WILL THE SUBMARINE DRIVE BATTLESHIPS FROM THE SEA?

England's Success in Defending Coast and Bottling German Fleet Held an Argument for Big Fighters

By WM. LEDYARD CATHCART.

"THE feeling grows perceptibly," says a leading daily newspaper, "that the submarine is the naval weapon of the future." To the lay mind there is much to inspire this feeling in the spectacular, if relatively infrequent, success of German submarines in attack on British warships.

The battleship of to-day is, like the ship of the line of all ages, the most effective combination of power to strike and strength to resist which it is possible at this time to float and drive at fair speed. When such a mobile fortress, carrying nearly a thousand men, is sunk in a few minutes by a torpedo fired from an unseen submarine the swiftness and completeness of the tragedy shock the world, and the helplessness of the huge ship against such a stilettolike blow from the depths may well stir the question: "Is not the dreadnought's day done?"

This question has been asked before—more than forty years ago, when the Whitehead torpedo, the ancestor of the savage slayer of to-day, first appeared. The British Admiralty of that time answered it with the announcement that England would build no more battleships; that the new weapon would drive them from the seas. And yet in the years since then, although the automobile torpedo has made marvellous advances in speed, range and deadliness, the battleship has more than held its own in its steady progress from the primitive Monitor type to the superdreadnoughts and battle cruisers of our time. To-day both England and Germany are building dreadnoughts with furious energy, and the General Board of the United States navy said in its last annual report:

"What has been true throughout all naval wars of the past and what is equally true to-day is that the backbone of any navy that can command the sea consists of the strongest seagoing, seakeeping ships of its day—that is, of its battleships."

To the great body of naval men, therefore, the assumption that the submarine has been a cardinal factor in the purely military work of this war seems unwarranted. Except in the fact that they have imposed a nerve wracking watchfulness and an unceasing aircraft and destroyer patrol the effect of German submarines in preventing or obstructing materially the major operations of the British fleet has been practically negligible.

The primary function of a battle fleet in war is to gain and hold command of the sea, for that command means that the enemy's fleet will be penned up or destroyed, that his military expeditions for invasion dare not put to sea, that his fast cruisers cannot escape to ravage the trade routes, that his ports will be blockaded, his merchant marine swept from the ocean and his overseas possessions isolated and reduced. All this and more the British fleet has done.

England's naval mobilization a day before war began found the German fleet momentarily unready and virtually imprisoned it in its home ports. No one except Admiralty officials and the German spy system knows the exact location of Admiral Jellicoe's force. It may be on the north coast of Ireland, in the Orkneys or elsewhere. But, wherever it is, its silent guns by the mere dread of their still latent power have held German naval strength in leash.

Strategically that fleet has been a main, if not the chief, factor in the western theatre of war in protecting the French seaboard, in covering the landing of British troops in France and in keeping England itself from invasion. As the London *Times* says, "The British navy set free the whole military forces of the empire"—and all this despite the submarine, which during ten months of war has sunk only about ten British warships, and these successful attacks were made either under cover of darkness (Formidable and Triumph) or on ships steaming slowly (Aboukir, Cressy and Hogue) or at anchor (Niger). Large, deep draught ships at low speed have been its chief victims.

These results, however, cast no reflection upon German ability and daring on the sea. In safeguarding its markedly weaker battle fleet in home ports the German naval General Staff has been governed by time honored strategical principles. Its submarines have been most potent agents in defending those ports and the adjacent coast. That, militarily, they have done relatively little else is due to the fact that in its present development the submarine is primarily but a coast defender. Simon Lake, the Nestor of submarine design, says in the *Scientific American:*

"To intercept a battleship at sea even a high speed submarine must lie in wait, perhaps for days or even weeks at a time, much like a gunner in a 'blind.'"

