

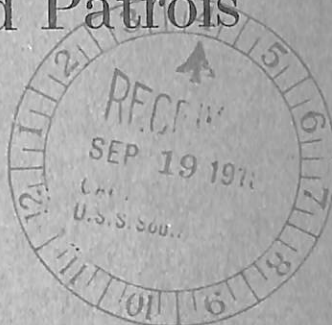
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REMARKS
ON
Protection of a Convoy
by Extended Patrols



NAVY DEPARTMENT
OFFICE OF NAVAL INTELLIGENCE
FEBRUARY, 1918



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1918

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NAVY DEPARTMENT,
OFFICE OF NAVAL INTELLIGENCE,
Washington, February 25, 1918.

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ROGER WELLES,
*Captain, U. S. Navy,
Director of Naval Intelligence.*

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It is, therefore, considered not too much to assume that enemy submarines can travel 7 miles in the first hour submerged, and still have in reserve sufficient battery power with which to escape if hunted.

Assuming the convoy's speed of advance to be $7\frac{1}{2}$ knots, the depth of a column to be three ships, *i. e.*, half a mile, and considering a browning range of 3,000 yards, the danger angle, if the visibility of the convoy to a submerged submarine is 7 miles, is 71 degrees from ahead of the wing columns.

As the "visibility submerged" decreases, the danger angle increases until the limit is reached, at which the submarine is within browning range when she sights the convoy.

The table on page 5 gives the danger angle for various speeds of convoy and visibility worked out on the foregoing assumptions.

DIVING DANGER AREA.

Referring to the diagrams, the area (AAXY) within the danger angle, and ahead of the convoy, is called the "Diving Danger Area."

Any submarine within this area will be able, whilst submerged, to sight the convoy and get in an attack.

It will be seen that the limits of this area depend on the visibility submerged and the danger angle.

SURFACE DANGER AREA.

Outside the diving danger area lies the surface danger area (BB) whose limits are determined by the distance at which the convoy is visible to the submarine on the surface. In Diagram I this is shown as 11 miles, but may be greater if the convoy includes unusually large ships, or is making much smoke.

Any submarine in this area will, if there are no extended patrols, sight the convoy and be able to get into position for attack.

CRITICAL POINTS.

The points X and Y are critical points and must be considered in deciding on the positions of the escort. If a submarine following up astern, or coming in from the flanks, having the convoy's masts and funnels in sight, but being herself unseen, can get ahead of these points she can dive in and attack submerged.

OTHER CONSIDERATIONS.

Submarines originally in the Diving Danger Area, if forced to dive, will in any case sight the convoy whilst still in a position to attack it. Submarines between the two areas AA and BB, if forced to dive, will not sight the convoy until they come to the surface too late to attack.

Submarines outside BB will not sight the convoy at all. Consequently, it is most desirable to cover as much of the area between AA and BB as possible with the extended escort.

Again, it is considered that the escorts should be stationed outside the Diving Danger Area. If within it, the enemy has only to adopt the simple plan of always diving in toward and getting in the wake of any single patrol vessel sighted, to be sure of always getting

within striking distance of the convoy. The position of the extended patrol should therefore satisfy as far as possible the following conditions:—

(a) The critical points X and Y should be guarded.

(b) As much as possible of the area between AA and BB should be kept under observation.

(c) The patrol vessels should be outside the Diving Danger Area.

Taking 6 miles as the minimum distance at which a submarine must submerge to avoid being seen by a patrol vessel, the positions (P_1 and P_2) in which the patrols should be stationed are fixed by the foregoing conditions within narrow limits.

These positions, for various speeds of convoy and visibilities, are given in the following table:

TABLE GIVING POSITIONS OF EXTENDED ESCORTS AND DANGER ANGLES FOR DIFFERENT VISIBILITIES AND SPEEDS OF CONVOY.

This table is based on the following assumptions:

The position submarine has to reach is 3,000 yards abeam of the last ship of the wing column in order to get a chance of a reasonable browning shot.

Depth of column = half a mile.

Maximum average speed of submarine = 7 knots.

Maximum distance she can travel at this speed = 7 miles.

