

## EXPERIENCES WITH RADIO NAVIGATION SYSTEMS MADE DURING A VOYAGE TO ECUADOR AND BACK

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I. — During a voyage with the motor vessel *Perseus* (a vessel for refrigerated cargo owned by the firm of Messrs. Laeisz) to Ecuador, at which time, amongst other things, I obtained new data on ship's safety, I was able to devote my special attention to the following radio navigation systems:

- 1) Navigation by Radar,
- 2) Navigation by means of the Decca Navigator,
- 3) Consol beacons,
- 4) Radio beacons in the North Sea and the English Channel,
- 5) Loran covered area,
- 6) The shore-based radar installations in the Elbe estuary.

The voyage of the motor vessel *Perseus* — 2,860 gross registered tonnage — did not begin in summer as may be assumed from the photograph, but late in winter of this year, when coastal waters and rivers were heavily covered with drifting ice. On March 1st, we pushed our way out of the Port of Hamburg through dense drifting ice-floes; in addition to the drifting ice, a strong breeze sprang up, as can be gathered from the wind indicator mounted on the roof of the Marine Weather Bureau (Seewetteramt) beside our BVM.

II. — Navigation on the Elbe was difficult, since almost all the buoys either were withdrawn or out of position. The pilot was equipped with a portable V.H.F. radio telephone equipment so that we could obtain information from the *shore-based radar station* of the Brunsbüttelkoog area.

Six nautical miles before the entry of the Northeast Canal, we established radio telephone connection with the shore-based radar station of Brunsbüttelkoog, which shortly afterwards saw us on their screens. The positions communicated to us were fully reliable; we checked them by visual observations. There was clear weather, but there was only drifting ice and a strong breeze. In addition, we checked our positions as to bearing and range by means of our ship-borne radar equipment and watched the rest of the traffic. In these winter conditions, particularly good use could be made of the guidance data received from the shore-based radar station.

When using shore-based radar guidance, we employ the method according to which no information is provided as to the course, evading movements and speed, but information is issued on the position, and reports on the general traffic in the area covered are given, e.g. at what distance from the guided vessel there are oncoming ships, ships proceeding in the same direction, mooring ships etc. Of course, in the reports on the general situation only such information is passed on to the guided ship as is of importance.

The system of position indication by the so-called « Radar Line » has been successful. This line practically coincides with the centre line of the navigation channel, and often it is identical with the alignment of lights or the centre of the guiding sector. Information such as :

You are just north of the radar line, buoy x so many meters off this or that position is unambiguous, and, according to my opinion, sufficient for navigation.

Besides, information, which may be provided by the shore-based radar station, to the effect that vessels astern are proceeding faster than the guided ship and are about to overtake it, is most valuable. When the course needs to be changed, then manoeuvres will be made particularly carefully, especially in poor visibility conditions, when visual location of the other ship is not possible in advance, and where the echo of the ship-borne radar equipment gets lost because of the funnel or the dead sector of the masts.

For the purpose of piloting in dense fog conditions, especially larger ships, employing two pilots is recommended, since one pilot then can attend to the guidance service via V.H.F. radio telephone. Moreover, the additional use of the ship-borne radar installation will further increase safety.

As long as ships are not yet equipped with permanent V.H.F. radio telephone stations operating on the frequency of the respective shore-based radar station, we are faced by the problem of the receiving and transmitting power and the form of the aerial of our portable V.H.F. equipment. The performance of the equipment has not been good enough and perhaps aeriels that can be hoisted should be used in the place of the flexible rod type aeriels mounted on the V.H.F. sets.

Herr Steidle, in a separate paper, will be able to give us information on future plans with regard to ship-borne permanent V.H.F. equipment.

III. — I now refer to location by the Decca Navigator System. The equipment was lent to me for the voyage in question, and I should not omit to thank Messrs. Debeg and Decca Navigator Co. of London for their kind assistance.

Perhaps it can be taken as a sign of growing European integration that it is advisable to use the Danish chain in the Lower Elbe region, and the German chain only farther off-shore. The system provided precise fixes in the Elbe area and along the compulsory routes to the English Channel.

So we observed perfect coincidence of the position as provided by the Decca Navigator System and the fixes taken by optical means and radar. Off the English south coast the Decca positions were compared with radio bearings of St. Catherine Point (Isle of Wight) and Barfleur, and full correspondence was established.

