The Submarine Problem—IV.

Closing the North Sea with a Bomb-Curtain

By J. Bernard Walker

IT would be the height of folly to conclude that the reduction in the losses of ships during the past two or three weeks indicates that the German submarine warfare is on the wane, and that the curve of losses will drop steadily from now on until the vanishing point is reached. As we go to press, indeed, the present week shows a rise of over 100 per cent above the week preceding. Of all the leading powers concerned in this tremendous problem—Great Britain, France, Italy, ourselves and Germany—the last-named power only can explain these fluctuations, and for obvious reasons Germany keeps the truth to herself.

What is the meaning of this reduction in losses? Have the Allies, ourselves included, devised some altogether new and very effective means which are sinking the U-boats faster than Germany can build them?

Is it a fact that the multiplication of hostile surface craft has so completely dominated the infested waters, that the submarines must stay below and hesitate even to show their periscopes when they hear the throbbing propellers of an approaching ship?

Is it that Germany has been working her submarine fleet and the crews which man it with such furious persistency that the submarines are badly run down and the crews are exhausted?

Or is it that Germany is seeking to develop a sense of false security, so that she may gain the moral effect of another sudden and portentous outburst of activity which will make the Allies hopeless of ever successfully meeting the problem? As to the truth of these surmises we are utterly in the dark.

This much, however, we do know. That every dictate of military, political and economic prudence demands that we prosecute the anti-submarine war, not with relaxed but with redoubled energy, assuming always that the worst may happen, and leaving no stone unturned to meet it.

Losses Are Still Very Serious

The goal at which the Allies should aim and short of which they should not cease their efforts, is the absolute defeat and wiping out of German submarine activity. There is a danger lest we take that terrible week when over fifty ships were lost, as our starting point, and fall into the habit of thinking that a weekly record of losses something less than that is cause for satisfaction and

good reason for easing up in the submarine fight. For we must realize that the recent low-water mark of a loss of fifteen ships of over 1,600 tons is in itself a truly appalling and irreparable disaster—a rate of loss, which, if continued, must place the Allies' cause at a most serious disadvantage.

If we assume an average displacement for these ships of 3,500 tons, we reach a total loss for the week of 52,500 tons, and if this rate were continued, and the ships under

ships; altogether too many; and there is something wrong either with the means and instruments employed against them or in the general principles upon which the warfare is being conducted. Now, there is nothing wrong with the instruments. They are ingenious and multi-form and are being most energetically employed on a truly enormous scale. It is our belief that in this game of submarine "swatting" ingenuity has been taxed to the limit, and we see little reason to hope that any single device, or combination of devices, or any of the tactics of submarine hunting as at present carried out on the high seas are going to prove effective in preventing this annual loss of 3,000,000 or more tons of shipping. It begins to look as though we would have to change radically our whole plan of campaign.

At the Source

It is pretty well understood that there are two broad policies by which the submarine can be fought. Either we may let the submarine fleet pass out on to the high seas, and then commence a still hunt for its individual units, or we may go to the source and shut up the U-boats within certain prescribed areas. Hitherto we have been following the former plan, and a rate of losses of 3,000,000 to 5,000,000 tons of shipping a year, proves, if it proves anything, that the plan is a failure. The fact cannot be questioned; and if this murderous piracy is to be wiped out we must adopt the opposite and obvious policy of blocking the submarine fleets at their point of exit and fighting them within their own waters. This may be done in two ways. We may institute a coast blockade by building continuous nets across the entrances to Zeebrugge, Wilhelmshaven, the Elbe and the Baltic, or we may surrender the North Sea entirely to the German submarines and shut them within it by a wall of obstruction across the English Channel at Dover and across the North Sea from Scotland to Norway.

Closing the North Sea

An estimate of the total length of netting and the total number of patrol boats necessary for closing these various submarine bases shows that a more satisfactory and more effective result can be obtained by sealing the Straits of Dover and building a huge net from the coast of Scotland to the coast of Norway. It is stated

Twenty-pound bomb, built into the net and forming the intersecting connections

1,600 tons were included this would mean a loss of not less than 3,000,000 tons per annum.

Existing Methods Are Inadequate

Now, if the Germans go on sinking 3,000,000 tons of shipping a year it will be because the present defensive and offensive methods against deep-sea depredations are a failure. Only a foolish optimism can lead us to any other conclusion. The Germans are getting too many

Top of net is 20 feet below surface. One mile distant is a continuous cable with 500-pound floating mines to prevent surface ships rushing the net and shut out raiders from the Atlantic. Beyond that are the mother ships, 50 miles apart, for destroyers, motor boats and aeroplanes

Birdseye view of anti-submarine bomb-curtain 200 feet deep, closing the North Sea

that the Germans have equipped their submarines with various types of net-cutting devices, which they claim are effective and will carry the larger submarines through any net that can be built. How true this is we do not know. Rumor has it that two kinds of cutters are used, namely, revolving knives carried well beyond the nose of the submarine, and long keen knife blades extending from the bow aft, which, it is claimed, will cut through the heaviest wire work. This may be true; though we doubt it. Anyone who has tried to cut a piece of plough-steel wire knows that it requires a sharp chisel, an unyielding anvil, and no little muscular strength to do the trick, and we very much doubt if any revolving knife or razor-like edge would cut through the thick but flexible wire of a heavy net.

