SUBMARINE MINING AND TORPEDO WARFARE.

In view of the widespread interest in torpedoes and submarine mines which has been awakened by the blowing up of the "Maine," we have prepared the following account of these destructive and little understood weapons. Speculation has been rife as to the manner in which the disaster occurred, and a widespread belief undoubtedly exists that the ship was blown up by design, yet few people have any clear idea of the difficulties involved in the task of blowing up a warship under the circumstances in which the "Maine" was placed. We shall not attempt to go into the history of torpedo warfare, but will merely explain the present methods of attack with high explosives.

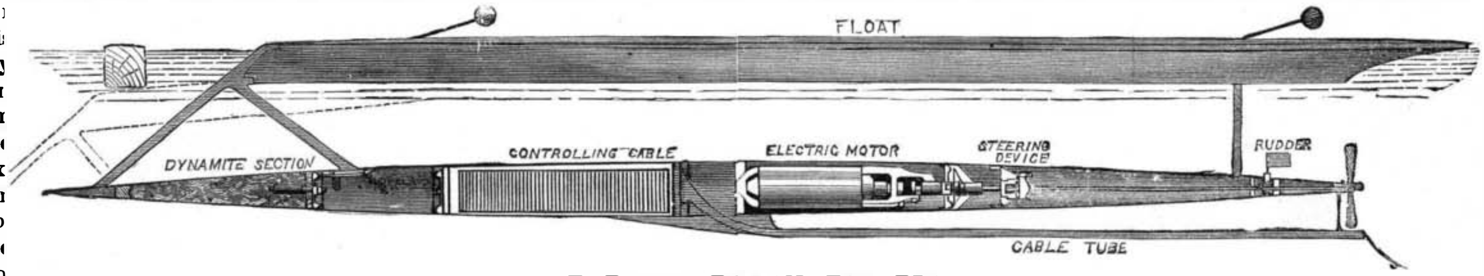
The attack against a ship with gun-cotton, dynamite and similar substances is carried out by firing them in shells from pneumatic guns, by exploding them at the head of a torpedo which is automatically propelled against the submerged hull of the ship, and by placing them in submerged mines, which are exploded mechanically on being struck by the ship or are fired electrically from a station on shore. The automobile torpedo is a cigar-shaped steel vessel, usually about 25 feet in length, whose interior is divided into three main compartments. The first compartment at the head contains a heavy charge of gun-cotton; the second forms the air receiver for the storage of compressed air; and behind this is the engine room, in which are the propelling engines and the mechanism for controlling the course of the torpedo. The best known type is the Whitehead, which is in almost universal use throughout the world. It is started on its course by firing it from a launching tube, by means of a charge of compressed air or a few ounces of gunpowder. One of our illustrations shows a torpedo in its flight from the tube to the water. On reaching the water its propellers, which have been set in motion by its discharge, drive it at a speed of 30 knots an hour against the submerged hull of the ship, the proper depth being maintained by automatic mechanism within the torpedo. On its striking the ship, the gun-cotton is exploded by the impact.

Another torpedo of the automatic type is the Howell, invented by a United States naval officer of that name. It is a cigar-shaped vessel, not unlike the Whitehead in appearance; but its motive power is entirely different. It is driven by the momentum of a flywheel contained within the shell, and it is started, like the Whitehead, from a launching tube. The flywheel is set spinning at a high velocity by means of a suitable motor which is disconnected before the torpedo is fired, the stored-up energy in the wheel serving to turn the double propellers and drive the torpedo at a high speed toward the ship.

The Sims-Edison torpedo, of which we present an illustration, belongs to the class of what are known as dirigible torpedoes. These are connected by electric cables with a station on shore, from which the speed and steering are controlled. The cable contains an outer and an inner conductor, the first of which conveys current for driving the motor in the torpedo, the other carrying current for exciting the magnets which control the steering gear. The cable is extremely flexible and has a total length of about two miles; it is wound on a reel which is within the torpedo and unwinds as it travels. The cigar-shaped torpedo proper is rigidly suspended from a boat-like float, upon which are two vertical rods which project above the water and indicate to the operator on shore, or on the ship, the position of the torpedo. The little rods carry flags by day and colored lights by night.

