general application when, in its context, it is merely a warning that there may be particular circumstances which only plotting will unravel with certainty.

(2) Captain Forrest and I are obviously agreed on the desirability of avoiding the close-quarter situation. No one will suggest that the plot is necessary to discover whether the bearing is moving; on the other hand, few will be able to tell from changes of bearing and range alone, e.g. so many degrees and so many miles in 5 minutes, whether a close-quarter situation is likely to develop; hence the remark quoted.

I entirely agree that the eye of experience can read much from the PPI, but the most experienced can read little from the nature of a ship echo at 8–10 miles, and it is that kind of range with which the report was dealing.

(3) With this unfortunately I cannot agree. There are many fast ships which decrease speed but little in fog. In any case, I do not think the principles or the examples depend upon 'pea soup' conditions.

I have no comment other than agreement on Captain Forrest's conclusion, except to say that I think he overestimates the amount of labour which would be involved in plotting, when experience has made it second nature, and underestimates the value of establishing a common procedure for all closing echoes, including, when practicable, a plot which will distinguish the close-quarter situation from others with the greatest speed and certainty and can be followed up or dropped as the depicted situation demands.

Radar and Collision at Sea

from Captain C. F. Halliday

(*S.S. Corfu*)

CAPTAIN WYLIE'S note 'Radar and the Compass Bearing' (*Journal*, Vol. VII, p. 200) voices the objection to the ship's-head-up display because it gives bearings relative to the fore-and-aft line instead of to the axis of the compass card. This objection will not appear to be a very real one to anybody accustomed to using a dumb-card pelorus: a glance at the compass, or a word to the man at the wheel, will give the correction to be applied to the bearing in order to make it relative to the course by compass. If the ship is a degree right of her course we add a degree, if two degrees left we subtract two, and so on, before using the bearing. If plotting, the plot is a COURSE-UP plot, *not* a ship's-head-up plot. It is, in fact, a compass-datum plot with a more convenient orientation than the north-up which is so strongly advocated. It would appear to be mere hair-splitting to regard the corrected bearings as not being compass bearings within the meaning of the Steering and Sailing Rules since the important thing is whether or not the bearing is changing appreciably and not the number of degrees it contains. However, this objection, and that of the angular displacement of the plotted tracks of targets when course is altered, can both be completely negatived by using the course-up, gyro-stabilized display; the heading marker is set to zero when the ship is on her course and the gyro allowed to take care of yaw.

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It appears that, in spite of official advocacy, most of us at sea have come to the conclusion that the north-up display and plot is *not* the best system for use in fog or impaired visibility although it is definitely better navigationally, and is academically more pleasing. I suggest the following as some of the reasons for the seaman's preference:

(*a*) When the visibility is impaired, but is still good enough for ships to continue at full speed, we will be using the radar as an extension of the visual look-out and may, or may not, be running a plot. Relative speeds are apt to be high, but it will often be wiser to wait until the other ship is actually sighted before deciding on what action to take, if any. As things are likely to be happening quickly it is evident that what we want from the radar is a continuous indication of the angle on the bow to tell us where to look. The indication must be as simple and as obvious as possible: complications such as mental subtraction of compass headings and bearings or concentric bearing rings are inadmissible. We would not, for example, tolerate them in connection with the ordinary visual look-out.

(*b*) The course-up system has the advantage of always showing the most potentially dangerous echoes in the same parts of the plotting sheet. Danger arises when we are in doubt as to the action, if any, we should take when an object is closing on a fairly constant bearing. The sectors in which such doubt usually arises are: (1) from right ahead to about half a point on the starboard bow, and (2) from right ahead to about five points on the port bow. It is obviously advantageous for us to be able to make difficult decisions without having to orient our thinking according to the course steered. What we need is the course of the other ship relative to our own—compass bearings and headings only confuse the issue.

(*c*) Both in conditions of impaired visibility and in thick fog one of the great boons conferred by radar is the quick recognition of the fact that another ship is passing clear and so can be dismissed from our thoughts while we concentrate on something more pressing. The course-up system is an easy winner here. Lines parallel to the course line can be permanently ruled up and down the plotting sheet to guide the eye, and so there is generally no need for the manipulation of parallel rulers to confirm that a ship is passing clear.

In reality most ships detected on the radar at sea will pass clear without any action on our part, so our system of parallel lines is in constant use.

(*d*) When we alter course temporarily the advantages I have outlined above are temporarily lost, but we get another important one as compensation; for now the heading marker gives us a constant and very valuable reminder that the ship is off her course and by what amount. We are, therefore, in a better position than if we had used a north-up display and plot from the start and so had never enjoyed the advantages of the course-up system. If the alteration of course is not just a temporary one we have to put up with the fact that the ship is no longer heading along the axis of the plot, but at an angle to it (indicated by the heading marker), until a lull occurs and we can set the heading marker back to zero when the ship is dead on her new course.