Speed of convoy in knots.....			6.5	7	7.5	8	9	10	12	14
Visibility: Submerged, 7 miles.	7	Danger angle.....	77	74	71	68	62	56	47	42
			45	44	43	42	40	37	33	30
Surface, 11 miles...	4	Position of P 1 and P 2 from right ahead.								
Visibility: Submerged, 4 miles.	4	Danger angle.....	96	89	78	76	70	66	56	52
			47	46	45	44	43	40	36	35
Surface, 6 miles...	3	Position of P 1 and P 2 from right ahead.								
Visibility: Submerged, 3 miles.	3	Danger angle.....	105	95	85	82	75	71	65	57
			52	52	52	51	50	49	46	44
Surface, 4 miles...	3	Position of P 1 and P 2 from right ahead.								

NOTE 1.—If the atmosphere is abnormally clear the visibility submerged may exceed 7 miles. Points X and Y will be farther out, and the Diving Danger Area will be extended in consequence. Under these circumstances, extended patrols should be farther away from the convoy, but on the same bearing as for visibility of 11 miles.

NOTE 2.—If the number of escort craft available permitted, it would be desirable to have a patrol stationed right ahead of the convoy as at P 3 in Diagram I.

The value of a patrol in this position would, however, depend on the chance of her sighting the submarine before she dived; and this chance is least in clear weather.

It will be noted that as the visibility decreases the patrols at P 1 and P 2 close in nearer the convoy, and the areas each has under observation approach each other until at 6 miles' visibility (Diagram II) practically the whole of the Diving Danger Area (which has decreased in proportion) is under observation.

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VALUE OF EXTENDED ESCORT.

This may be considered under two heads:

(a) Number of attacks prevented by the submarine being forced to dive whilst still out of reach of the convoy, or being prevented from steaming round it from a position abaft the beam.

This number will probably never be known, and theory must be taken as a guide.

The proportion of attacks that theoretically will be saved by extended escort is given by the proportion of the distance between AA and BB to the distance BB in the diagrams.

About 28 per cent of the attacks possible without an extended escort will be prevented in all visibilities above 6 miles. With lower visibilities the percentage decreases as the visibility through a periscope more nearly approaches that on the surface.

(b) Number of attacks prevented by the patrol actually sighting the submarine before diving.

Since British Atlantic convoys were first instituted, up till October 18, 1917, nine cases have occurred in which a submarine has been sighted on the surface by the convoy escort (escort in various positions), and in none of these cases was the submarine able to deliver her attack.

In the same period 17 attacks were made in which torpedoes were fired at the convoy, with or without success. The number of such sightings may be expected to decrease in proportion to the number of attacks as the enemy acquires more skill and begins to realize the number of opportunities he has lost.

RELATIVE VALUE OF T. B. D.'S AND TRAWLERS AS EXTENDED ESCORTS.

Considering the relative value of each as extended patrols:

T. B. D.'S.

(a) Advantages:

(1) Reserve of speed allows a more pronounced zigzag to be carried out if required.

(2) Better look-out is generally kept.

(b) Disadvantages:

(1) Superior value as an escort for preventing torpedo attack is not made use of.

(2) More easily seen in clear weather and more respected by submarine; consequently less chance of sighting on the surface, except when visibility is low.

TRAWLERS.

Advantages:

(1) Range of vision almost as good as in T. B. D.'s.

(2) At present enemy submarines are inclined to treat trawlers with contempt, and frequently do not dive if it is not convenient to do so.

SUGGESTIONS AS TO WHEN EXTENDED ESCORTS SHOULD BE USED.

It is considered, at present, that vessels employed as extended escorts stationed at P 1 and P 2, as given in the table (p. 7), are more usefully employed than when used as a screen against long-range brownings shots.

DIAGRAM I. (C.B.680)