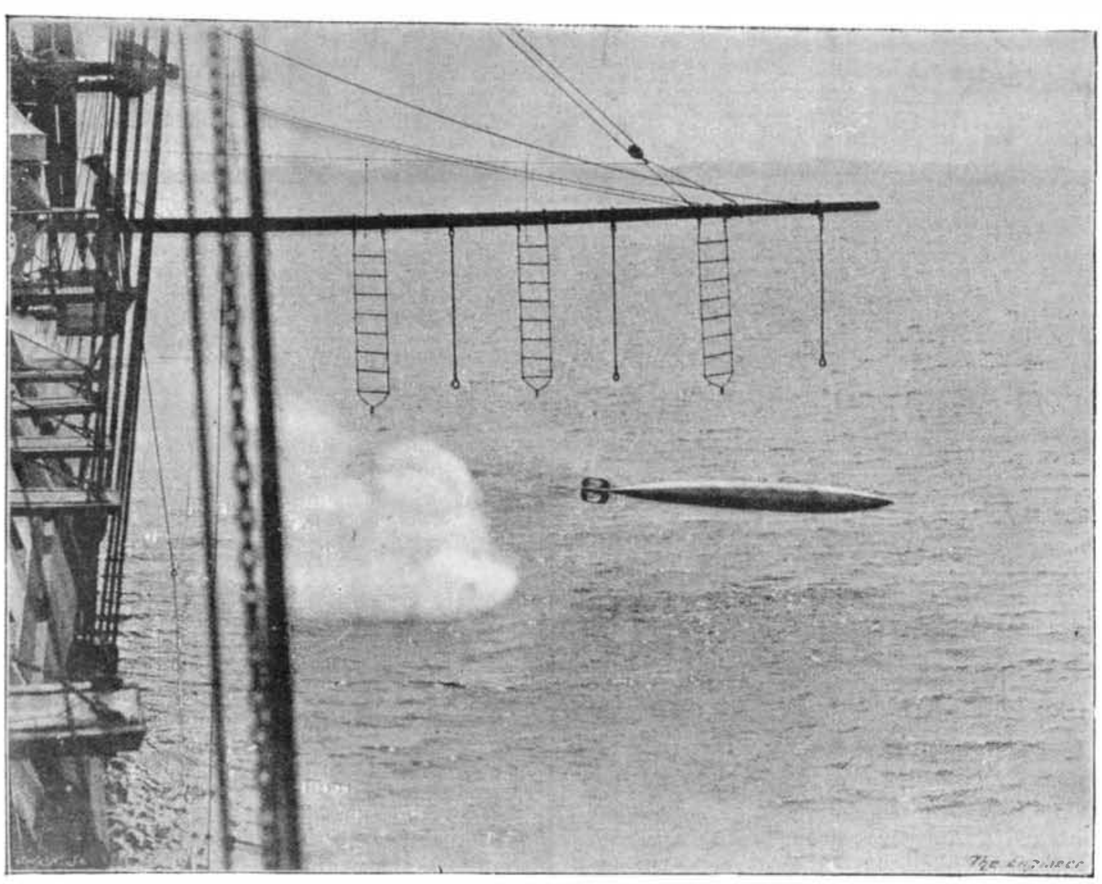
The Victoria is an Australian invention and is controlled from the shore or a ship like the Sims-Edison. It differs from the latter in being entirely submergible below the water, and in using air as its motive power. When it is started it hauls a cable after it, unwinding it off a reel on shore, and the first part of its course is covered at moderate speed. When the operator has guided it to within striking distance of the enemy, a current is sent through the cable which releases the reel on the torpedo and allows its cable to unwind. At the same time the current starts the air engines at full speed and the final dash for the ship is made.

The Brennan is another torpedo of the dirigible type, which acquired considerable fame from the fact that it was taken up by the British Admiralty and subjected to exhaustive experiments. Like all the machines of its class it has proved only moderately successful, and in common with them is not regarded with much favor by naval authorities. The Whitehead is par excellence the torpedo of the present day, and the recent struggles in Chile, Brazil and the East have served to demonstrate its deadly power.



THE SIMS-EDISON TORPEDO.