Hence a very large force of submarines of long radius of action would have been required to cover the great war area formed by the 1,700 miles of British coast line, and to prevent the raids on the Bight of Helgoland, the mine sweeping in the North Sea, the destruction of the Blucher and the transport of a million British troops to France. The other leading events of the war—the sinking of Von Spee's squadron, the Emden and the Dresden, and the transport of large forces of troops from the wide world over to England and the Dardanelles—were all distant, high seas work which the submarine, on those high seas and in its present development, could not possibly prevent.

And yet even in action in restricted areas the undersea fighter has not shown itself all powerful. As witness the comparative immunity of the great allied fleet—about ninety units in all—assembled at the Dardanelles, although bombarding warships, steaming slowly, are easy prey for submarines. In less degree this is true also of England's great fleet. Submarines will never have a more favorable field than the mist enshrouded North Sea and no larger quarry than the vast British armada of more than 450 vessels of all classes gathered in or near those stormy waters.

The submarine, when it scores, is the most deadly weapon in naval warfare. But, as Admiral Winterhalter of our navy says, "They are dangerous when they hit. The number of times they have not hit is legion." As to the Russo-Japanese war, Admiral Sir Reginald Custance said: "In all some 200 or 300 torpedoes were fired, and of these about 5½ per cent. resulted in hits. Even so many of these concerned ships at rest or moving slowly, and only about 2 per cent. of the torpedoes fired at ships in motion reached their mark." After six months of this war an English authority estimated that for every hit on a warship German submarines had made ninety misses.

This inaccuracy is not the fault of the torpedo, which is almost unerring, but of the difficulty in aiming it. The little cigar shaped submarine boat—twenty-one inches in diameter and twenty-one feet long in maximum sizes—is launched by compressed air from a torpedo tube on a battleship, or a destroyer, or in a submarine. A pressure diaphragm within it, operating a horizontal rudder, holds it at a predetermined depth. Gyroscopic mechanism, actuating a vertical rudder, keeps it absolutely true to its course. It has turbine engines and two propellers, driven by heated air at 2,200 pounds pressure.

Its speed, range and weight of explosive depend on the uses for which it is designed—long range work from battleships or close quarters fighting by submarines. The modern Whitehead torpedo, carrying 330 pounds of explosive, has a range of 11,000 yards at an average speed of 30 knots. The English 18 inch travels at 46 knots for 1,000 yards. Our Bliss-Leavitt is credited officially with a maximum range of 10,000 yards.

The charge, usually of gun cotton, is loaded in the war head or nose and explodes on impact against the enemy hull. It may be replaced by the torpedo gun, invented by Commander Cleland Davis, U. S. N., which, discharged on impact, sends an 8 inch shell carrying forty pounds of gun cotton into the vitals of the doomed ship.

The submarines serving in the world's navies are of all ages from 1898 onward and present many variations in details of construction. Broadly speaking they may be divided into two general types, both originating in America; the Holland, which dives like a porpoise, and the Lake, which descends on an even keel.

Although complex in detail the submarine is essentially very simple. It is but a torpedo boat, which can be driven on the surface by heavy oil engines and which when submerged by filling its ballast and trimming tanks can be propelled by electric motors, actuated by current from storage batteries charged in surface running. To return to the latter, the tanks are emptied by air pressure or pumps.

While manœuvring submerged the boat has a slight reserve buoyancy (200 to 800 pounds), which tends to lift it to the surface. This tendency is resisted either by a horizontal rudder at the stern or by horizontal rudders on the sides of the hull, which steer the boat in a vertical plane. When "sleeping" on the bottom the submarine has negative buoyancy, that is, with full tanks it is heavier than an equal volume of water. The air contained in the hull will last the crew for twenty-four hours. It can then be purified, or additional air allowed to leak out from the pressure tanks to replace the foul air expelled.

There are three classes of these underwater fighters—for harbor protection, coast defence (250 to 500 tons) and the projected seakeeping or fleet submarine (1,200 tons). Some of these boats carry bow torpedo tubes only, some bow and stern tubes, and others external deck tubes also.

