51 (Pluvoise) | 1907 | 398 | 12·2 | 8 | 160 | 16·4 | 24 | |
| Q 52 (Ventose) | .. | .. | .. | .. | .. | .. | .. | |
| Q 53 (Nivôse) | Building | .. | .. | .. | .. | .. | .. | |
| Q 54 (Germinal) | 1907 | .. | .. | .. | .. | .. | .. | |
| Q 55 (Floreal) | .. | .. | .. | .. | .. | .. | .. | |
| Q 56 (Prairial) | Building | .. | .. | .. | .. | .. | .. | |
| Q 57 (Messidor) | .. | .. | .. | .. | .. | .. | .. | |
| Q 58 (Thermidor) | .. | .. | .. | .. | .. | .. | .. | These two a little different to the other "Q's." |
| Q 59 (Fructidor) | .. | .. | .. | .. | .. | .. | .. | |
| Q 60 (Vendmiaire) | .. | .. | .. | .. | .. | .. | .. | |
| Q 61 | .. | 21 | ? | ? | ? | ? | ? | De Dion Boat. |
| Q 62 (Brumaire) | .. | 398 | 12 | 8 | 160 | 16·4 | 24 | |
| Q 63 (Frimaire) | .. | .. | .. | .. | .. | .. | .. | |
| Q 64 (Papin) | .. | .. | .. | .. | .. | .. | .. | Labœuf Type. |
| Q 65 (Fresnel) | 1908 | .. | .. | .. | .. | .. | .. | |
| Q 66 (Berthelot) | Building | .. | .. | .. | .. | .. | .. | |
| Q 67 (Monge) | .. | .. | .. | .. | .. | .. | .. | |
| Q 68 (Ampère) | .. | .. | .. | .. | .. | .. | .. | |
| Q 69 (Guy-Lussac) | .. | .. | .. | .. | .. | .. | .. | |

Thirty-five more "Q" Submarines (Nos. 70 to 104) projected.

| *Submersibles.* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Narval | 1899 | 106 | 12 | 8 | 111·5 | 12·4 | 9 | 200 tons submerged. |
| Sirène | 1901 | 155 | 8 | .. | .. | .. | 10 | |
| Triton | .. | .. | .. | .. | .. | .. | .. | |
| Silure | .. | .. | .. | .. | .. | .. | .. | |
| Espadon | .. | .. | .. | .. | .. | .. | .. | |
| Oméga | 1905 | 301 | 11 | 8 | 160·6 | 13·9 | 20 | |
| Cigogne | 1904 | 175 | 10·5 | 8 | 118 | 12·75 | 20 | 200 tons submerged. |
| Aigrette | .. | .. | .. | .. | .. | .. | .. | |
| X | 1904 | 168 | 10·5 | 8 | 128 | 10·2 | 15 | |
| Z | .. | 202 | 11 | 8 | 135·8 | 9·1 | 20 | |
| Y | 1905 | 213 | .. | .. | 144 | 9·1 | 15 | |
| Circe | 1907 | 351 | 13 | ? | 155 | 14·5 | ? | |

| Name. | Date of Launch. | Tons. | Speed. Above | Speed. Below | Lgth. | Beam. | Crew. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| | | | Knots. | Knots. | Ft. | Ft. | | |
| Calypso .. .. | 1907 | 351 | 13 | ? | 155 | 14·5 | ? | Tons submgd. |
| A .. .. .. | Projected | 577 | 15 | 10 | 197 | ? | ? | 810 |
| B .. .. .. | .. | 530 | .. | .. | 210 | ? | ? | 623 |
| C .. .. .. | .. | 550 | .. | .. | 184 | ? | ? | 735 |
| **Italian.** | | | | | | | | |
| Delfino .. .. (as reconstructed) | 1894 | 95 | 9 | 5 | 79 | 10 | 12 | 107 tons submerged. |
| Tritone .. .. | 1902 | ? | 8 | 5 | 59 | ? | 5 | |
| Glauco .. .. | 1906–7 | 150 | 14 | 9·9 | 118 | 13 | ? | |
| Squalo .. .. | .. | .. | .. | .. | .. | .. | .. | |
| Narvalo .. .. | .. | .. | 14 | .. | .. | .. | .. | |
| Otaria .. .. | .. | .. | .. | .. | .. | .. | .. | |
| Tricheco .. .. | .. | .. | .. | .. | .. | .. | .. | 220 tons submerged, by F. I. A. T. Co. |
| *Foca .. .. | 1908 | 175 | 15 | 9 | 138 | 14 | ? | |

