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SHIPS' ROUTEING
PRESENT STATUS AND FUTURE TRENDS

by Commander J. PATON, R.N.(*)

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INTRODUCTION

This paper is concerned with ships' routeing; and it would be as well first to be clear about what we mean by that term. The IMCO(**) definition of a Routeing System is:

> "Any system of one or more routes and/or routeing measures aimed at reducing the risk of casualties" [1].

and one might reasonably expand this to "reducing the risk of casualties caused by collisions or groundings". By this definition we are excluding, for instance, weather routeing which is, of course, an important subject in its own right. In the context of ships' routeing as I have defined it, I propose to give a brief historical review of how routeing at sea has developed, particularly in the last thirty years, then to cover the methodology of ship's routeing and the various criteria currently used in planning routeing systems, and finally to consider how such systems can best be presented to the mariner.

(*) Department of Trade, Marine Division, Sunley House, 90 High Holborn, London WC1V 6LP, U.K.

(**) Editor's note: Now IMO (International Maritime Organization) since May 1982.

HISTORICAL

Before discussing the present state of ships' routeing, it might be as well to have a brief look at its history, to see how we have reached the present position. For an excellent historical survey, I would refer you to BEATTIE's paper on routeing at sea [2]. Here I will only mention a few salient points.

The first recorded routeing measure to be introduced was the system of one-way steam lanes for the separation of trans-Atlantic traffic, proposed by Lt. MAURY of the U.S. Navy following a disastrous collision in the last century. The resulting North Atlantic Track Agreement of 1898 between shipping companies was still extant in 1960, when reference was made to it in the Safety of Life at Sea Convention of that year.

When we come to near-shore routeing the pioneers were again our trans-Atlantic cousins, who introduced one-way routes to be followed by shipping in the Great Lakes in 1911 and subsequent years, this again following a number of collisions.

But the most prophetic and percipient ideas about traffic separation appeared much earlier, in a paper published anonymously in the *Nautical Magazine* in 1857 [3]. The author's theme was that coastal lighthouses were essentially danger marks, but their presence tended to encourage ships to close the dangers they marked and thus to run the risk of stranding. He therefore proposed one-way routes through the English Channel and the Irish Sea (Fig. 1) with marking along the separation zone by floating lighthouses, what we would now call major floating

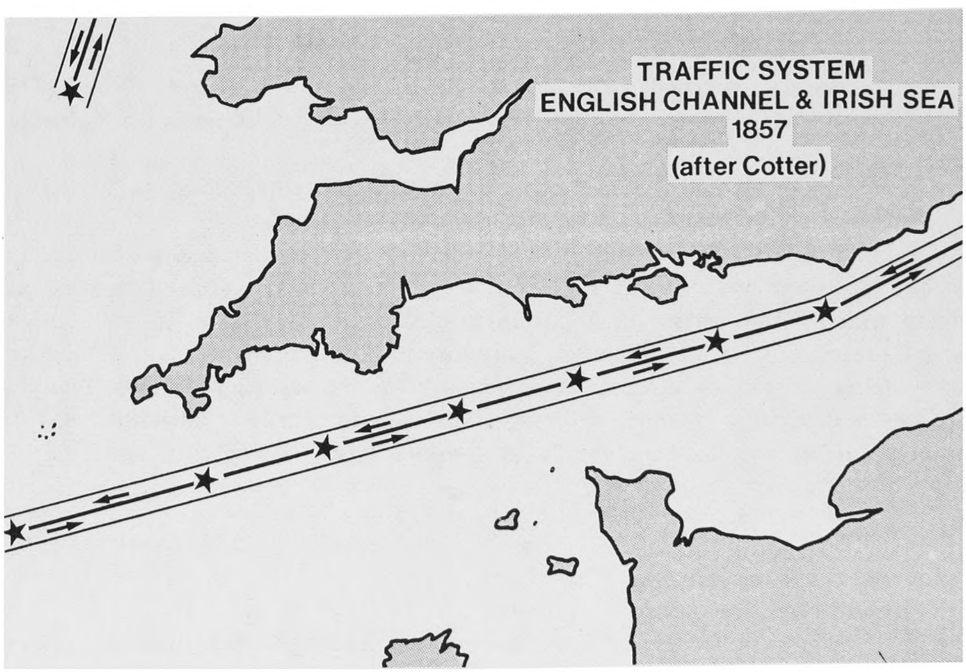

FIG. 1

aids. Not only did our unknown author put his finger on a problem which is still with us today, though in an accentuated form because of coastal pollution hazards, but he also proposed a solution which, to those of us who have recently been concerned with routeing in the English Channel, has a remarkably familiar look about it.