It will be evident from this brief review that torpedo operations are not so secret or easy of concealment as is popularly supposed, and there are features connected with it which make it highly probable that the sinking of the "Maine" in Havana Harbor was not done by a mobile torpedo. The torpedo itself is a bulky affair, and, together with its launching gear, could never have been brought within striking distance without attracting attention. The Whitehead, if launched from a neighboring ship, would have been accompanied by a report and a splash as it left the gun and plunged into the water (see illustration), which would certainly have attracted attention on board the "Maine." If the Sims-Edison or any other form of dirigible torpedo had been used, it is inconceivable that the necessary plant could have been in existence on shore without detection. Moreover, it would have been next to impossible to run a torpedo, with a cable trailing behind it, through the crowded waters of the harbor, without its becoming entangled with the ferry boats or shipping. The lights which a dirigible torpedo must carry by night to indicate its course would be visible from the shore and from all the shipping near it.



DISCHARGING A WHITEHEAD TORPEDO.

It may safely be said that if the "Maine" was destroyed by some external cause, it was not a torpedo, but some form of submarine mine that wrought the mischief.

Submarine mines are of three different kinds: 1. Observation mines, which are fired from shore when a ship is seen to be in their vicinity. 2. Electrical contact mines, which, on being struck by a ship, give notice to the operator, who, by pressing a button, fires the mine. 3. Automatic mines, which are self-firing on being struck by a ship.

Generally speaking, the mine consists of a steel shell of comparatively light plating which is filled with a charge of high explosive, usually gun-cotton, and contains at its base some exploding or detonating device for setting off the mine. Of the three kinds mentioned above, the mechanical mine is less used than the other two. For purposes of firing, cables are led from the igniting charge to an observation station conveniently located on shore. The mines are built in a variety of shapes, some of them being cylindrical, with rounded ends, and others conical, with the sides somewhat bulging. The observation mines possess considerable advantage from the comparative simplicity of their construction, and the fact that when they are laid they may be adapted to allow the passage of friendly vessels while barring those of a hostile power. When they are placed on the bed of the river or harbor, they are known as ground mines. In some countries this type is of the roughest and cheapest construction, consisting of a rough cast iron case with projecting legs to enable it to anchor itself securely in the mud. There is practically no limit to the size of these mines; lying deep down beneath the surface they are entirely hidden from view, they are not liable to be laid bare with the fall of the tide, and they contain sufficient explosive to insure that any ship within a radius of fifty feet will be destroyed.

Another type is known as the buoyant mine. These are made considerably larger in order to secure sufficient displacement, and they are anchored by a cable of such a length as to insure that they will float at the required depth below the surface. They have an advantage over the ground mine in the fact that they lie nearer to the object of attack, and, therefore, do not require to be filled with such a heavy charge of explosive.

Observation mines may be fired by one or two observers. If by one observer, the mines are laid down in rows, the lines of which converge to the observation station. All the mines in one row are connected so that they can be simultaneously fired when the ship is passing the range line. When the mines are connected with two observers, they are laid according to a system of cross observation, by which it is possible to fire any particular mine when the ship is above or in close proximity to it.

The great advantage of the electrical contact mine is that a very small charge of gun-cotton suffices for the destruction of a ship as compared with that which is necessary in a buoyant or in a ground mine. These mines are provided with an automatic circuit closer, by means of which, on the mine being struck be a vessel, a current is sent to the observing station, from which the operator fires the mine. In one form of contact mechanism a vertical pendulum is hung in such a position that when the mine is struck it will swing over and close the circuit by striking a contact point. In the case of ground mines the circuit closer may be anchored to them by a cable and float above them at the proper distance beneath the surface. In the buoyant mines the circuit closer is contained within the shell of the mine itself. It will be seen that in this system the operator has perfect control of the mine, and can permit a friendly vessel to pass, by failing to close the firing circuit when the warning is received, while, at the same time, he may have his finger upon the button ready to sink a hostile ship the instant that the warning is automatically sent in from the mine.