*Seven others of this class building or projected.

| Name. | Date of Launch. | Tons. | Speed. Above | Speed. Below | Lgth. | Beam. | Crew. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| **German.** | | | | | | | | |
| Howalt Boat .. | 1901 | 85 | 7 | 6 | 49·25 | 6·5 | 3 | |
| Holland 1 .. | 1902 | 120 | 7 | 5 | 64 | 12 | 5 | |
| Submarine U 1 .. | 1906 | 180 | 12 | 9 | 128 | 117 | 10 | 240 tons submerged. Armoured Conning tower. |
| Submarine U 2 .. | 1908 | .. | .. | .. | .. | .. | 10 | |
| Submarine U 3 .. | .. | .. | .. | .. | .. | .. | .. | |
| Submarine U 4 .. | Building | .. | .. | .. | .. | .. | .. | |

Four others projected.

| Name. | Date of Launch. | Tons. | Speed. Above | Speed. Below | Lgth. | Beam. | Crew. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| Lake Boat 1 | Building in America | .. | .. | .. | .. | .. | .. | "Protectors" |
| Lake Boat 2 | | .. | .. | .. | .. | .. | .. | |
| Lake Boat 3 | | .. | .. | .. | .. | .. | .. | |
| Lake Boat 4 | | .. | .. | .. | .. | .. | .. | |
| **United States.** | | | | | | | | |
| Holland .. .. | 1896 | 74 | 8 | 5 | 54 | 11 | 5 | |
| Adder .. .. | 1901–2 | 120 | 8 | 5 | 63·33 | 11·75 | ? | |
| Grampus .. .. | .. | .. | .. | .. | .. | .. | .. | |
| Mocassin .. .. | .. | .. | .. | .. | .. | .. | .. | |
| Pike .. .. | .. | .. | .. | .. | .. | .. | .. | |
| Plunger .. .. | .. | .. | .. | .. | .. | .. | .. | |
| Porpoise .. .. | .. | .. | .. | .. | .. | .. | .. | |
| Shark .. .. | .. | .. | .. | .. | .. | .. | .. | |
| Octopus .. .. | 1906 | 278 | 11 | 10 | 106 | ? | ? | |
| Cuttlefish .. .. | 1906 | 170 | 10 | 9 | 80·5 | 12·5 | ? | |
| Viper .. .. | Building | .. | .. | .. | .. | .. | .. | |
| Tarantula .. | .. | .. | .. | .. | .. | .. | .. | |
| Burger Boat 1 .. | .. | ? | ? | ? | 104·9 | ? | ? | Semi-submersible. |
| Burger Boat 2 .. | .. | .. | .. | .. | .. | .. | .. | |
| Burger Boat 3 .. | .. | .. | .. | .. | .. | .. | .. | "Protector" type. 8 others of this class projected. |
| Burger Boat 4 .. | .. | .. | .. | .. | .. | .. | .. | |
| Lake Boat .. | .. | ? | ? | ? | ? | ? | ? | |
| **Russia.** | | | | | | | | |
| Ossetyr .. .. | 1902 | 170 | 11 | 7 | 70 | 11 | ? | Ex "Protector." |

