

## TROOPSHIP CONVOY PROTECTED BY SMOKE-BOXES FORMING WALLS OF SMOKE

The troop ships are seen in a line in the background to the right. To baffle the threatening U-boat a fast naval destroyer has moved up between the submarine and the troop ships (a portion of the destroyer can be seen at the bottom of the right

hand corner). The destroyer has dropped a succession of smoke-boxes to form a fog-screen behind which the convoy may go forward safely. The ships also carry smoke-producing apparatus with which to hide themselves from the U-boats.

skilfully distributed over a certain area, the chances of destroying a submarine are very good.

Aeroplanes are becoming increasingly effective in detecting and destroying the U-boats. The hydroplane is a form of aeroplane specially adapted for warfare at sea, either alone or in combination with warships. It is able to ride on the surface of the water when necessary.

Warships conveying transports or patrolling the ocean carry hydroplanes, which fly out over the ocean hunting for submarines and return to the ship, according to a regular schedule. Other hydroplanes go out from the ports to look for U-boats in coastal waters.

Aeroplanes possess an enormous advantage over ships in detecting submarines, owing to certain optical laws. An object under water, at the angle at which an observer on the ship would see it, is seen completely displaced from its real position, owing to the change in the direction of light passing from air to water. Moreover, the inequalities of the surface of the water destroy its transparency when viewed at a slanting angle.

The nearer an observer can come to a perpendicular position above a submerged submarine the more clearly can he detect it. Hence the aviator, when he flies over a submarine, can see the latter, even though he is flying very high and the submarine is very deep in the water. If the light is fairly good, the deeply submerged U-boat appears as a dark streak somewhat like a fish seen far down.

When the hydroplane has detected the U-boat it dives down to the surface, as a watching seagull dashes at a fish, and drops a depth bomb over the spot.

Some hydroplanes also carry wireless and send word to the destroyers. These come flying to the scene, and round the U-boat on every side to locate it.

by lying still in a muddy sea they call it. In such cases the drag the bottom with a steel the U-boat. Two destroyers on and two running in another knot. As soon as the submarine's delicate machinery upset from naval men which prove

that many scenes of unspeakable horror have occurred again and again in the depths of the ocean. Men trapped in a disabled U-boat find themselves faced with suffocation in the most terrible form. If the electrical machinery is disarranged or flooded with water the chemicals give forth poisonous gases. It is impossible to escape by opening the hatchway when the boat is at a great depth on account of the pressure of the water. Germans have been found in wrecked submarines who had killed one another in dreadful ways — had even gnawed and throttled one another in their last mad frenzy.

Smoke screens in various forms have proved extremely valuable in protecting transports and merchant ships from U-boat attacks. When a ship is skilfully concealed behind a smoke screen it is calculated that the U-boat's chance of striking it with a shell or torpedo is reduced by 75 per cent.

After many experiments the tests made by the allied navies have ended in the adoption of two smoke-producing apparatuses—one fixed and the other movable, so that it can be thrown into the sea or used on the ship.

The first apparatus consists of a hollow container supported by three feet, between which are arranged two metallic cylinders similar to those used for carbonic-acid in commerce. Each contains a gas of different nature under pressure. The mixture of these two gases produces the smoke. By opening the valve the gases escape through tubes fixed in the mouth of the cylinders. The gases come together in the container where the mixture is effected. The size of the cylinders permits the emission of smoke for a period of twenty minutes, which can be stopped when desired by closing the valve.

Then there are the smoke boxes, which are dropped at intervals, and spread a fog over the water, which hides the U-boat's prey.

This apparatus includes a cylinder containing a smoke-producing charge in the form of a paste and a ring-shaped buoy. In the upper part of the cylinder are three percussion lighters, which are worked by pulling on a cord and which set fire to the charge within a period of seven or eight seconds, so that there is time for the men to throw the apparatus into the sea without being burned. The arrangement is similar to that of our grenades. The duration of discharge of the smoke screen is twenty minutes, as in the other machine. They also make this apparatus without a buoy, in order that it may be used on ships too heavily loaded on deck to provide a place for the fixed apparatus on a tripod. The operation of producing the smoke is then carried out in any kind of barrel.