It is a question whether a submarine mine of the ordinary type, with its charge of from 50 to 200 pounds of gun-cotton, would be sufficient to account for the absolute destruction which appears to have been wrought in the forward half of the "Maine." It is, of course, conceivable that the explosion of a buoyant or floating mine of the ordinary type in close proximity to the ship might have caused the greater and more destructive explosion of the magazines within the ship itself, and this theory would be consistent with the double report, the first muffled and the second louder and more terrible, which many of the eye witnesses appear to have noticed. Outside of the various kinds of submarine mines there is one other possible device which might be answerable for the catastrophe. It is conceivable that some form of torpedo provided with an automatic detonating device operated by clockwork might have been placed beneath the hull of the ship, attached thereto and left to do its work. Such devices are not unknown, nor considered impossible by the experts in torpedo warfare and mining operations. Of course, the difficulties in the way of carrying out such a scheme would be enormous.

In summing up, it is evident that, if the "Maine" was blown up from the outside, it is extremely improbable that the work was done by an automobile or a dirigible torpedo, and the only practical device would have been some form of submarine mine. It is simply common justice, in view of the atrocious and unspeakable nature of such a crime, to point out that there are two considerations which render the submarine mine theory very doubtful. The first is that the explosion of dynamite in a body of water invariably causes the death of all the fish within a wide radius, and the second is that the great upheaval of water is followed by a big wave which travels in every direction from the scene of the accident. We are aware that it has been denied that there are any fish in the harbor of Havana; but we are assured by those who have been long resident in Havana that the harbor abounds with fish.

Either of the above phenomena would, to our thinking, provide very strong proof that the "Maine" was blown up from below; but, so far, we have failed to find any evidence offered by eye witnesses that either result followed. Both of these points will undoubtedly be the subject of close examination on the part of the Board of Inquiry, and will furnish strong presumptive evidence, one way or the other, apart from the condition of the wreck itself.

Sugar-eating Nations.

The sugar crop of the world amounts in a normal year to about 8,000,000 tons, of which the larger part, about 4,500,000 tons, comes from beets and the balance, 3,500,000 tons, from sugar cane. Of the latter the largest proportion comes from the West Indies and a large amount from the island of Java, says the N. Y. Sun.

Among the countries producing beet sugar, Germany comes first, with about one-third of the world's crop; then Austria, with about as much; and then France, Russia, and Belgium and Holland together, with substantially the same quantity.

In respect of the production of beet sugar in the United States, there has been a vast increase since the establishment of the McKinley tariff in 1890. The year previous the American product was 2,800 tons. Two years later it was 12,000 tons. Four years later it was 20,000 tons. Last year it was 43,000 tons, and the product is on the increase. The McKinley tariff established between July 1, 1891, and July 1, 1905, a bounty to be paid by the United States government to sugar producers, with a view of stimulating the industry and compensating those engaged in it for the changes made in the duty upon imported sugar.

Among scientists the opinion has been general that a moderate amount of sugar, like a moderate amount of salt, should enter into the dietary of the people of each nation; but it is only when the figures of the consumption of sugar are examined that it is seen that the quantity consumed varies radically, and it is a curious fact that in those countries in which the maritime spirit—the spirit of navigation, commerce, travel and colonization—is strong there is a very considerable consumption of sugar per capita; whereas in those countries in which these qualities are not predominant among the inhabitants the consumption is smaller. In England, first among the maritime nations of the world, the consumption of sugar is 86 pounds a year for each inhabitant. In Denmark it is 45, in Holland 31, in France 30, and in Norway and Sweden 25, whereas in Russia it is only 10, in Italy 7, in Turkey 7, in Greece 6, and in Servia 4. The consumption of sugar seems to have very little connection with or relation to the production of sugar; for in Austria, the sugar product of which is large, the average consumption is only 19 pounds, while in Switzerland, in which there is no production to speak of, it is 44. And another curious phase of the matter is that there is a great disparity in the consumption of sugar in the two tea drinking countries, England and Russia. The large amount of sugar consumed in France is attributed in part to the fact that the French confectioners and candy makers, and more especially those doing business in the city of Paris, use in their trade enormous quantities of sugar in a year, adding abnormally to the average consumption of sugar in the French republic.

AN institute bearing the name of Christopher Columbus has been started in the port of Genoa on board a vessel, which has been specially adapted to the purpose, with the object of providing instruction for master mariners, machinists, electricians, torpedo engineers, etc. This is the only institute of the kind which exists in Italy.