The hull of the two former classes is circular in cross section at the middle, tapering to ellipses at bow and stern. The test depth for modern designs is usually 150 feet. In manœuvring, however, if accident occurs at 100 feet or more the chance of rising to safety is slim

The time required for unrigging to submerge averages about five minutes. A running dive from the awash condition may be made in from 30 seconds to 2½ minutes. The lost U-29, which was until recently the last word in German construction, displaced about 1,000 tons, had speed on the surface of eighteen knots and submerged of ten and a surface cruising radius of 2,000 miles. She was equipped with four torpedo tubes, two fourteen pounder guns and two high angle one pounder guns for repelling aircraft. In general modern submarines can run at maximum speed submerged for about one hour and for twenty-four hours at one-third that speed.

In clear weather the submerged submarine can see a large ship eight miles away through its periscope, a collapsible vertical tube fitted with lenses and prisms, which gives the commander a view like that through a telescope on the surface. She can both speak and hear—for distances varying, according to conditions, from one to eight miles—through the Fessenden oscillator, a vibrating diaphragm fitted in each bow, which either transmits sound waves to or receives them from the surrounding water. The vibrations of these diaphragms are gathered by the microphone and conveyed to the telephone receiver in the conning tower, or vice versa.

The vessel is steered by the gyroscopic compass, which, by eliminating the sluggishness and deviation of the magnetic needle, has opened the Seven Seas to these boats. Large submarines of recent construction have sleeping accommodations, steam heat, electric cookers and refrigerators for fresh food.

The dimness of twilight and dawn, fog and the rough surface of a choppy sea all favor submarine attack. Even in other conditions the boat can scarcely be distinguished five or six miles away. Apparently the submarine should have fair chances of success with so accurate a projectile as the torpedo, if its aim were not frequently defective.

Take the question of sight and distance: If a tangent to the curved surface of the sea be assumed to sweep around from the top of a periscope with the maximum exposure of twenty feet it will describe a sea horizon having a radius of 10,000 yards, which is thus the limit of the submarine's vision. At this distance a dreadnought is to it but a dot filling one degree—1-360th—of its horizon. To find and fire at such a speck makes long range work very unreliable and also decidedly costly with torpedoes at $8,000 or more each. So the submarine is perforce a close quarters fighter at a torpedo range of not more than 2,000 yards.

When the enemy is sighted, six miles or more away, the submarine commander takes his bearings, withdraws his periscope and by the gyroscopic compass steers an accurate course to within torpedo range, preferably 500 yards. Then the periscope is exposed just enough for aiming and the torpedo is fired.

The latter is aimed by pointing the boat, which is the torpedo gun. For a moving target and with torpedoes capable of angle fire the angle between the torpedo's path and the line between the boat and its target is set by the torpedo director, an automatic instrument.

The chief difficulty in aiming lies in the fact that while the submarine commander can estimate his distance, he has no way of ascertaining the enemy's speed and course, although at a range of one mile expert torpedo officers can generally hit a large vessel. A 40 knot torpedo takes 44 seconds to traverse 1,000 yards. During that time a 600 foot dreadnought will travel about 1,485 feet, or more than twice her length. The possibility of error is therefore not remote.

Again, in a rough sea a submarine submerged to fighting depth rolls like an aeroplane in a gusty wind. Also, like an unstabilized aeroplane, the porpoise diving type is in indifferent equilibrium in the vertical plane and except at high speeds her motion in that plane is somewhat uncertain. Finally, as compared with a swiftly moving target the boat is relatively slow, clumsy and unresponsive in manœuvring.

In view of these limitations to his aim and the possibility that in projecting his periscope to take it the commander may draw upon his boat a death dealing destroyer it is evident that the discharge of a torpedo by a submarine is distinctly a "one man job" and that that man must be instant in action and iron in nerve.