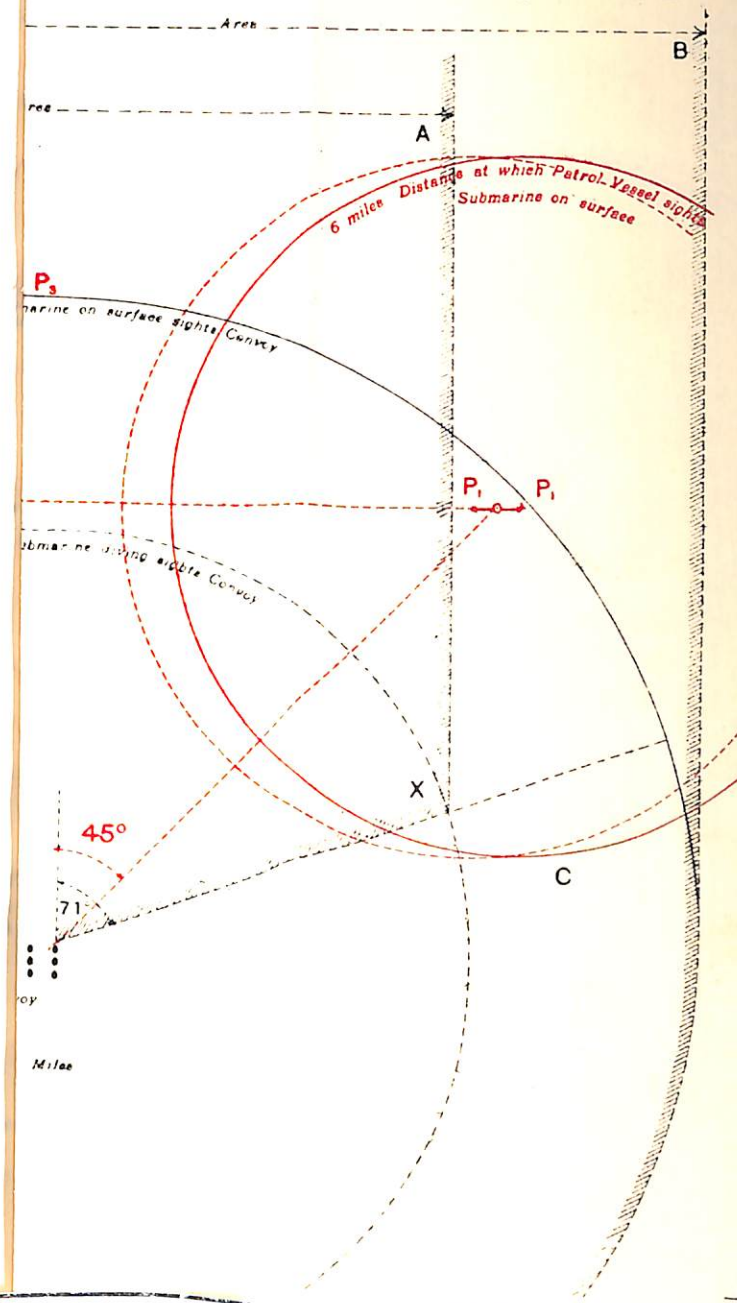
Speed of Convoy = $7\frac{1}{2}$ Knots.

Visibility = 11 Miles.

Visibility through Periscope = 7 Miles.

Danger Angle = 71°

P₁ P₂ = Patrol Vessel zigzagging at 9 Knots,
i.e., steering 3 points off Mean Course.



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Speed of Convoy = $7\frac{1}{2}$ Knots.
 Visibility = 11 Miles.
 Visibility through Periscope = 7 Miles.
 Danger Angle 71°

Diagram illustrating the search area for a submarine, showing distances and angles relative to a Convoy.

Key elements and labels:

- Convoy**: The central point of interest.
- Search Angles**: Two 45° angles are shown originating from the Convoy, defining the search sectors.
- Distances and Arcs**:
 - 6 miles**: Distance at which Patrol Vessel sights Submarine on surface (indicated by red arcs).
 - 11 miles**: Distance at which Submarine on surface sights Convoy (indicated by a black arc).
 - 7 miles**: Distance at which Submarine on surface sights Convoy (indicated by a dashed arc).
- Points**:
 - P_1, P_2, P_3 : Points on the 6-mile arcs.
 - X, Y : Points on the 11-mile arc.
- Other Labels**:
 - Surface**: Indicated at the top.
 - Danger**: Indicated at the top.
 - Diving Danger Area**: Indicated at the top.
 - Distance at which Patrol Vessel sights Submarine on surface**: Repeated label for the red arcs.
 - Distance at which Submarine on surface sights Convoy**: Repeated label for the black arc.
 - Distance at which Submarine on surface sights Convoy**: Repeated label for the dashed arc.
- Scale**: A horizontal scale bar at the bottom, marked from 0 to 11 Miles.