Nearly all ships are now provided with the fixed and movable types of apparatus and largely supplied with cylinders and other smoke-producing charges. The different kinds of smoke pro-

duced are a yellowish-white or a blackish-gray, according to the material used. They have the common characteristic of forming a cloud without an opening in it, which moves in a mass without separating. The clouds remain nearly at the height at which they are discharged, but with a tendency to fall.

Small apparatuses of the second type are made for small boats, such as patrol boats, fishing boats, pilot boats, etc. The duration of the discharge of the smoke is the same, but the volume of the smoke is considerably less.

The ship protected by the smoke screen manoeuvres so that this screen, which is driven by the wind, is always between itself and the enemy. The latter is then unable to see the points where his shells fall and cannot regulate his fire, or "register," as it is technically called. Skill in manoeuvring is an essential condition of success; it is necessary that the enemy as far as possible should see nothing, or almost nothing, of the boat, and as the ship is obliged to make a zigzag course it is not an easy thing to keep it within the limits of the moving smoke screen. At certain moments it is desirable to hide quickly a portion of the hull, the smoke-stack or some other part of the ship. Then the fixed apparatus renders great service by permitting the instantaneous discharge of clouds of smoke.

It sometimes happens that the submarine rather than submerge and abandon the chase has recourse itself to the smoke screen to conceal itself momentarily from the sight of a ship whose fire is very accurate.

Special instructions illustrated by pictures have been printed for the use of captains to enable them to familiarize themselves with this new defensive method and to understand what they must do under certain circumstances of the present war. These smoke tactics recall those of the octopuses, which are provided with sacs filled with a black liquid which they discharge in order to escape from a hungry enemy, such as a shark, which pursues them. Nature has foreseen everything.

Camouflage, that word which so quickly took its place in the American language, with a dozen shades of meaning, is undoubtedly one of the most valuable methods of protecting ships from submarine attack.

Everybody who has been in one of our Eastern harbors knows that ships go out painted in all the colors of the rainbow, in the most fantastic manner conceivable. To many persons they suggest "cubist" painting. That is marine camouflage.

Originally the idea of marine camouflage was to paint a ship so that she would be confused with the colors of the sea and sky—gray and blue. Then a more ingenious scientific idea was suggested of painting them in such colors that

they would blend into the color of the atmosphere, and thus create the illusion that there was nothing in sight. Strange as it may seem, this was theoretically possible, but proved ineffectual in practice because of the constant changing of light and atmosphere.

The newest idea in camouflage is to paint a ship not to make her invisible, but to make her a shapeless mass in appearance, so that she will be very difficult to aim at with shell or torpedo. An artist who has been engaged in designing this kind of camouflage explained:

"The latest conception treats low visibility as a secondary consideration, seeking primarily to destroy the form and character of a vessel, and so make her hard to hit, even though her presence may be evident to the waiting submarine. This is accomplished by the use of large masses of contrasting color, which at a distance give the impression of shadows where none exist, and distract the eye from those that do exist.

"Sometimes an attempt is made to give a ship a false bow or stern. Sometimes the aim is to break her in two. The fundamental idea is to destroy all lines and all contour. Vessels so treated frequently look at a distance as if they had great holes in their hulls. They have the aspect of derelicts, or ships that have been wrecked by bombardment from enemy guns.

"The object of destroying the lines and contour of a ship is twofold:

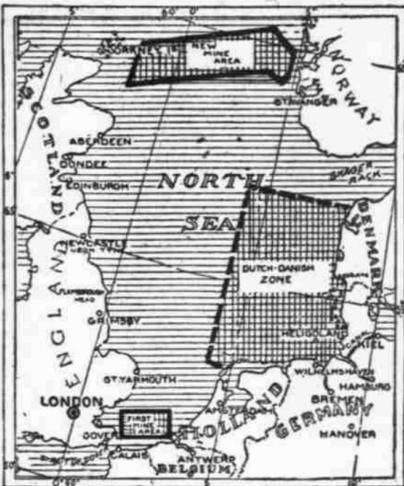
"(1) It makes it hard for the submarine to gauge the distance between her and the vessel.

"(2) It renders it difficult to determine from the submarine how the steamship is heading."

