FORUM

Navigation with No Aids At All

from Sir Charles Darwin, K.B.E., M.C., F.R.S.

SOME of the readers of the Institute's *Journal* may be amused at the following experiences in navigation, which I had fifteen years ago. In February 1942 I was crossing the Atlantic from Halifax N.S. to Liverpool in a convoy, and the passengers were of course never told anything about our position from day to day. I had no instruments, and not even a table of logarithms or of sines and cosines, but I did have much leisure and a good supply of blank paper, and I occupied myself by trying to find out where we were. On two occasions I told my estimates to the Chief Officer of the ship, who was not allowed to make any answer at the time, but on each occasion four or five days later he told me how far I had been from the true position.

The only data I had were the ship's time, which was a known number of hours from Greenwich time, and the date, from which I could calculate the Sun's declination. In a pocket atlas I also had a map of the Atlantic about 4 inches across, which, on an unknown projection, showed latitudes and longitudes at intervals of 10°.

The first location was very simple; it was a noon observation. My stretched forefinger and thumb at arm's length span nearly exactly 15°, which I could verify because six spans went from horizon to zenith. On one day at intervals during an hour and a half round about mid-day I took the Sun's altitude four or five times, and by interpolating from these I estimated its altitude at noon, and the time of culmination. I cannot now recall the figures, but I did conclude that if we had to take to the boats, I could set a course which would hit some part of Iceland at a distance between two and three hundred miles. This I afterwards verified as correct, when the Chief Officer told me what our position had been.

The calculation of the second location was much more formidable. About halfway across the Atlantic the Canadian escort left us, and we were picked up by the British, who instructed us to alter our clocks to Greenwich time. This meant that we got up in the dark, and the next morning, while it was getting light after breakfast, I was walking the deck in weather too cloudy to see the Sun, when I noticed that the clouds had rather suddenly turned pink. So I concluded that I knew fairly exactly the time of sunrise. I had never done any practical navigation at all, but I had heard of the method of the Sumner line, and this obviously could give me a Sumner line.

Without the help of mathematical tables the calculations were quite formidable. Everything had to be done by long multiplication and long division and the detailed extraction of square roots. It was necessary first to evaluate numerically the known irrational values of the sines or cosines of angles like 18°, 22° 30′, 30°, 36°, &c. and then to get the value of the sine of any angle in between by using series for the smaller difference angles. It proved not too hard to arrive at the sine or cosine of any angle to five figures in this way, but I found that much the most tedious part of the whole business was to get the cosine of an angle when the sine had been determined, involving as it did one long multiplication for squaring, and then the extraction of a square root. From the general principles of spherical

trigonometry I found the position of this Sumner line during a full morning's work. It fortunately cut at a very broad angle the course that we must anyhow be steering so as to come towards the south of Scotland, and I could therefore get quite a good position. Indeed some days later the Chief Officer told me he had been rather shocked because I had succeeded in telling him our longitude correct to fifty miles, and our latitude to a hundred or so. I would, however, not have ventured to estimate the probable error of my position.

There was a sequel. During the interminable voyage the passengers arranged a sweepstake about the day and time of our arrival at Liverpool; I think this was on a Wednesday and most of the passengers guessed we should arrive some time between the following Tuesday and Thursday. Using my (as yet unverified) estimate of the position and taking the known speed of the convoy—and also having to estimate the position of Liverpool which could not be accurately read from my atlas—I could calculate that the great circle to Liverpool would bring us there much sooner, in fact on the earlier Saturday. However there would obviously be delays, and so since nobody else had put down nearly so optimistic a date, I gave the time as Sunday afternoon at 4 p.m. We actually touched the quay at 3.30 p.m., so my methods of navigation proved quite profitable.

Columbus the Seaman?

from Professor E. G. R. Taylor

COMMANDER WATERS'S review[1] of Professor Morison's recent book on Columbus (*Journal* **10**, 216) should be read in the light of the following facts, published in 1932 by the City of Genoa.[2] They were supported by facsimiles of the documents from which they derive. The Great Discoverer was born in 1451, the son of a wool-weaver of Genoa. The family moved for a time to Savona, and were living there in 1472 when Christopher, in signing a deed, described himself as 'a wool-worker of Genoa'. He went to Lisbon not before 1476, and while there visited Madeira to buy sugar for two Genoese merchants. He made a brief business visit to Genoa in 1479, when he said he must soon return to Lisbon. In all this there is no hint of a person who has knocked about the sea from the age of ten. There is no evidence that on the voyage to Guinea Columbus travelled as a sailor, while as regards the voyage to Iceland, he said it was made in February 1477, that the south of the island lay in lat. 73° N., not 63° N., and that he sailed 100 leagues (400 miles) beyond it and found that the sea was not frozen. The authenticity of this voyage may be left to the judgment of the reader.

The outstanding feats of Columbus were to plan the voyage, to secure equipment for the voyage, and above all to carry it through despite the fears and the unwillingness of the mariners. His stature is not lessened by his romancing about his younger days, nor by his failure to grasp the rules for taking Sun and star—not even, perhaps, by his readiness to falsify the log-book. For it was a general maxim of ancient sea-laws that before the captain or master took any action of serious consequence, like cutting the cables, or leaving port in a storm, he must consult the ship's company and abide by a majority decision. John Cabot had been forced by his crew to turn back on his first effort to cross the ocean. Columbus did not turn back.