The fact that from the outbreak of war British troop ships have crossed the Channel in ever going numbers without, so far as is publicly known, a single attack by submarines is attributed generally to a most efficient patrol and convoy by destroyers and aircraft.

The destroyer in smooth water or light seas is the fastest ship that floats. Although relatively small, it is exceedingly quick in manœuvring and can rise from slow to maximum speed almost immediately. Further, it carries a battery of small calibre guns of extreme rapidity of fire, capable of destroying any submarine on whose exposed periscope they are trained. The wake of such a periscope can be detected in a smooth sea at 5,000 yards, and the hull of a submerged submarine makes a disturbance in the water which is visible from aloft in a watchful ship.

The value of aircraft in detecting submarines lies in the fact that their height eliminates reflection at the surface of the water, as the water telescopes of sponge fishermen and the glass bottomed boats of Nassau do. In clear water the aviator can see a submarine at a depth of fifty feet or more and can signal to a following dirigible. The latter, approaching the surface closely, can drop a heavy bomb on the submarine, which, if it rises to repel the attack by its high angle guns, can be rammed by nearby destroyers.

No effective structural defence against torpedo attack has yet been devised for a battleship's hull. The effect of the blow may be localized by a minute system of compartments and the inrush of water may be checked by admitting compressed air to the damaged sections. Light interior armor, not attached to the outer skin, has been advocated. It has been proposed also to cover the whole bottom externally with four inch armor, but the tendency of battleship development may rather be toward the reduction of all armor, as in the battle cruiser. At present extreme vigilance, destroyers and aircraft seem the chief defence.

Despite its limitations the great value of the submarine at this time in coast defence is unquestionable. That it will soon serve with fleets on the high seas seems wholly probable. As Admiral Winterhalter puts it, "the ultimate goal of submarine construction is high speed under water" in a boat which when submerged can charge the enemy's column.

To reach this goal the discovery of new motive power may be necessary. Thus far no way has been found for consuming or expelling the products of combustion from oil engines that does not leave a wake which destroys the invisibility of the submarine.

Two of the German U type submarines running in the North Sea with only their periscopes showing. A German seaplane overhead.

Copyright by the *Illustrirte Zeitung*

Despite Activity of U Boats Writer Points Out That She Has Swept Oceans Clear of Enemy Ships

ENGLAND'S PLANS TO FIGHT GERMANY IN THE AIR ON A HUGE SCALE

Greatest Fleet of Aeroplanes in the World Said to Have Been Assembled by Extraordinary Effort

The writer of the following article returned to New York recently after spending several months in the war zones of Europe. While abroad he had unusual opportunities for obtaining information in regard to matters concerning military aviation.

AFTER months of extraordinary effort Great Britain has assembled the greatest fleet of aeroplanes in the world. An aerial campaign of unprecedented scale is, it is believed, about to be launched against Germany with her squadrons of Zeppelins and Taubes.

Certain it is that the supremacy of the air will be decided aloft, aeroplane against airship, for this war has conclusively proved that every form of aircraft is almost immune from attack from below.

I was in England during the first eight months of the war, and spent a great deal of my time at the naval and military aerodromes at Hendon and Brooklands. From friends, officers in the Royal Naval Air Service, I gathered that England was determined, if possible, to rule the "central blue" as effectively as she does the sea.

Under Secretary of State for War Tennant in the British House of Commons recently let in a little light on the situation when he said that Great Britain now had ten times as many aviators as she had at the outbreak of war. As last August there were in the country about 750 airmen it must follow that their number has since been increased to somewhere around 7,000. As for new aeroplanes, it has been officially stated that most of the latest machines in the Royal Naval Air Service and the Royal Flying Corps can fly anywhere between one hundred and one hundred and fifty miles an hour.

Up to the present stage of the war Germany's air fleet of both aeroplanes and airships has proved a comparative failure. They have not fulfilled the threat of blowing the British Isles off the map. British airmen in cooperation with the French have shown their superiority time and again. This has been conceded by many independent observers.

