By way of conclusion the following remarks about particular tables are offered.

Amplitudes. A thoroughly dangerous method of checking compasses in high latitudes.

Ex-meridian tables. As long as meridian altitudes are taken there will be a demand for ex-meridian tables.

Dip, refraction, and kindred tables. Although not generally necessary for sea use, they take up so little space that their inclusion or exclusion is, surely, unimportant.

The Region of Collision

from Captain H. J. Sadler

SINCE the advent of radar, the need for correct interpretation has become only too clear from the record of so called radar-assisted collisions. The practical navigator has been shown various methods of noting PPI data and solving the problem of how best to avoid collision. We have the practical system of plotting, either with ship's head or true north upwards. We are now being offered some ingenious graphs and tables by Captain Wylie, Mr. Slater and others (*Journal*, 9, 161, 448). The navigator has an opportunity to study these methods and use them at sea, in clear weather, in conditions where he can assess the advantages of each method and also their accuracy.

When plotting with ship's head or true north upwards we are using all possible data, bearing, distance and time; but with graphs and tables we have only two of the three elements, distance and bearing, time and distance, or bearing and time. We can note the third element with advantage, but we still haven't a clear picture of the situation. It seems evident, therefore, that plotting is by far the best method. Although there are many reasons put forward for using a plot with ship's head upwards, I agree with Captain Wylie that plotting with true north upwards is better, mainly because an alteration of course on own ship does not disturb the plot of other vessels showing on the PPI and therefore shows the true situation at all times. However, as has been said before, the best method is the one with which the navigator is most familiar.

The case suggested by Dr. Sutton has already been noted in this *Journal* (9, 163), where a vessel whose bearing on the bow is increasing ends up in the region of collision. It is clearly seen on graphs and tables that risk of collision is imminent, but by plotting with time, distance, and bearing data much more information is available, and we find the surprising situation of a ship which should pass clear, one mile off, altering course several times after closing within 2½ miles as if it desired a collision.

Although I advocate the use of plotting, I do not suggest that tables and graphs should be ignored. Of these I prefer Mr. Slater's distance-bearing system. I would say that the graph is better than the table because it gives a better picture of the situation, but if you can graph it's better to plot. If the navigator is stationed at the PPI and has no facilities or assistant to plot, a situation by no means unknown in the Merchant Navy, then the distance-bearing table is an

Range (n.m.)	Nearest approach (n.m.) 0·5	1	2	3	1 Time	1 Bng.	1 Change	2 Time	2 Bng.	2 Change	3 Time	3 Bng.	3 Change	4 Time	4 Bng.	4 Change
8	—	—	—	—	0600	015G	—	0900	41R	—	1200	057G	—	1500	030½G	—
7	0·5	1·0	2·1	3·4	0604	016	1	0903	40	1	1204	056½	½	1503	030½	0
6	0·8	1·4	2·9	4·6	0608	018	2	0906	38	2	1208	055½	1	1506	031	½
5	0·9	1·9	4·1	7·0	0612½	021	3	0909	36	2	1212	054	1½	1509	031½	½
4	1·4	3·0	6·4	11·6	0616½	026	5	0912	33	3	1216	052	2	1512	032½	1
3	2·4	5·0	11·8	41·4	0621	033	7	0915	28	5	1220	055	3	1515	034½	2
2·5	2·0	4·1	11·3		0623½	041	8	0917	23	5	1222	057½	2½	1516½	Ro50½	7
2·0	3·0	6·4	36·9		0626	056	15	0919	16	7	1224	061	3½	1519	062	11½
1·5	5·0	11·8						0920½	4	12	1226½	066½	5½	1522	094	32
1·0	10·5	48·2						0923½	44G	48	1228½	079	12½			
0·75	12·0															
0·60	14·3															

excellent aid, because the navigator can jot down the information on a card without leaving the PPI, and can make use of the information to decide on whatever appropriate action has to be taken.

The tables opposite are on a card that I have made for practical use, based on Mr. Slater's distance-bearing system. I have made a small refinement by tabulating the change of bearing at each interval instead of from the original bearing, as when the latter method is used an alteration of course by the other ship might lead to confusion. I have made columns for nearest approach of 0·5 miles, 1·0 miles, 2 miles, and 3 miles from a range of 8 miles down to 0·6 miles. The columns marked 1, 2, 3, 4, are for tabulating the data, in pencil, for different echoes where more than one ship is approaching the region of collision at the same time. The information here refers to four different situations.

Column 1. This is the data where own ship steaming at 7½ knots sights a vessel 15 degrees on the starboard bow approaching at 7½ knots. The change of bearing is between the 1- and 2-mile columns and shows the vessel will pass about 1½ miles away.

Column 2. Shows the change of bearing of a vessel approaching at 15 knots with own vessel making 10 knots. It finally crosses ahead with a nearest approach of 1 mile. The change of bearing is similar to the 1-mile column. It is interesting to note that the distance-bearing data is exactly the same where own vessel is overtaking another at 10 knots, while the other vessel is steering 017 degrees to starboard of own course at 8·3 knots. The difference between the two examples is that in the first case the vessels close from 8 miles to 1 mile in 23½ minutes, and in the second case it takes 2 hours 24 minutes.

Column 3. With own vessel making 9 knots, the echo of a vessel making 13·6 knots is seen on the PPI 57½ degrees on the starboard bow at 8 miles. The decreasing bearing indicates a vessel crossing ahead, and the change of bearing that it will pass about ¾ mile away, until, when 4 miles off, the vessel alters course 17 degrees to port so as to pass little more than ½ mile astern. This is shown by the angle on the bow increasing and the change of bearing being similar to the change shown in the ½-mile column.

Column 4. In this case a vessel approaching at 11 knots is sighted 30 degrees on the starboard bow while own vessel is making 10 knots. The small change of bearing from sighting at 8 miles to 3 miles shows the other vessel will pass close astern. If an alteration of 78 degrees to starboard is made at 3 miles, the approaching vessel will then pass clear about 1½ miles off on the port side, as can be seen from the change of bearing which is now between the 1-mile and 2-mile columns.

The situation tabulated in Column 4 demonstrates the superiority of plotting where facilities make it possible. If an alteration is decided upon to avoid collision, the course required to make the other vessel pass clear at any stipulated distance can be quickly found by construction on the plot, whereas when using a graph or tables we can do no more than make a bold alteration to ensure passing clear.