DIAGRAM II. (C.B.680)

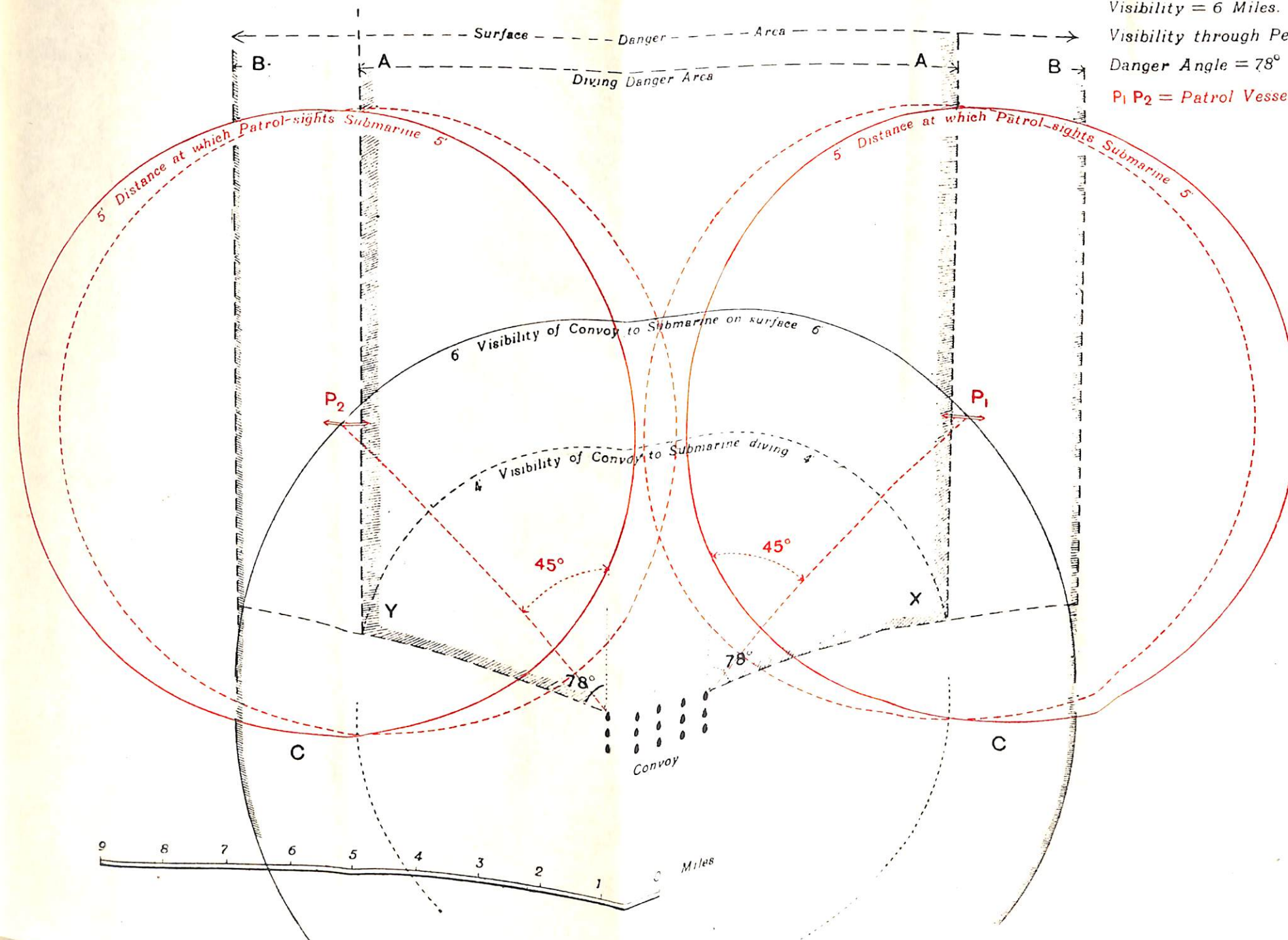
Speed of Convoy = $7\frac{1}{2}$ Knots.

Visibility = 6 Miles.

Visibility through Periscope = 4 miles.

Danger Angle = 78°

$P_1 P_2$ = Patrol Vessels zigzagging.



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DIAGRAM III. (C.B.680)