Disregarding wartime measures, such as the NEMEDRI routes through mined areas, modern routeing really dates from the early nineteen-sixties, when the Navigation Institutes of Britain, France and Germany set up a joint Working Group on traffic separation. The principal result of their labours was the Dover Strait traffic separation scheme, jointly submitted to IMCO by the British, French and German Governments and implemented in 1967. This was followed by various proposals for the North Sea, Baltic and elsewhere, considerable impetus being given by the *Torrey Canyon* disaster off the Scilly Isles in 1967.

The 1974 Safety of Life at Sea Convention, which came into force last May, while recognizing IMCO as the only body responsible for establishing or adopting ships' routeing measures on an international level, goes on to say that the initiation of action regarding routes is primarily the responsibility of the Governments concerned. Today there are some 70 traffic separation schemes and 9 deep-water routes adopted world-wide by IMCO; in addition, there are at least 45 national schemes within territorial waters, most of which are framed in accordance with IMCO's provisions even though not submitted for adoption by the Organization. Finally, and most important, since the coming into force in 1977 of the 1972 International Collision Regulations, ships using IMCO-adopted traffic separation schemes must comply with Rule 10 of the Regulations.

METHODOLOGY OF SHIPS' ROUTEING

In the fourteen years since the first major traffic separation schemes were adopted by IMCO, the Organization has taken the lead in developing methods to be used in ships' routeing and the planning and design criteria to be followed. These are now set out in the General Provisions for Ships' Routeing adopted by IMCO in 1977 [1]. Although there is no doubt that these provisions are capable of improvement and refinement, and that there are a number of difficult problems which are not fully dealt with, I suggest that on the whole they do provide a basically sound framework within which new routeing measures can be developed.

I don't intend to go through these provisions in detail today. Instead I am going to select particular points which merit further consideration, and which have a bearing on future developments. I shall concentrate on traffic separation schemes, which are designed to reduce collision risk. But we should not forget that there are other routeing measures, such as deep-water routes and areas to be avoided, which have as their main aim the avoidance of grounding or stranding, and which are thus particularly relevant to the prevention of coastal pollution.

TRAFFIC SEPARATION

The basic idea of separating opposing streams of traffic so as to reduce collision risk is a simple one, and in the light of the long-standing Rule in the International Collision Regulations which requires ships to keep to the starboard side of a narrow channel or fairway, the principle is not new. It has long been appreciated that narrow angle encounters between ships on opposite or nearly opposite courses present the greatest collision risk, and the risk is clearly reduced if the opposing traffic streams are separated. The adoption of such a measure pre-supposes that there is a significant volume of traffic, something more than 20 ship movements per day, and that there is a reasonably well defined axis of traffic flow along which the separation scheme can be orientated. In other words, and this is important, traffic separation schemes were not envisaged as a means of imposing an entirely artificial pattern of traffic flow, but rather were intended to give greater order to an existing traffic situation.

Traffic separation schemes lend themselves to use in straits. Normally there is no difficulty in providing sufficient conventional navigational aids to enable ships to fix their positions in the lanes; neither is there a problem in defining the mid-strait axis of traffic flow. Furthermore, tankers using such a system will automatically be kept as far offshore as the geographical constraints of the strait allow, thus minimizing coastal pollution hazards. There remain however serious problems in regard to crossing traffic, which we will return to later.