Be that as it may, we are strongly of the opinion that the most effective barrier would be a combination of the net and the mine, in which the net performs the function of a carrier to sustain a continuous wall of mines, so spaced that any submarine which touched the curtain would be broached and opened to the sea in one or more places.

A Curtain of Bombs

We have worked out in the accompanying drawings a system which is not only comparatively cheap to construct but (what is more important in this emergency) one which could be very rapidly put through. Considered as a feat of engineering and seamanship, it would be perfectly feasible to build and maintain a bomb-curtain to a depth of 200 feet throughout the whole stretch of water between Scotland and Norway—a distance of about 250 miles.

Since the province of this net is to act merely as a carrier for a vertical minefield, it could be built of commercial one-half inch steel rod. The mesh would be ten feet and the connection at the alternate intersections would consist of a buoyant spherical bomb, containing 20 pounds of trinitrotoluol. The bombs would be built in two hemispherical halves, with holes formed in the flanges for the attachment of the lengths of wire rods. The ends of the rods would be attached to the bomb by merely threading them through the flanged holes and twisting three or four turns of the rod snugly upon itself. Since the bombs would be spaced 20 feet apart and staggered, it is certain that at least one and probably three or four bombs would come in contact with a submarine that attempted to drive through. At the intersections, alternate with the bombs, connection would be made by a ring of the same steel rod.

Just here, we may mention that the bombs would have a sufficient positive buoyancy to carry their own load and a part of the load of the net itself, thereby making it possible to use floatation buoys of moderate size 20 feet below the surface. The net would be anchored by steel wire rope extending from each side of the net and secured to heavy mushroom anchors.

The fact that soundings off the Norwegian coast show depths of from 800 to 1,000 feet, presents no serious difficulty; it would simply necessitate the provisions of a greater length of mooring cable.

Protecting the Barrier

Inevitably, the Germans, on finding themselves utterly cut off from the Atlantic, would make desperate efforts to break through by sending a heavy force of ships to rush the net at high speed and carry it away. To prevent this, about a mile inside of the net there would be strung across the North Sea from coast to coast and parallel with the net, a continuous line of surface mines of the largest size, connected by cable and so adjusted that there would be two miles of this cable to a mile of linear distance, the cable being anchored at considerable intervals to keep it approximately in place. This would allow sufficient slack in the cable to insure that any surface ship charging at it would carry the cable with it and cause several of the bombs to swing into contact against its side.

Patrolling the Barrier

Inasmuch as the construction of a continuous wall of high explosives across the North Sea would mean the absolute defeat at a single stroke of the whole German dream of winning the war by submarine piracy, we may be certain that desperation would drive them to employ every conceivable form of attack against the barrier. Therefore, to make assurance doubly sure, it would be well to establish, a mile or so within the last-mentioned string of floating mines, a thoroughly organized system of patrol by aeroplane, destroyer and motor boat. The function of this patrol would be not only to detect, and as far as possible, prevent the ap-

proach of submarines to the net, but also to maintain the net itself, making good immediately any damage or displacement which it might sustain as a result of the enemy's attack, or the stresses of wind and weather. The basic element in this patrol would consist of half-a-dozen mother ships moored in line from coast to coast at intervals of from forty to fifty miles. These would form the supply depots from which the surface craft and aircraft would operate. The mother ships would consist of old tramp steamers (a suggestion of Mr. Chas. G. Curtis) which would be anchored securely by the head, heavy anchors and cables of great length being used, so that the ships would ride easily in the heaviest weather. For protection against torpedo attack, each ship would be surrounded by a double line of extra-heavy torpedo netting, maintained in place by unusually heavy booms and guy ropes. At the stern of each ship, sections of the net would be arranged so that they could be lowered to admit the destroyers and motor boats when they came alongside for repairs and the replenishment of fuel and supplies. In preparing these ships as starting and landing platforms for the aeroplanes, they would be swept clear of all upper works, smoke-stacks, masts, rigging, etc., and landing platforms would be built throughout their entire length, the platforms extending out

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DN-1 leaving the floating hangar at the Pensacola Aviation Station, preparatory to a trial flight

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The Navy non-rigid dirigible DN-1 in flight. Note the boat-like car which permits the dirigible to alight on water

twenty to thirty feet on each side so as to provide smooth runways, say 100 feet wide by some 400 feet in length.