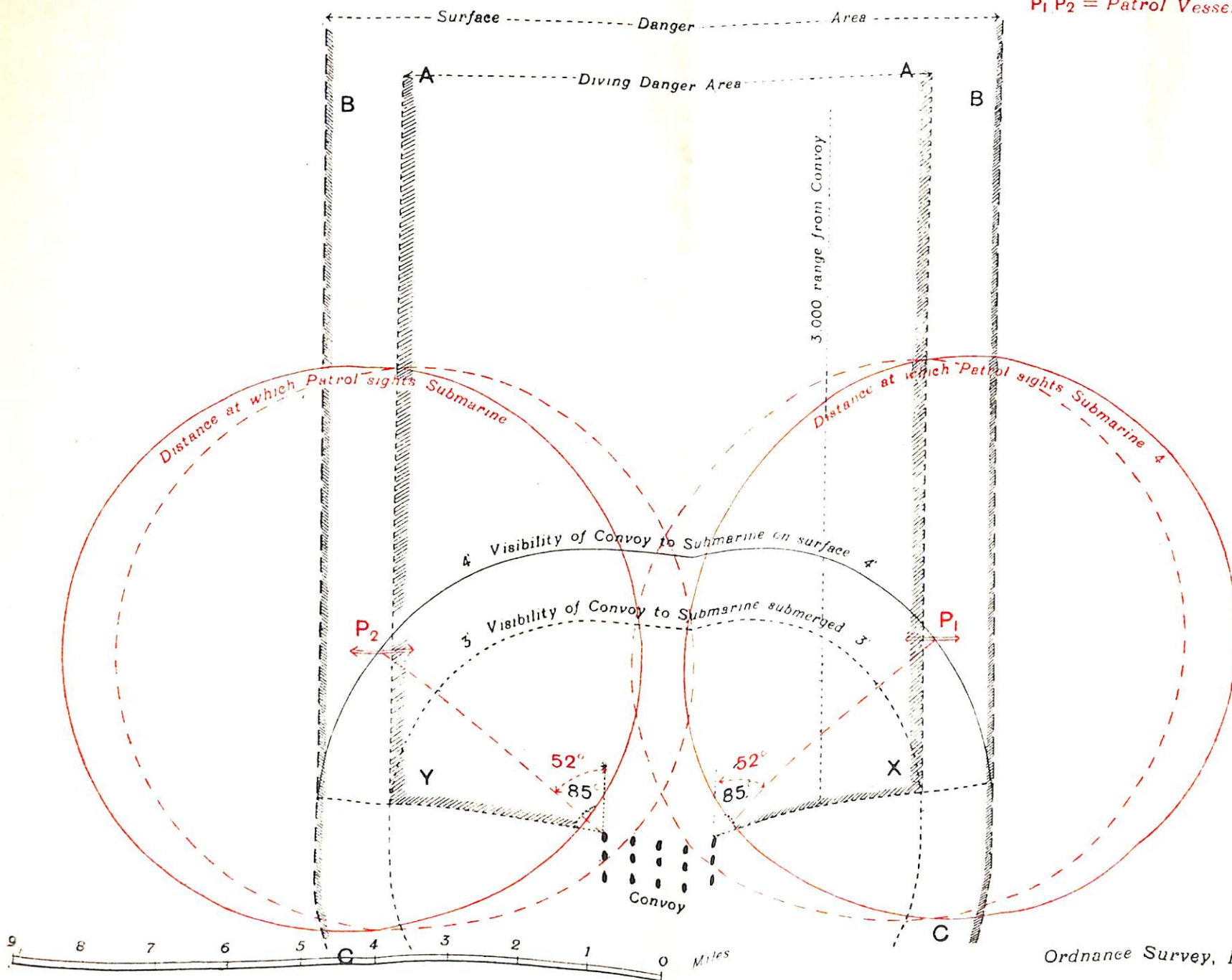
Speed of Convoy = $7\frac{1}{2}$ Knots.

Visibility = 4 Miles.

Visibility through Periscope = 3 miles.

Danger Angle = 85° .

$P_1 P_2$ = Patrol Vessels zigzagging.



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Whether extended escorts should be used must depend on the numbers available after the minimum requirements for close escort have been met.

The minimum number for close escort is considered to be as follows (vide diagrams in C. B. 620):

Two T. B. D.'s on each flank in positions 1, 3, 4, and 6 of the 8-escort diagram.

One T. B. D. ahead of each wing in positions 7 and 8, and, if the number of columns exceed 5, one T. B. D. ahead of center column in position C.

If only one T. B. D. is then available she should be stationed at P 1 or P 2, unless the visibility is less than about 3 miles, when she should zigzag across the path of the convoy.

If the convoy is straggling and the columns cannot be kept as close as 4 cables, the senior officer should use his discretion as to stationing the whole of the escort available in the close escort positions.

If the escort force is a composite one, i.e., T. B. D.'s and trawlers, trawlers should be stationed in the extended escort positions.

Extended escorts should not be used when the path of the convoy is being effectively covered by aircraft.