TRAFFIC SEPARATION OFF HEADLANDS

It is when we come to shipping concentrations off headlands or landfall points that we run into substantial difficulties in applying the concept of traffic separation, and these difficulties are easier to identify than to resolve. Headland traffic separation schemes proliferated following the *Torrey Canyon* disaster near the Scilly Isles in 1967, for it has been said that casualties are our masters. This routeing solution bore little relation to the immediate causes of the disaster, but there was an idea that such schemes would not only separate opposing traffic flows, but would also be effective in keeping shipping at a safe distance offshore. The schemes were placed some 5 to 15 miles offshore, so as to preserve the possibility of ships making a landfall and to enable them to fix their positions in the traffic lanes, and of course they accorded pretty well with the natural pattern of traffic flow off these headlands.

Typical of these headland schemes was that off Ushant. But then came the *Amoco Cadiz* disaster in 1978, still fresh in our memories (Fig. 2). The cause, as we know, was a steering breakdown in heavy weather uncomfortably close to an inhospitable lee shore, upon which the ship was subsequently driven aground and foundered causing massive pollution of the coast. Immediately prior to her breakdown, *Amoco Cadiz* was using the headland traffic separation scheme off

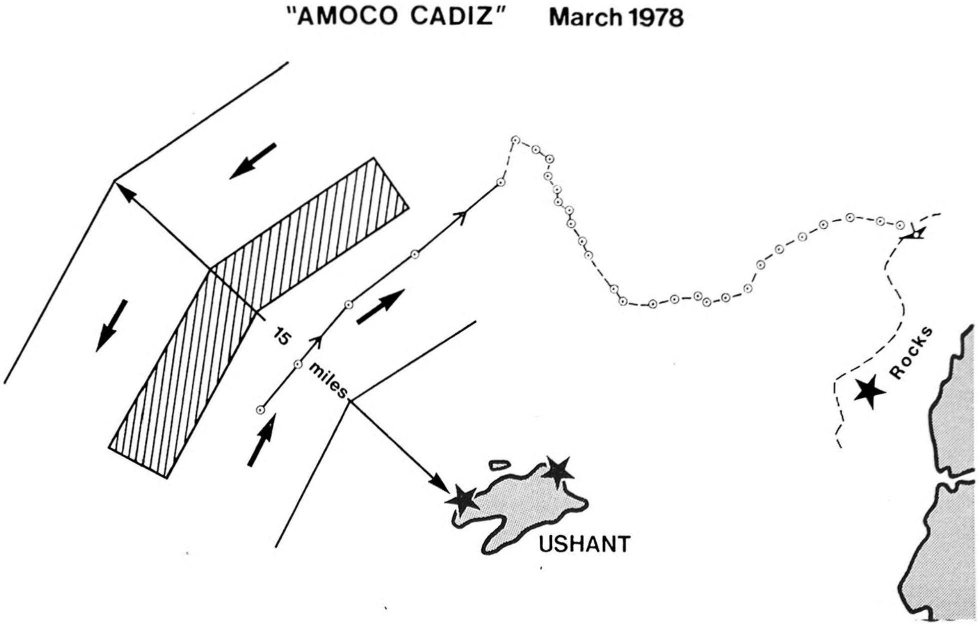

FIG. 2

Ushant. The ship was free to keep to seaward of this scheme provided that, as required by the International Collision Regulations, she avoided it by as wide a margin as possible and indeed the British Admiralty Sailing Directions advise giving Ushant Island a wide berth – at least twenty miles is suggested – in view of the prevalence of thick weather and onshore sets.

The immediate changes to the routeing scheme which were made after the accident, and approved by IMCO for implementation in January 1979, aimed to do just that, obliging laden tankers to keep a long distance offshore. Unfortunately there is little doubt that while this new scheme reduced the dangers of tankers stranding, it also to some extent increased the risk of collision, as I shall explain. This is the real difficulty with routeing off headlands; how can a proper balance be struck between the need to avoid collisions and the equally pressing need to prevent strandings? It is difficult to achieve such a balance in the immediate aftermath of a disaster on the scale of the *Amoco Cadiz* where public opinion has been aroused and political pressures for immediate action are strong.

