

## REFERENCES

- <sup>1</sup> Sameshima, N., and Kawamoto, F. (1949). Probability density and ellipse of the most probable position fixed from astronomical position lines. *J. marine Instrn.* (Tokyo), 3, 1.
- <sup>2</sup> *Admiralty Manual of Navigation* (1928). Vol. 2, p. 61.
- <sup>3</sup> Pierce, J. A., McKenzie, A. A., and Woodward, R. H. (1948). *M.I.T. Radiation Laboratory Series No. 4*.
- <sup>4</sup> Jessell, A. H., and Trow, G. H. (1948). The presentation of the fixing accuracy of navigation systems. *This Journal* 1, 313.

## Radar and Collision at Sea

*from* Commander P. C. H. Clissold

CAPTAIN G. C. FORREST's letter (this *Journal*, Vol. VII, p. 203) raises some interesting points well worth discussion:

'(1) That radar-using ships, taking broad evasive action, shall alter course to starboard only, and not at all once they are within five miles of the other vessel, though they may reduce speed or stop.'

If we consider ship A in fog which sees another, B, some eight or nine miles on her starboard side, what should her action be? After plotting observations of B, A (we will assume) finds that B is crossing her own course and that if each ship maintains her course and speed they will be dangerously close together at the crossing. A is not yet bound by any rule to take any action (for the Rule of the Road, devised long before radar was thought of, clearly assumes ships to be in sight of one another when laying down the correct action for crossing steam vessels), but if she continues as she is going she will eventually arrive in such a position as to be compelled by the rules to take avoiding action. Prudence dictates that she should take some action to avoid the dangerous close-quarter situation: what action should that be? She can reduce speed, alter course or do both, and before deciding what she should do we must consider ship B.

If B has no radar she will continue at her present course and speed; if she has radar, she will become aware of the situation at about the same time as A. Not yet bound to any course of action, B will, if the situation develops unchanged, be in the position of the standing-on ship, directed to keep her course and speed until collision cannot be avoided by action of the giving-way vessel, A, alone. She may not relish this prospect and desire to avoid close quarters. Should she slow down or alter course to pass under A's stern? She cannot tell if A is using radar, but will guess that if she is A may alter course to pass under *her* stern. So an alteration of course to port by B may not achieve the desired effect and will in any case increase the relative speed of approach and reduce the time available for avoiding action before the danger point is reached. Reduction of speed will not do this; but will keep her clear of A should A not have radar, and will not embarrass A should A alter course sufficiently to pass under B's stern; while if A slows down the situation remains as before but with more time to negotiate the crossing. It seems definitely to be the safer plan.

If B then reduces speed, A can safely alter course to pass under her stern and, since she may expect B to reduce speed (if B has radar), A should allow for this and alter course until B is fine upon her port bow. When this alteration is bold, B, if using radar, will soon be aware of it.

We might sum up our findings as follows: When two steam vessels are crossing so as to involve risk of collision and observe each other upon their radar screens at a good distance apart, the vessel which has the other upon her starboard hand and forward of her beam shall keep out of the way by altering course to starboard sufficiently to pass astern of the other. The other vessel may reduce speed, but she shall not alter course to port.

'(2) That the international code signal "C" (Yes) in morse on the whistle should signify in fog "I am using radar", and should be used in place of every third blast required by Article 15.'

Sound is notoriously difficult to locate in fog and it could never be certain that a vessel sounding 'C' *apparently* in a particular direction was *in fact* the one appearing upon the radar screen. It seems more likely that this signal would mislead and confuse rather than help.

'(3) The establishment on charts of a traffic dividing mark at a suitable distance off headlands or other turning points: ships with land on their starboard hand to keep inside of it and those with the land on their port hand to keep outside of it.'

This seems both desirable and practicable in crowded traffic lanes, particularly in areas where Decca renders it possible for very accurate courses to be followed whatever the visibility.

## Visual Judgments in Motion

THE following discussion, here printed in summary, took place on Mr. E. S. Calvert's paper 'Visual Judgments in Motion', which was presented at an Ordinary Meeting of the Institute on 21 May. The chairman was Air Chief Marshal the Hon. Sir Ralph Cochrane, G.B.E., K.C.B., A.F.C. The paper was printed in the last number of the *Journal* (July).

THE CHAIRMAN: Am I right in thinking that I.C.A.O. have accepted the Crossbar system of lighting? Is it the normal pattern in international airports?

MR. E. S. CALVERT: The I.C.A.O. standard calls for a centre line and Crossbar pattern, but is worded in such a way as to include patterns which differ in detail from that used in this country. This was done to meet the wishes of the Americans and Dutch. The Americans use one large bar at 1000 feet from the threshold, and short bars of equal length in the rest of the system. The Dutch use long bars at the same spacing as in this country but of equal length. These differences are important only in visual ranges of half a mile or less.

MR. G. W. STALLIBRASS (Ministry of Transport and Civil Aviation): There are a number of things that need finding out in regard to runway lighting, and no doubt work is being carried out in more than one Ministry. Could Mr. Calvert give some indication as to what should be the lateral spacing, assuming there has to be some form of elevated lighting? There has been considerable variance of opinion in that regard. Papers have been published suggesting that the best indication for the pilot from the angular point of view is if the lateral spacing is no more than about 150 feet; there is a slight fall when the spacing is 200 feet and indication falls very rapidly at more than 250 feet. The Ministry of Transport and Civil Aviation are interested because we are probably going to use elevated-type runway lighting rather than the flush-type.