The Germans have not so far attempted an air raid on Great Britain on an extensive scale. They have yet to send out their air fleet, and they, too, have been making colossal efforts to perfect their plans. Both the people and the army and navy in England have been buoyed up with expectations as to what will happen when the great aerial conflict opens in grim earnest.

It is now believed in England that Germany plans a simultaneous attack by land and sea. The proposal, it is said, is to send three aerial fleets, each consisting of one Zeppelin and four aeroplanes, on a raiding expedition over England by way of the south coast, the Thames estuary and the Wash and concentrating on London.

The Zeppelins are intended to attack British camps and other important points with explosive and incendiary bombs. If they are at all successful, they will proceed toward London, specially aiming at the fortifications and docks of the lower Thames.

The plan is for the Zeppelins to proceed with the work of destruction while the aeroplanes act as defending flotillas. It is not explained, however, what the British airmen will be doing while all this is going on.

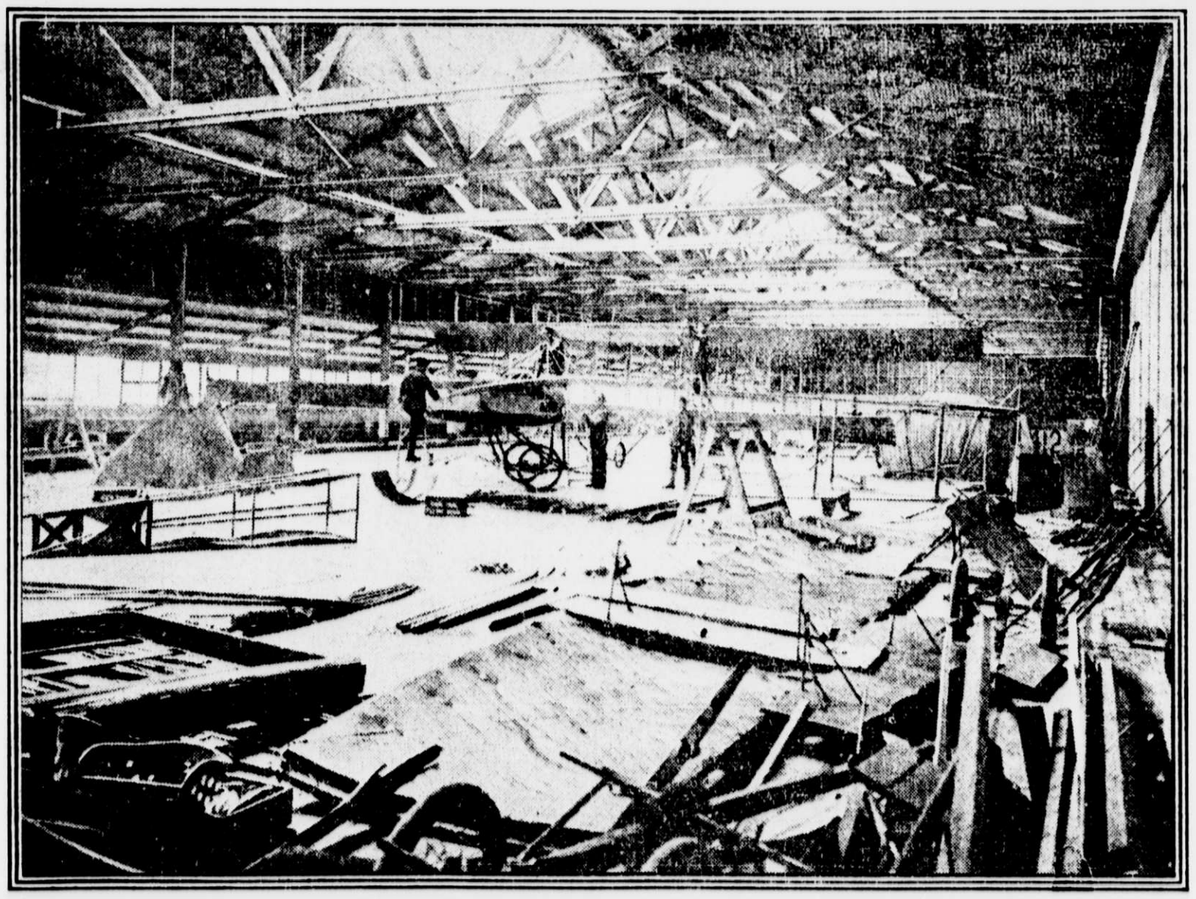
When war broke out Germany had something like 800 Taube monoplanes and 100 biplanes. In this respect she was the best equipped of all the combatants, and her success in the early days of the war was in great measure due to the manner in which her airmen, who were practically unhampered, cooperated with her artillery.