I think that here I should enlarge a little on the chief problems which the new routeing arrangement has given rise to, particularly as they have a general relevance to the design of traffic separation schemes. First is the difficulty of fixing a ship's position within the traffic lanes of the scheme and their approaches, brought about by moving the scheme offshore to the absolute limit of range of the land-based navigational aids (Fig. 3). Ushant is a landfall area; hence the concentration of traffic and the consequent need to separate the traffic flow into one-way lanes. But if we make it difficult for ships to obtain an accurate landfall fix, it follows that we can have little confidence that they will be able to keep within the appropriate one-way traffic lanes. It seems at least a possibility that this circumstance may have had some bearing on the collision between the *Gino* and *Team*

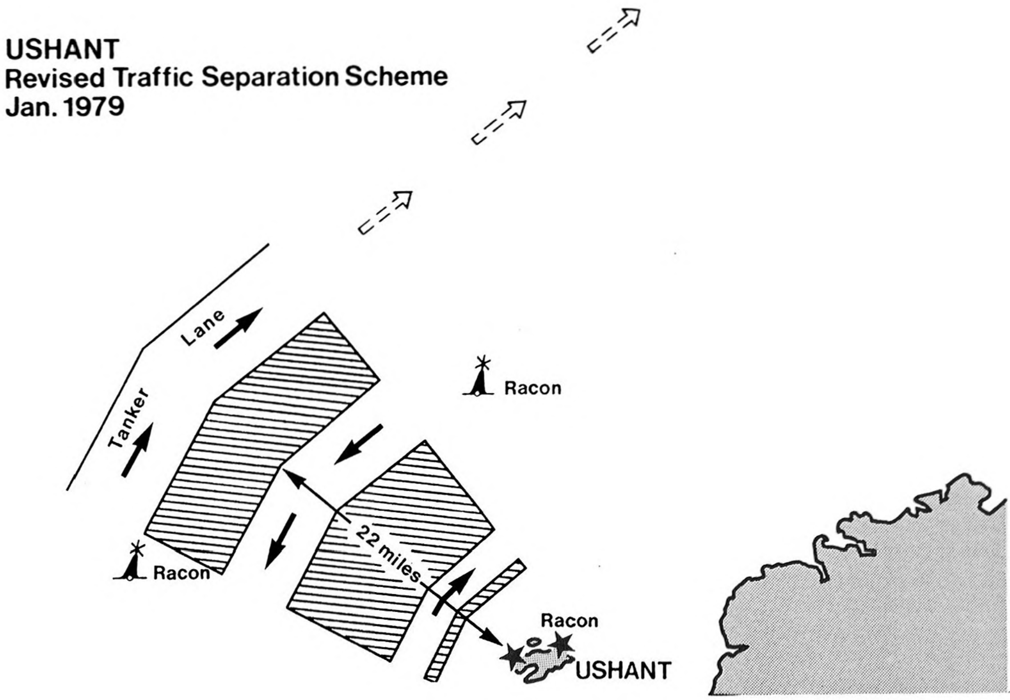

FIG. 3

Castor which occurred in April 1979 in the southern approaches to the revised scheme.

The second drawback to the post-*Amoco Cadiz* arrangement is that it leads to an increase in the encounter and crossing situations which will always be associated with an area of converging and diverging traffic such as we have in the western approaches to the Channel. As we can see (Fig. 4) this results from the requirement that all inward-bound laden tankers must keep to seaward of the new scheme; they are thus placed in the position of having to cross the main south-west-bound traffic flow at some stage before entering the Channel proper. Although the number of ships so affected is not very large, and there is plenty of sea-room, we are aware of some potentially hazardous encounters having occurred in the area to the west of the new Casquets traffic separation scheme.

As I said, there are no easy answers to traffic separation off headlands. Such schemes are designed for use by all ships, not just by tankers. As we have seen, if we direct tankers to use special offshore lanes or to pass to seaward of the scheme, we will usually cause an increase in head-on or narrow angle encounters, exactly the situation which traffic separation is designed to minimize. If however we require all ships to keep a long way to seaward, this may increase the navigational hazards for small vessels.