| Name. | Date of Launch. | Tons. | Speed. | | Lgth. | Beam. | Crew. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| | | | Above | Below | | | | |
| | | | Knots | Knots | Ft. | Ft. | | |
| Schtschuka .. | 1903–5 | ? 450 | 9 | 7 | ? 150 | ? | ? | |
| Kassatka .. .. | .. | .. | .. | .. | .. | ? | ? | Improved "Protectors." |
| Skat .. .. | .. | .. | .. | .. | .. | ? | ? | |
| Sterliad .. .. | .. | .. | .. | .. | .. | ? | ? | |
| Forel .. .. | .. | .. | .. | .. | .. | ? | ? | |
| Losas .. .. | .. | .. | .. | .. | .. | ? | ? | |
| Byeluga .. .. | .. | .. | .. | .. | .. | ? | ? | |
| Som .. .. | .. | .. | .. | .. | .. | ? | ? | |
| Graf Schmertef .. | 1903–5 | 175 | 7 | 5 | 77 ? | ? 14 | ? | "Hollands." |
| Okuny .. .. | .. | .. | .. | .. | .. | .. | ? | |
| Sig .. .. .. | .. | .. | .. | .. | .. | .. | ? | |
| Piotwa .. .. | .. | .. | .. | .. | .. | .. | ? | |
| Pescar .. .. | .. | .. | .. | .. | .. | .. | ? | |
| Kefal .. .. | .. | .. | .. | .. | .. | .. | ? | |
| Makryei .. .. | 1904–6 | 20 | 10 | 5 | 50 | 14 | ? | Pukaloff Boats. |
| Kata .. .. | .. | .. | .. | .. | .. | .. | ? | Was lost off Vladivostock during war, but is to be raised. |
| Bytschok .. .. | .. | .. | .. | .. | .. | .. | ? | |
| Nalim .. .. | .. | .. | .. | .. | .. | .. | ? | |
| Paltus .. .. | 1903 ? | 113 | 10 | 5 | 80 | 14 | ? | Drzewiecki. |
| ? | .. | .. | .. | .. | .. | .. | ? | Kuteinikoff and Kolbasieff. |
| Petr Kochka .. | 1902 | 60 | 6 | 3 | 50 | 14 | ? | |
| Delphin I .. | 1903 | 175 | 10 | 8 | 77 | 14 | 24 | Bubnoff Boat. |
| ,, II .. | ? | .. | .. | .. | .. | .. | .. | |
| ,, III .. | ? | .. | .. | .. | .. | .. | .. | |
| ,, IV .. | ? | .. | .. | .. | .. | .. | .. | |
| ,, V .. | ? | .. | .. | .. | .. | .. | .. | |
| ,, VI .. | ? | .. | .. | .. | .. | .. | .. | |
| D'Equevilley I .. (Karp) | 1905 | 200 | 12 | 9 | 130 | 9·10 | ? 9 | Built at Kiel (240 tons submerged). |
| D'Equevilley II .. (Karas) | 1906 | .. | .. | .. | .. | .. | .. | |
| D'Equevilley III (Kambala) | 1906 | .. | .. | .. | .. | .. | .. | |
| Krokodil .. .. | 1908 | 400 | 14 ? | 7 ? | ? | ? | ? | At Petersburg. "Protectors." |
| Kaiman .. .. | .. | .. | ? | ? | ? | ? | ? | |
| Draken .. .. | .. | .. | ? | ? | ? | ? | ? | |
| Aligator .. .. | .. | .. | ? | ? | ? | ? | ? | |
| Akula .. .. | .. | 360 | ? | ? | ? | ? | ? | At Kiel. |
| Minoga .. .. | .. | 177 | ? | ? | ? | ? | ? | |
| SWEDEN. | | | | | | | | |
| Enroth .. .. | 1902 | 146 | 12 | 8 | 82 | 14 | ? | |
| Hajen 1 .. .. | 1903 | 120 submerged | 10 | 7 | 71 | 12 | 6 | |
| Hajen 2 .. .. | .. | .. | .. | .. | .. | .. | .. | Projected. Improved "Hajens." |
| Hajen 3 .. .. | .. | .. | .. | .. | .. | .. | .. | |
| Submersible 1 .. | Building | 180 | 15 | 9 | 139·5 | 14 | .. | By F.I.A.T. Co. 230 tons submerged. |
| AUSTRIA. | | | | | | | | |
| Lake (4) .. .. | Building | 250 | 12 | 7 | 160 | 10·5 | | 2 at Pola. 2 at Fiume. |
| Holland (2) .. | Building | ? | ? | ? | ? | ? | ? | At Barrow. |
| D'Equevilley (3) .. | .. | 296 | .. | .. | .. | .. | .. | At Kiel. |