During the struggle around Mons the French aircraft were on the Alsace-Lorraine border, or at the Paris base, owing to miscalculated plans, and the few British airmen were hopelessly outnumbered. But all that has been changed, and even as regards numbers Germany no longer has a superiority in smaller aircraft.

England is not building up with feverish haste a mighty fleet of aeroplanes for the purpose of defence only. She is, I have been authoritatively informed, planning to carry the campaign into the enemy's country—or, perhaps it would be more correct to say, enemy's skies. I have a relative in England who tells me that "everybody" is talking about the "forthcoming raid on German cities."

My informant also tells me that he has received a War Office contract to build 100 aeroplane wings a week until further orders, and that other firms in his neighborhood besides his own have received similar orders. As these firms are in normal times engaged in erecting small suburban homes it may be seen that unusual efforts are being made in Great Britain to get together an air fleet of overwhelming proportions.

For the purpose of warding off attacks of hostile aircraft England has now air stations dotted all around her coasts, more particularly, of course, along the shores of the North Sea. Some of these are situated at Eastchurch, Calshot, Isle of Grain, Felixstowe, Yarmouth, Fort George (Inverness), Rosyth, Newcastle, Sheerness, Chatham, Dover, Portsmouth, Portland, Devonport, Pembroke and in the Orkneys and Shetlands, off which islands the squadrons of battle cruisers and dreadnoughts await the pleasure of Admiral von Tirpitz.



Rigging aeroplanes in the Central Flying School at Upavon.

Extensive Raids Over German Cities in Preparation—Superior Naval Air Service a Pet Project of Winston Churchill's

For the protection of London the Royal Naval Air Service has in commission 150 aeroplanes that are stationed at points within a radius of one hundred miles of the metropolis. A sharp lookout for enemy Zeppelins and Taubes is kept by patrols of seaplanes and torpedo boat destroyers in the North Sea, which on the approach of German air raiders wireless the news to shore.

Acting Commander John Cyril Porte, R. N., who at this time last year was experimenting at Hammondsport, N. Y., with the hydroaeroplane America, in which he hoped to cross the Atlantic, was, when I left England, in charge of the Royal Naval Air station at Felixstowe, near Harwich. He was in command of a squadron of a dozen aerial battle cruisers, the most formidable aeroplanes of any of the air navies of the belligerents.

These were built by Glenn H. Curtiss, the American aviator, at Hammondsport, and are bigger that anything the Germans have so far produced. They are designed after the model of the Rodman Wanamaker 184 horse-power flying boat America. Felixstowe is on the direct air lane between Helgoland and London, and it is Commander Porte's duty to guard the capital of the empire from attacks by Zeppelins and aeroplanes. He has one of the most important posts in the British air service.

It is in the matter of airships, of course, that Germany claims to have a superiority over her rivals, and on these she bases her hopes. At the outbreak of war she is supposed to have had between forty and fifty of

Continued on Twelfth Page.