As regards marking, if, for whatever reason – whether to keep tankers well offshore or to route shipping clear of inshore fishing grounds – it is decided to move a traffic separation scheme appreciably further offshore than would normally be considered a safe distance, then adequate major floating aids must be laid offshore to augment or substitute for the coastal aids. Incidentally, electronic position fixing systems, satellite navigator and the like, cannot be considered as acceptable substitutes for conventional fixing so long as there are not international carriage requirements for the associated receivers, and even should carriage requirements be adopted, there will still need to be a back-up from conventional aids in case of system failures. Meanwhile, it must always be possible for a ship using an IMCO-adopted traffic separation scheme to fix its position within the traffic lanes or their approaches by day and night using radar, D/F or visual means.

The application of this principle is now illustrated in IMCO's recent adoption of a revised traffic separation scheme off Ushant which, at the same time as reverting to a two lane system – i.e. doing away with the special tanker lane – also requires the establishment of several major floating aids and a fixed platform with powerful light to mark the offshore separation scheme. Because of these elaborate and costly marking requirements set by IMCO, this modified scheme cannot be implemented before 1985 at the earliest.

TRAFFIC SEPARATION IN STRAITS

Traffic separation in straits and narrow waters brings its own problems, as I hope to show. But first I should like to deal with a few general considerations, starting with separation zones and their optimum widths. I shall be illustrating these with examples from the English Channel and Dover Strait, firstly because it is an area with which I am familiar, and secondly because all the problems we are to

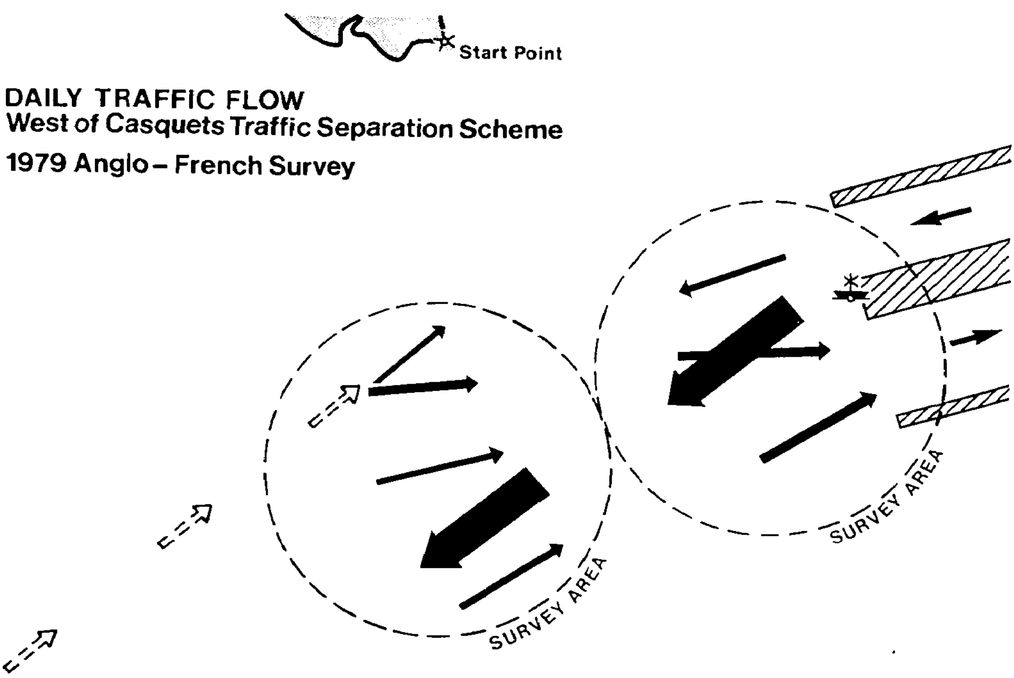

FIG. 4

consider exist there to a greater or lesser degree and are accentuated by reason of this being one of the busiest straits in the world.

IMCO has laid down that the "extent of a traffic separation scheme should be limited to what is essential in the interests of safe navigation" [1]. In other words, the one-way lanes should be no longer or wider than is absolutely necessary on safety grounds; it follows that very long, continuous traffic separation schemes should be avoided. In my view this is right; merchant ships are not the only users of the seas. We must also consider the fishing and yachting fraternities; those concerned with the search for and recovery of hydrocarbons and marine aggregates, and other activities such as cable laying. The presence of traffic separation schemes, to which Rule 10 of the International Collision Regulations applies, imposes severe restraints on the activities of these other users of the seas.