The patrol would be in three zones—the inner one extending between the mother ships would be covered by the flotillas of motor boats; the intermediate zone, from twenty-five to thirty miles in width would be covered by the destroyers, and the outer zone, reaching one hundred miles or more into the North Sea, would be under the watchful eye at all times of the aeroplanes.

Bomb-Curtain versus Wire Netting

The advantages of such a bomb curtain over a steel-wire net of sufficient strength to stop a 2,000-ton submarine are:

I. That because of its simple construction and the speed with which the wire rods could be turned out at the mills, it could be built in far less time.

II. That whatever the size and speed of the submarine or the character of its net-cutting devices, contact with the bomb curtain would mean certain destruction, or at least disablement.

In this matter of defeating the submarine, time is the very essence of the contract, and although a curtain 200 feet deep and 250 miles in length is a colossal undertaking, it could be built for a reasonable cost and within reasonable time.

Half-inch steel rods weigh about two-thirds of a pound per foot, and they could be delivered, cut to length at an English port for about \$150 per ton. Such is the capacity of our mills that the whole amount of 18,000 tons could be turned out in a couple of weeks' time. The cost of the rods, anchors and cables would be about \$4,800,000. The bomb containing 20 pounds of trinitrotoluol would be sufficiently powerful to cut a hole through the interior hull of a submarine or badly wreck its outer hull, rendering it unmanageable. The bomb would be made in two halves, and with its flanges could be stamped out of three-sixteenth plate. Manufactured on a basis of quantity-production, the bombs could be produced complete with contact points and firing mechanism for about \$35 apiece, which would represent a total cost for the bombs of about \$45,000,000. Adding the cost of materials for the net and anchorages, \$4,800,000, we arrive at a total cost for materials of the whole net of about \$50,000,000, which is less than the total value of ships and cargo sunk by the submarines in a single week of the present campaign.

The firing mechanism of the bombs would have to be of special design, to prevent the whole net from being set off by sympathetic shock when one of the bombs was detonated. We understand that a firing mechanism can

be produced, which will resist the sudden shock from a nearby explosion, and can be operated only by a blow or push of comparatively low velocity, such as would be applied if the firing pin were struck by a submarine moving at a rate of eight or ten knots. To render the bombs safe for handling by the seamen as they build them into the net, the firing pin would be locked by a cement which would be soluble in water, thereby insuring that the bombs would become alive only after they had been in water for ten or fifteen minutes.

If the approaches to the North Sea were protected by successive lines of aeroplanes, scouts, destroyers and patrol boats, and finally by an impassable wall of bombs, it is safe to say that the Atlantic routes would be rid, once and for all, of the submarine pest, and America would be free to send over food, munitions and troops without fear of molestation.

A similar net at Gibraltar and at the Straits of Otranto (the mouth of the Adriatic), would effectively block the submarine bases of Germany's allies.

Our Navy's First Non-Rigid Dirigible

AT the aviation station at Pensacola, Fla., our Navy's first non-rigid dirigible recently undertook its test flights. Success attended these preliminary aerial voyages, and the DN-1 has been added to the aeronautical equipment of our naval forces.

Under the direction of C. F. Smyth and Hans O. Stigel, general manager and pilot, respectively, of the airship's constructors, the DN-1 underwent the first trial flight. After leaving the floating hangar at the aviation station the dirigible ascended to a height of 1,000 feet, crossed the bay, sailed around Santa Rosa Island, and then circled the city of Pensacola. During the flight the DN-1 made two landings on the water, for which purpose the underbody or car is especially designed.

The balloonets only were used in making the ascents and descents, and 22 gallons of gasoline were consumed to maintain a cruising speed of 30-35 miles an hour during the two-hour flight. In fact, the performance of the dirigible exceeded even the expectations of the constructors.

Two dirigibles of the same type are now under construction and will probably be ready for the Government some time in July.

Broken Cast-Iron Pulley Replaced by One of Concrete

ONE of the pair of cast-iron pulleys carrying the main elevator in a large eastern stone crushing plant recently had practically the entire rim broken out. The pulley was 54 inches in diameter with a 20-inch face, and a spare unit was not available. To avoid shutting down the plant for some time while a new pulley was procured it was decided to repair the damage by pouring the pulley full of concrete. A form was built in place around the remains of the old pulley, using perforated metal faced with building paper for the rim and wood for the sides. The belt was not removed while the entire interior of the form was poured full of 1:2:3 concrete. The work of pouring was completed at 6 P. M. on Saturday and the pulley was put in service at 11 A. M. the following Monday. The work was accomplished satisfactorily and the belt runs directly on the concrete.