I was furthermore interested in the precision of the position data obtainable in the English Channel, where checks could be made easily, and in the ranges of the English Chain (chain No. 5) and the South West British Chain (chain No. 1) in the area of the Channel exit and the outer Biscay.

The other Decca position data may be gathered from the following photographs. You will see that positions greatly exceed the region of the Decca warning line that is shown on the English charts. Such location data were reliable

in that they coincided with fixes obtained by other methods of navigation. No unsteadiness of the pointers of the Decometers was observed and the coarse signals corresponded to the precision readings.

For instance, a position obtained from the Ploneis Consol beacon was compared with the Decca position in the afternoon of March 5th, and full agreement was obtained; this position was  $48^{\circ} 11.5'$  North,  $7^{\circ} 11'$  West.

At 22.45 hrs. of the same day I obtained the last perfect position from the No. 5 chain as follows:  $46^{\circ} 50'$  North,  $10^{\circ} 15'$  West i.e. 80 nautical miles south of the warning line.

It was still possible to obtain the last Decca position of the No. 1 chain on 6th March:  $44^{\circ} 06.5'$  North,  $16^{\circ} 11'$  West.

From this position onward the green Decometer still operated.

In concluding the report as to the ranges of the Decca chains I would like to refer to the return voyage.

On April 2nd we obtained a regular sequence of colours of the Decometers on the English Chain as from the following position:  $41^{\circ} 26'$  North,  $25^{\circ} 37'$  West.

At noon of April 4th, the Decca position was different by only two minutes in latitude from the position obtained by celestial navigation. And we were still 110 nautical miles southwest of the warning line and 25 nautical miles south-west of the Ushant-Scillys line!

It will be hardly necessary to explain the value of such a method of position finding in the outer Biscay for the safe and shortest approach to the English Channel — independent of the possibility of celestial navigation — and the value of data that can be read quickly in the case of an emergency action for ships in distress.

I now return to the English Channel and the radio beacons installed in that area:

No use was made of the radio beacons from the lightships « Elbe » and « Weser » up to position S 2 on the Humber-Elbe lane or Texel resp. because the compulsory lane was well provided with buoys, and because of distance measurements made by radar and the use of the Decca Navigator. This may be different, however, in the case of different conditions, e.g. if the buoys have drifted away after a gale and if there is no Decca Navigator on board the ship.

In the area of the English Channel there was considerable heterodyne interference of the transmitter Goeree of the 2131 H radio beacon group so that this transmitter was hardly of use to us. — No radio bearings were taken up to the south corner of the Isle of Wight, since in the English Channel good radar positions are available from the shore. — The 2164 group of the West exit of the English Channel then was used. Casquets, however, was frequently disturbed by heterodyne interference. Subsequently, the 2255 group was observed, but good bearings were obtained from the Ile de Bas only; Saint-Mathieu — masked by land — was received only occasionally.

Further to the West, only bearings of Ushant (Creach) and Round Island of the 2156 group provided good results. In this area, the Lizard radio beacon should be transmitting permanently; unfortunately, it operates in the case of poor visibility conditions only, and on a different frequency. Ushant unluckily

was considerably disturbed by the Spanish radio beacon of Cabo Silleiro (operating on 310.5 Kc.p.s. as compared with Ushant operating on 308 Kc.p.s.). The signals of Cabo Silleiro, having a range of 110 nautical miles, were at their maximum strength when the Ushant signals were at their minimum. This disturbing effect was particularly noticeable in the western Channel exit.

(With regard to the usefulness of *radio Consol beacons* I should like to make the following remarks :

The interception and counting of the acoustic signals is extremely difficult because of interfering noise, especially at great distances from the transmitter when the strength of the incoming signals decreases. The number of dots and dashes observed varies greatly and is subject to individual errors in perception. Also on our voyage, we frequently could not reach agreement as to the number of signals observed. On the other hand, there was agreement as to the passage of the beam when we read the signals of the voltmeter of the receiver. However, reading the signals off the voltmeter is possible only when the signals are being transmitted in a time-code of 60 seconds, as provided by the Lugo and Sevilla beacons and, until recently, by the Stavanger beacon.

The Stavanger station was lately converted to a 30-second signal sequence, and, to the best of my knowledge, shipping was not consulted before the change. This example shows how the navigational requirements of aviation and shipping may differ, and that good cooperation must be promoted further, especially since aviation has a permanent international organization — ICAO — dealing with air-safety regulations, whilst there is no similar organization available to shipping (IMCO is still in the planning stage).