However, with discontinuous schemes there is a problem in maintaining separation of the traffic flows between them. This is graphically illustrated by Captain Cockcroft (Figs. 5 and 6), to whom I am indebted for his analyses of collisions in the English Channel before and after the introduction of traffic separation. As can be seen, collisions between ships on opposing courses have been greatly reduced, but those that still occur tend to do so between the individual traffic separation schemes.

Thus anything we can do to reduce these occurrences, short of having continuous traffic lanes, should be done. And one measure which suggests itself is to ensure that the separation zones are as wide as reasonably possible at the entrances and exits to separation schemes themselves, in the hope that ships will tend to maintain this separation while proceeding between the schemes. Indeed it could be argued that wide separation zones are more necessary in these circumstances than wide traffic lanes.

Another way to encourage traffic separation in these gaps between separation schemes is to recommend directions of traffic flow between them, with appropriate symbols of pecked-outline arrows on the charts. As an illustration, IMCO'S recent adoption of a revised routeing system for the English Channel and Dover Strait uses this treatment for the area between the Casquets and Dover Strait traffic separation schemes (Fig. 7). It will be seen that, additionally, three large buoys are laid along the centre-line, each being protected by a circular "area to be avoided".

It would seem appropriate here to say a word about centre line marking of routes. There are those who assert that ships will be drawn to the buoys as moths to a candle, and thus there will be an accentuated danger of near-head-on encounters and collisions. The critics will cite previous unsatisfactory experience with the old NEMEDRI routes through mined areas, which were usually buoyed along their centre lines. I believe that the critics are right in cases where there is a very narrow separation zone or a single separation line, and in such cases I suggest that centre line buoyage should be supplemented by other measures to keep the opposing traffic streams separated; this could be either by separation zones or by making use of "areas to be avoided" around the buoys. In any case, buoys used along the centre line should be large and prominent.

Where geographical constraints are such that there is no room for separation zones on the centre line, then it would be advisable to mark the outer limits of the traffic lanes in addition to, or even in preference to, the centre line. This is well

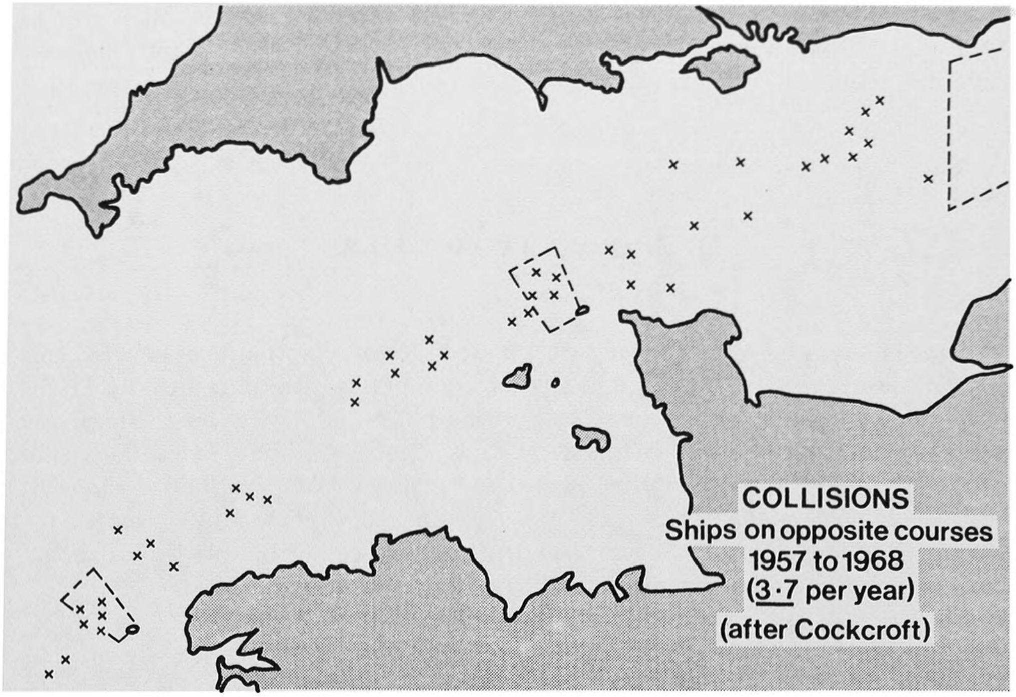
COLLISIONS
Ships on opposite courses
1957 to 1968
(3·7 per year)
(after Cockcroft)