(*e*) The north-up plot requires a larger plotting sheet (or a smaller scale) than the course-up plot since, in the former, the maximum useful range is required in all directions. If 20 miles ahead of the ship is taken as the maximum useful range a 1-in. scale requires a 40 × 40 in. sheet. But we only require say, a range of 10 miles on each beam and rather less astern of the

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ship, so a course-up plot allows us to reduce the dimensions to 30 × 20 in.—a 62½ per cent reduction in area. This is an important consideration when the plotting sheet has to share the chart table with the navigational chart, or if it has to be accommodated in an odd corner of the wheelhouse. The reduced size, and the fact that the more important part of the plot is always in the same place, makes an arrangement for screened lighting much simpler.

In putting forward the claims of the course-up display and plot I have only considered the needs of the foreign-going merchant ship whose business is to get direct from port to port. Outside pilotage water such a ship will be steering a constant course for long periods. Alterations of course to avoid other ships will normally be relatively small—rarely amounting to, or exceeding, thirty degrees. In fog large alterations are liable to get us involved with the innocent passer-by or fishing vessels and so lead to complicated and dangerous situations. Other users of the sea who are liable to make frequent and large alterations of course will not find much virtue in the course-up system. For them north-up is obviously indicated.

It is to be hoped that the principles behind the various systems of radar plotting will be taught in navigation schools so that the practical side can be properly developed at sea. It appears to the writer, however, that it would do more harm than good if practical plotting became a stereotyped classroom subject before it has been so developed. What may be very good indeed in the classroom and for examination purposes may be almost useless at sea. Examples would, I think, include the true, and geographical plots, and any other kind of plot requiring the use of drawing instruments. There is no time for painstaking draughtsmanship when we are dealing with relative speeds ranging from thirty to over fifty knots, which we have to be prepared to deal with if we wish to make use of a radar plot when visibility is good enough for ships to be going full speed. The present need is for training in the speedy and accurate plotting by eye on the spider's web, and in the interpretation of the plot. In considering systems for merchant ships we must not lose sight of the fact that the plot will, as likely as not, be kept by the officer of the watch in addition to various other duties which may even, upon occasions, include watching the clock and blowing the whistle!

Captain Wylie comments:

It is a well-known fact that, when two ships are closing on a steady compass bearing, one or both of them may make a number of alterations of course and/or speed without causing the compass bearing to alter substantially. The relative bearing from each vessel, however, is altered each time she alters course. These are first principles, admitting of no dispute. In a lifetime in a sea service, I have never met anyone who doubted that the phrase 'compass bearing' in the introduction to the Steering Rules means a bearing by compass and that it is used for the above reason.

In his opening paragraph, Captain Halliday graphically explains how to correct a relative bearing for yaw and concludes that it is then a compass bearing within the meaning of the Rules. There is one point in his paper on which we are agreed and that is his intolerance of mental arithmetic at such moments. He cannot, therefore, fail to appreciate that on a ship's-head-up or a course-up display, whether gyro-stabilized or not, one cannot obtain compass bearings, except when the course ordered happens to be 000°, without arithmetic, mental or otherwise.

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When he speaks of plotting in the same paragraph, he suggests that a 'course-up' plot uses corrected relative bearings, while a ship's-head-up plot uses them uncorrected. I do not think anyone in their senses would do the latter, as it would mean that the bearing datum would move from moment to moment. In fact, there was no need for him to coin his new phrase at all, since these two forms are identical in their effect. Both of them seem to refer to the direction in which the ship has been 'ordered to steer' and not to the momentary direction of the head or to the mean course.

Captain Halliday then makes it clear that he does not know what is meant by the term 'compass-datum plot'. In this, the orientation of the plotting surface is fixed with regard to the compass. It can, of course, be held ship's head up or north up according to preference, but its main advantage is that the plots of echoes are not interrupted by alterations of own ship's course and that the compass bearings of plotted echoes are continuously in evidence.

With reference to Captain Halliday's second paragraph, if one is using a plot with a ship's-head datum or his course-up datum, an alteration of course by own ship is bound to result in approximately equal and opposite angular displacement of the plots of all echoes. The orientation of the PPI can have no effect whatever on this. The only way to avoid such displacement is by using a compass-datum plot. Captain Halliday also claims that the 'course-up' gyro-stabilized display does away with the objection to the use of corrected relative bearings instead of compass bearings. This, of course, is not so; providing that the heading marker is set to zero and reset whenever own ship alters course, the bearing scale will merely enable corrected relative bearings to be read. If the heading marker is not reset when course is altered, as is suggested later in the paper, the zero on the PPI bearing scale represents neither the new ship's head nor true north, and this appears to invite unlimited confusion.