The experiences I made on that voyage with the Loran equipment, kindly lent to me by Messrs. Elna, were of a limited nature because of the following reasons :

1. The route, in part, was close to the range limit of propagation of the ground waves of the existing Loran chains;
2. The voyage took place in a period of most heavy magnetic storms (sun spots), owing to which the reception of the Loran sky wave and even the communication in the short wave frequencies were disturbed considerably;
3. I had no previous experience in the handling and evaluation of Loran equipment and data.

In spite of the above mentioned facts, I obtained useful fixes in the region of the Mona passage and, on the return voyage, north of Puerto Rico.

I am of the opinion that we could learn still a great deal from aviation as to the use of Loran for, as far as I know, the Lufthansa employs successfully the Loran equipment on its South America route.

VII. — I now refer to *ship-borne radar equipment*, a Decca Radar 45. For the purpose of taking photographs, the firm kindly provided me with a special camera.

In the 45-mile range, both the English and the French coast-line can be clearly identified in the Straits of Dover. From the individual targets you get an idea of the heavy traffic. The photograph shows that with such a PPI picture,

navigation by shore-based radio beacons very often may be dispensed with even in the case of fog.

In the middle ranges of 10 miles, we just passed Dover, Dungeness being off by 7.1 miles. The harbour of Dover was identified clearly. In passing within short range, we even could observe the turning of the ferry within the moles. A strong rain squall was on the port beam.

Although in the morning dawn, in the area of the Azores, the contours of the Island of Terceira were hardly visible at a distance of 10 nautical miles, the contours of the island were clearly defined on the radar PPI, and thus unambiguous position checks could be made.

When entering the Caribbean Sea, we travelled through the Mona passage. On the photograph (25 mile range), Mona Island was 6 nautical miles athwart.

The group of rocks called « The Monks » that are situated on the route from Curacao to Columbia or Panama resp. constitute a certain problem, especially during the night.

In the case of good visibility conditions during daytime, passage is possible without difficulty; at night, the group is by-passed at a safe distance, if there is no radar equipment available. With the aid of radar, we were able to travel at night and thus saved the by-pass. In the 45-mile range you will see the coastline of the peninsula Goajira (as seen from the north coast of South America), and at both sides of the ship, directly on its course, the Monks. In the 10-mile range, a clear picture of the individual rocks, Monge del Norte, Monge del Este and Monge del Sur is presented; the echoes astern are those returned from the waves produced by the northeast trade-wind.

Now I omit the passage through the Panama Canal, and here we make for our port of destination: Guayaquil; we are in the Pacific Ocean, 2° south of the Equator. It is completely dark and there is heavy tropical rainfall. Relying on the radar equipment only, we can proceed along the Guaya River. In the short (3-mile) range, athwart of Punta de Piedra, both banks of the river, covered with mangroves, and the entrances to the side channels are clearly discernible as a sharp coastline picture. Without injury to a clear overall picture, the shower clouds are suppressed almost completely with the anti-clutter switch being set on « RAIN ».

Back now to the west entry of the Panama Canal: In the 10-mile range, we have before us a clear picture of the Balboa roadstead with the islands Taboga and Taboguilla.

On the English south coast athwart there is Hastings before Rye Bay: you can see a large agglomeration of ships, a chain of small fishing vessels that are presented on the PPI as a connected line.

Finally, on the compulsory route off the Ostfriesland islands, in the 25-mile range, the islands of Langeroog, Spiekeroog and Wangerooge are on the starboard side, and behind them, there is the coastline of the continent. On the port side ahead there are a number of vessels in the area between the lightship « P - 12 » and the Weser estuary; at lightship « Weser » 7 miles ahead, an agglomeration of ships.

Shortly afterwards we reached our home port having covered 11,000 nautical miles in 37 days.

VIII. *Concluding remarks.* — Such a voyage shows the success and the variety of possibilities inherent in the use of modern radio navigation systems. Although much can be simplified as compared with previous methods, by the use of such equipment in position finding and as safety devices during poor visibility conditions, the navigator has to meet considerably higher requirements as compared with previous standards. He must be master of modern techniques and technics, and he has to know the possibilities and the limitations of the equipment he uses. Only in this way will it be possible to reduce the duration of a voyage whilst, at the same time, making it safer. In concluding I should like to express my gratitude to the firm of Messrs. LAEISZ, to Captain PIENING, and to the staff of the *Perseus* headed by its master, Captain NIELSEN, for all the assistance they gave me in connection with the voyage.

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