FIG. 5

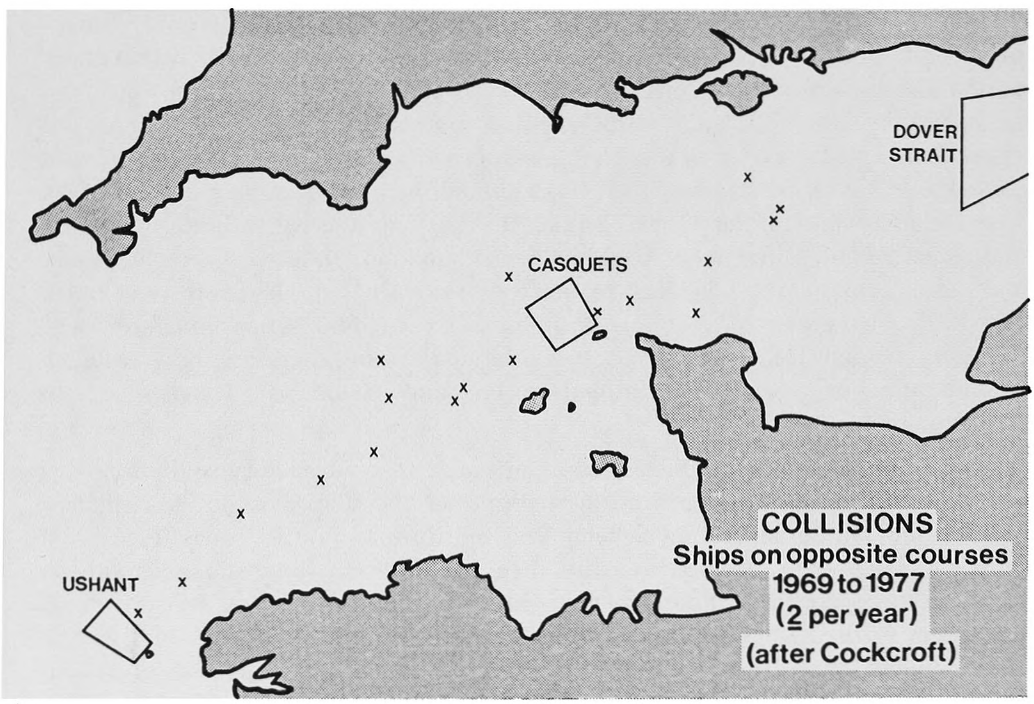
DOVER
STRAIT
CASQUETS
USHANT
COLLISIONS
Ships on opposite courses
1969 to 1977
(2 per year)
(after Cockcroft)

FIG. 6

demonstrated by the situation near Sandettie Bank at the entrance to the Deep-Water Route (Fig. 8) where, in addition to F.1 buoy on the centre line, we have the South Falls and the Sandettie buoys and light vessel marking the outer lane limits.

INSHORE TRAFFIC ZONES

In the areas between the landward boundaries of a traffic separation scheme and the coast, traffic may proceed in any direction unless there is an Inshore Traffic Zone. The only rule which applies to Inshore Traffic Zones, apart from any national regulations, is Rule 10 (d) of the International Collision Regulations; this says that Inshore Traffic Zones designated as such by IMCO shall not *normally* be used by *through traffic* which can *safely* use the appropriate traffic lane in the adjacent Traffic Separation Scheme. Clearly the application of this Rule depends greatly on the interpretation placed on the words emphasized.