The Draining of Lake Fucino.

A remarkable undertaking has been very quietly completed in Italy, says The American Architect. From time to time, for the last forty years, the technical journals have given partial accounts of the work which was going on for draining the Lake Fucinus. This lake lies in a valley of the Apennines, some seventy miles southeast of Rome, and about one hundred and twenty from Naples. This valley, which is nearly two thousand feet above the sea, is entirely surrounded by mountains so that it forms an inclosed basin, occupied partly by very fertile meadow land and partly by the water of the lake. Unfortunately, the proportion between the land and the water is very variable, so that, after a series of rainy seasons, the farms which had been tilled for years, and even the habitations of the farmers themselves, become submerged in the lake, to reappear perhaps fifteen or twenty years later. The advantages of draining the lake, and reclaiming the sixty thousand acres or so of rich land which it covers, have been obvious for many centuries, and history represents the Æqui and Marsi, who inhabited the territory, as appealing to the Roman commonwealth, long before the imperial era, for aid in preventing the periodical inundations of the lake. In the time of Claudius operations were really begun in earnest by the central authority, and the skill and energy of the Roman engineers were sufficient to cut a tunnel, more than four miles long, partly through hard rock and partly through disintegrated ledges of the most dangerous kind, under the mountains to the little river Liris, which afforded an outfall to the sea for the lake waters. It has been supposed, in modern times, that this enterprise, on which the imperial government is recorded to have spent eighty million dollars, was abandoned before completion, but we now know that it was carried through successfully, and that it drained away the water of the lake until it became gradually choked by the fall of loose material, which the science of those days was insufficient entirely to prevent. Moreover, it has now been learned that the Roman engineers, when the tunnel was obstructed, either just before or soon after completion, by a great fall of loosened rock from the roof into it, started again, with characteristic Roman perseverance, and cut a tunnel around the obstruction.

In the course of ages, the accumulation of stones and rubbish so completely interrupted the flow of water that the tunnel was practically useless, and the periodical rise and fall of the lake waters became as troublesome as ever. Attempts were made by some of the popes, and by one or two of the kings of Naples, to provide drainage, but they ended in nothing. At last, some fifty years ago, a company was formed, the capital of which was subscribed in England, to carry out drainage works, and English engineers were sent to study the problem; but, after a few trials, the difficulties of the enterprise were found so great that operations ceased. Then Prince Torlonia, a rich banker of Rome, who was a large stockholder in the company, bought the remaining shares, and resumed the work on his own account. Three French engineers were employed, and under their guidance the labor of forty years has now been carried to a successful issue, and the waters of the lake pour through the tunnel, at the rate of forty-eight cubic meters per second, into the sea. A history of the work was published some time ago, which should have great interest for engineers, but the Torlonia family is said, for some unexplained reason, to have bought all the copies in booksellers' hands. However, the main facts are well known. The French engineers began their work by measuring the inflow into the lake and the capacity of the channel of the Liris, so that their tunnel could be proportioned to both, and the accuracy of their conclusions may be inferred from the fact that the tunnel, which is about fifteen feet in diameter, is filled to within eighteen inches of the top by the flow. In general, the new tunnel follows that of the Roman engineers, but it is much larger, the Romans having evidently no conception of the capacity required. Moreover, the Roman engineers did not possess instruments like ours, and the alignment of their tunnel was found to be irregular, sometimes falling below the true direction and sometimes rising above it, so as to form a succession of traps. The formation, even where the rock is firm enough to keep in place without lining, is full of water-bearing seams, and the work was one of great difficulty and danger throughout. The Roman engineers had adopted a curious mode of lining, consisting in shoring the walls and ceiling of the tunnel with timber uprights and planks, and substituting by degrees concrete for the planking. As it was necessary to leave the uprights until the end of the operation, the concrete was filled in around them, and they were finally cut off flush with the concrete surface. Of course, they soon rotted away, leaving holes, through which water and mud came freely, so that this ignorance of the properties of timber must have had much to do with the choking of the tunnel. The French engineers, of course, lined their work in the modern fashion, and there is every reason to believe that the present tunnel will endure for many centuries.

Two Great Cargo Carriers.