| Name. | Date of Launch. | Tons. | Speed. Above | Speed. Below | Lgth. | Beam. | Crew. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| | | | Knots | Knots | Ft. | Ft. | | |
| NORWAY. | | | | | | | | |
| Holland 1 .. | Building | ? | ? | ? | ? | ? | ? | |
| F. I. A. T. 1 .. | ,, | ? | ? | ? | ? | ? | ? | |
| D'Equevilley 1 .. | .. | 260 | ? | ? | ? | ? | ? | At Kiel. |
| SPAIN. | | | | | | | | |
| Peral .. .. | 1889 | 87 | 10 | ? | 70 | 8·5 | ? | |
| PORTUGAL. | | | | | | | | |
| Plongeur .. .. | 1892 | 100 | 6 | ? | 72 | 11 | 6 | |
| Fontes III .. | 1901 | ? | ? | ? | ? | ? | ? | |
| HOLLAND. | | | | | | | | |
| Luctor et Emergo | 1906 | ? | ? | ? | 66 | 11 | 9 | A "Holland." |
| BRAZIL. | | | | | | | | |
| Jacinto Gomez .. | 1903 | 25 | 6 | ? | ? | ? | ? | "Goubets." |
| Mello Marques .. | .. | .. | .. | .. | .. | .. | .. | |
| 5 "Hollands" | Building | .. | .. | .. | .. | .. | .. | |
| ARGENTINA. | | | | | | | | |
| Submarine (Recaldoni) | 1901 | ? | ? | ? | ? | ? | ? | |
| Several "Hollands" | projected. | | | | | | | |
| CHILI. | | | | | | | | |
| Urzua-Curat .. | Building | ? | ? | ? | ? | ? | ? | Possibly the one projected in 1898. *V.* Appendix I. |
| JAPAN. | | | | | | | | |
| Holland 1 .. | 1904 | 120 | 8 | 7 | 65 | 12 | ? | |
| ,, 2 .. | .. | .. | .. | .. | .. | .. | .. | |
| ,, 3 .. | .. | .. | .. | .. | .. | .. | .. | |
| ,, 4 .. | .. | .. | .. | .. | .. | .. | .. | |
| ,, 5 .. | .. | .. | .. | .. | .. | .. | .. | |
| Japanese built 1 .. | 1906 | 62 | ? | ? | ? | ? | ? | |
| ,, ,, 2 .. | .. | 86 | .. | .. | .. | .. | .. | |
| Submarine 1 .. | 1908 | 314 | 14 | 8 | 135 | 13·5 | ? | Like British "C" Class. |
| ,, 2 .. | 1908 | .. | .. | .. | .. | .. | .. | |
| ,, 3 .. | Building | .. | .. | .. | .. | .. | .. | |
| ,, 4 .. | .. | .. | .. | .. | .. | .. | .. | |
| ,, 5 .. | .. | .. | .. | .. | .. | .. | .. | |
| ,, 6 .. | .. | .. | .. | .. | .. | .. | .. | |
| ,, 7 .. | .. | .. | .. | .. | .. | .. | .. | |
| Russian Type 1 .. | ? | ? | ? | ? | ? | ? | ? | Probably captured in the war. |

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