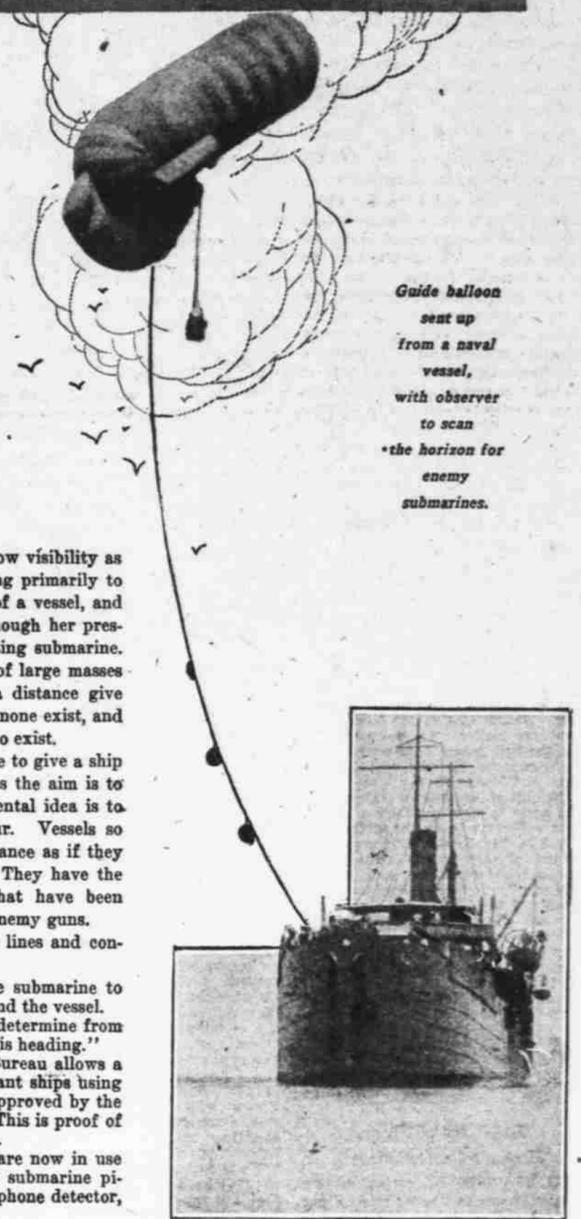
The United States War Risk Bureau allows a lower rate of insurance to merchant ships using any of the forms of camouflage approved by the United States Shipping Board. This is proof of the practical value of camouflage.

Many other ingenious devices are now in use to protect our ships against the submarine pirates. Among these is the microphone detector, which gives warning of the approach of a submarine. The sound made by the propeller of the submarine is transmitted through the water and through the bottom of the ship, and is there reproduced by the microphone. Unfortunately owing to the slight sound produced by the submarine propellers, the microphone was until recently only able to detect the disturbance at a short distance, but our scientists, including Thomas A. Edison, are working on an instrument that will give warning of U-boats several miles away.

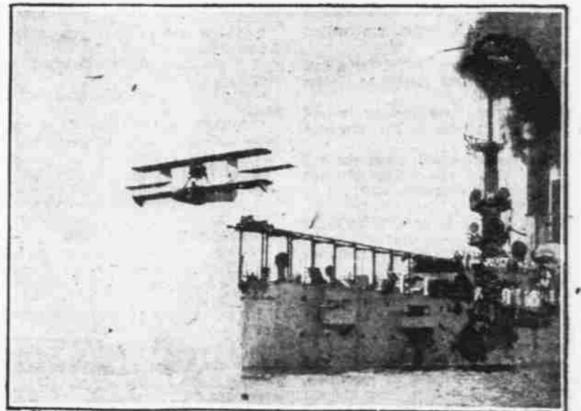
No better demonstration of the effectiveness of these defenses could be furnished than the behavior of the U-boats that reached this side of the Atlantic. They found their few victims away from the great channels of shipping.



Map showing great mine fields the British navy has sown in the path of German submarines, which they must travel through both coming and going from their home ports in Germany.



Guide balloon sent up from a naval vessel, with observer to scan the horizon for enemy submarines.



United States cruiser with special deck for hydroplane runway, from which the naval flying machines are sent out to scout for enemy submarines.