Regarding his paragraph three, I doubt whether Captain Halliday is justified in speaking for 'most of us at sea' and he evidently has not appreciated that a compass-datum plot can be held ship's head or course upwards, particularly if a two-scale plotter is used. It may be that seamen eventually will accept the north stabilized PPI, with all its advantages, used in conjunction with a ship's-head-upward compass-datum plot.

It is not necessary to comment in so detailed a manner on clauses (*a*) to (*e*), since much of it is common knowledge or personal preference. But it is interesting to note again his objection to mental arithmetic at moments of crisis, because it would seem to me that his course-up stabilized presentation demands either re-aligning the PPI at the most critical moment of the approach, i.e. immediately after an alteration of course, or indulging in mental arithmetic to obtain the bearings. I should also mention the indications in clause (*b*) of Captain Halliday's interpretation of the Collision Regulations in fog. If this interpretation is what it seems to be, I do not think that Captain Halliday is justified in claiming that most of those at sea are on his side.

Paragraph (*d*) is an ingenious way of turning the defects of one's system to one's own advantage! It suggests, however, that after a 'temporary alteration' Captain Halliday is content to remain in a position where he is not immediately ready to read bearings. This suggests an optimism to which I would not subscribe. The discrimination in his concluding paragraphs between one kind of ship and another seems to be based on the small alteration to avoid, which may be thought to require more cooperation from other ships than one is justified in expecting.

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In my view, it is desirable to avoid making rules and qualifications, obedience to which may be hoped for, but can never be counted on.

I entirely agree with Captain Halliday on training in radar plotting. It is highly desirable that a decision should be reached on the best form of plotting and, thereafter, training should concentrate upon that method.

A Radar Plotter

from Captain F. J. Wylie, R.N.

(*Radio Advisory Service*)

An illustration of a plotting aid having two bearing-scales was included in my note on 'Radar and the Compass Bearing' in Volume VII, No. 2, page 201. This instrument was a prototype from which that now illustrated as Fig. 1 has emerged.

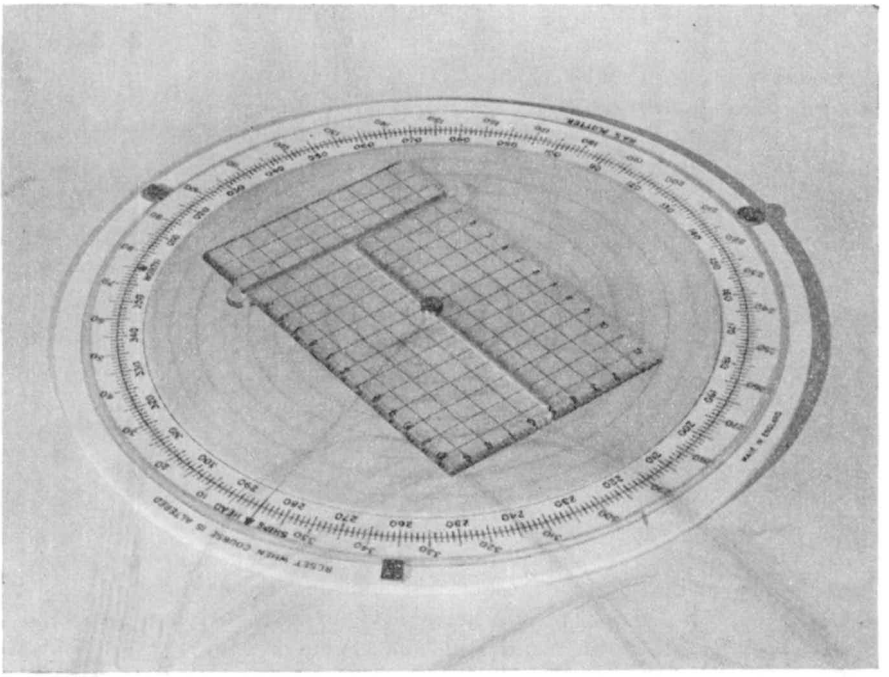

Fig. 1. The Radio Advisory Service Plotter.

The principles involved are unaltered. The compass bearing scale is engraved on the plotting surface and the relative scale on the base; the two may be kept locked together, except when adjusting for a change of own ship's course. To simplify operation and reduce parallax errors, the grid has been taken from the base and placed on the under side of the 'ruler'. The heading line and the range circles are left on the base; both of these are conveniences and they are not used for accurate measurement.

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