There have just arrived in New York the two largest cargo carriers in the world, the "Cymric," of the White Star Line, and the "Pretoria," of the Hamburg American Line. Both of the vessels have just made their maiden trip, one from Liverpool and the other from Hamburg. The "Cymric" is 600 feet long, 64 feet beam and 42 feet deep, with a gross tonnage of 12,340 tons and a displacement of 23,000 tons. She has two sets of quadruple expansion engines whose aggregate horse power is 6,500. On her trial trip the "Cymric" made about seventeen knots. Her time from Liverpool was 11 days 2 hours and 49 minutes; the average hourly speed was 11·53 knots. Her commander says that the "Cymric" is the steadiest ship he has ever been aboard. The fifty staterooms of the "Cymric" are larger than those of the ordinary passenger ship. All the cabin passengers can be seated at once. No second cabin passengers will be carried, and she has accommodations for 800 steerage passengers, and more may be taken by utilizing some of her cargo space.

The "Pretoria" is next to the largest cargo carrier afloat, the "Cymric" only exceeding her. She is 586 feet long, 62 feet beam and 42 feet deep. She has twin screws driven by quadruple expansion engines; she measures 12,800 gross tons and can carry nearly 14,000 tons dead weight and about 20,000 tons cargo measurement, which, her agents say, might be represented by the contents of 25 trains of 25 freight cars each. The "Pretoria" has accommodations for 328 cabin passengers and 800 steerage passengers. She made the run from Hamburg in 11 days.

A Primitive Maya Jewsharp.

Mr. M. H. Saville gives the following interesting information in a recent note in the American Anthropologist: The ancient forms of musical instruments known to have been used in Yucatan have been almost entirely superseded by those introduced since the Spanish conquest. In some of the interior pueblos the tunkul, or ancient wooden drum, is still used on feast days. "During the winter of 1890-91, while engaged in explorations at the cave of Loltun, we employed a number of Mayas who came from small villages in the interior remote from Spanish influences. Their evenings were passed in singing plaintive melodies in their native tongue, accompanied by a primitive form of stringed instrument which I have never seen described. It was called hool, and consisted of a piece of ropelike vine (ohil) stretched between the two ends of a pliable stick, making a bow about two feet long. One end of this bow is placed near the face, about one-third of the distance from the end, so that the mouth covers but does not touch the string, forming a resonator. Between the string and bow a piece of wood is placed in such a manner that it may be pressed against the string or relaxed at will. The tones are produced by tapping on the string, and somewhat resemble those made in playing a jewsharp, but are more agreeable to the ear. Variation of tone was produced by varying the pressure of the stick upon the string and also by the opening or partial closing of the mouth. The music is weird and not unpleasing."

Reversing in Steam Turbines.

Mr. Parsons, of steam turbine fame, has succeeded in producing a turbine of the general type which is known by his name which is capable of running in the reverse direction. At the time that the performance of the "Turbinia" startled the marine world, it was pointed out that such a boat would be useless for torpedo warfare because she was unable to reverse her engines. To remedy the defect Mr. Parsons at first proposed to install a separate motor for running astern—an obviously uneconomical arrangement. It is now stated that by using a system of "butterfly" reversing steam valves a motor is constructed in which the steam may be made to flow through the blades of the turbine in either direction—the whole horse power of the engines being thus available for going astern. We shall hope to give further details in a later issue.

The Current Supplement.

The current SUPPLEMENT, No. 1157, contains twenty-four articles, thirty-two short notes and twenty-two illustrations. The contents of this number by their variety will appeal to all our readers. The latest portrait of the Emperor William II. of Germany is accompanied by a biographical sketch. "My Recent Journey from the Nile to Suakim" is an interesting article by the celebrated war correspondent Frederic Villiers. "The Causes of Poverty" is an article based on the report of the Committee of Statistics of the New York Charity Organization Society, and is an important addition to sociological literature. "Machine Moulding Without Stripping Plates," by E. H. Mumford, describes a moulding machine. "Artificial India Rubber" and "Deep and Frosted Etching on Glass" are technological articles. Electricity is represented by "The Koppel Electric Locomotives" for narrow gage and pioneer lines and "Liquid Rheostats."