The problems affecting safety which arise are two-fold. Firstly, coastal states are naturally unhappy to see large ships, particularly laden tankers, sailing close to their shores rather than using the mid-channel traffic lanes provided. But while it is entirely reasonable to expect all ships proceeding in the direction of the adjacent traffic lane to use it rather than the inshore zone, the right course of action for a ship proceeding in the opposite direction is not so clear. Take a ship bound up-channel and picking up a pilot at Folkestone; she has the option of sailing up the north-east-bound lane and crossing the south-west-bound lane to reach Folkestone – by no means a simple manœuvre for a large tanker, particularly in poor visibility (Fig. 9). But as she is not a through ship, she is also free to proceed to Folkestone via the inshore zone. Now consider a ship en-route to the Thames, but not taking her pilot at Folkestone. Under the new IMCO routeing system for the Channel and Dover Strait, which excludes the Thames estuary from the English Inshore Traffic Zone, she will now be a through ship, and should therefore use the main north-east bound traffic lane in the Dover Strait; she has no alternative to crossing the south-west-bound traffic lane to reach her destination. Indeed, if she has sailed from Southampton, she will need to make two crossings of the south-west traffic flow. Some have argued that this is an unsafe procedure when compared with sailing up through the inshore zone. It will be understood, therefore, how crucial is the interpretation placed on "through-traffic" and "safely" in Rule 10 of the Collision Regulations.

The second problem, which is more amenable to a satisfactory solution, is that which arises when ships are proceeding in opposite directions close to the boundary between the Traffic Separation Scheme and the Inshore Traffic Zones (Fig. 10). If danger of collision is deemed to exist, then the Collision Regulations require an alteration of course to starboard so as to pass port-side to port-side. But this could well result in the ship which was in the inshore zone (the give-way ship) finding herself sailing against the traffic flow in the adjacent lane. This sort of risk is accentuated when ships in the lane deliberately cross into the inshore zone, which is a regrettably frequent occurrence in this area.

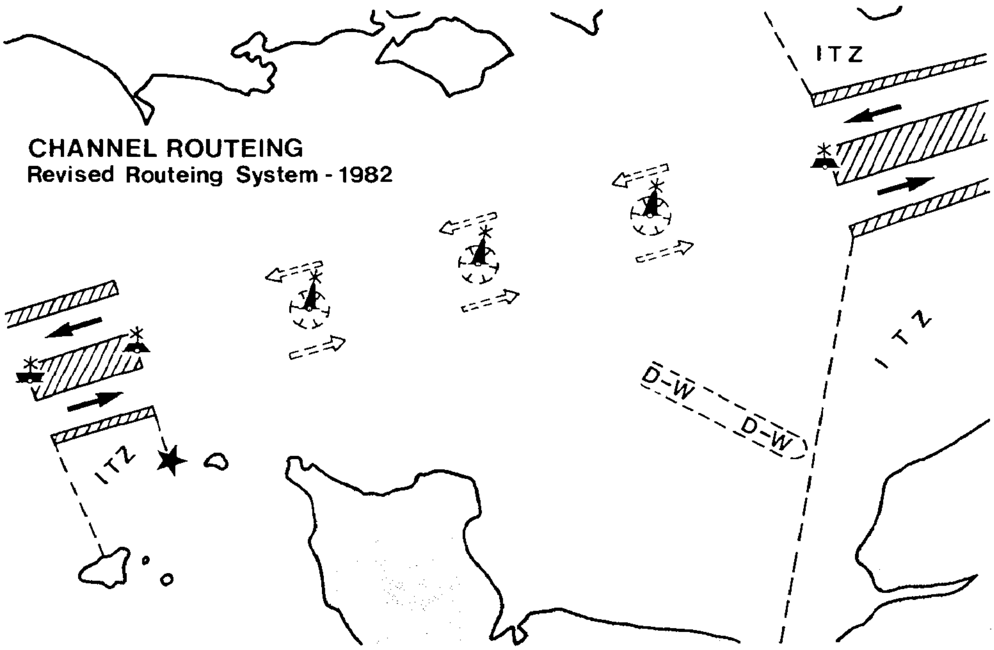
CHANNEL ROUTEING
Revised Routeing System - 1982
ITZ
ITZ
ITZ
D-W
D-W

FIG. 7

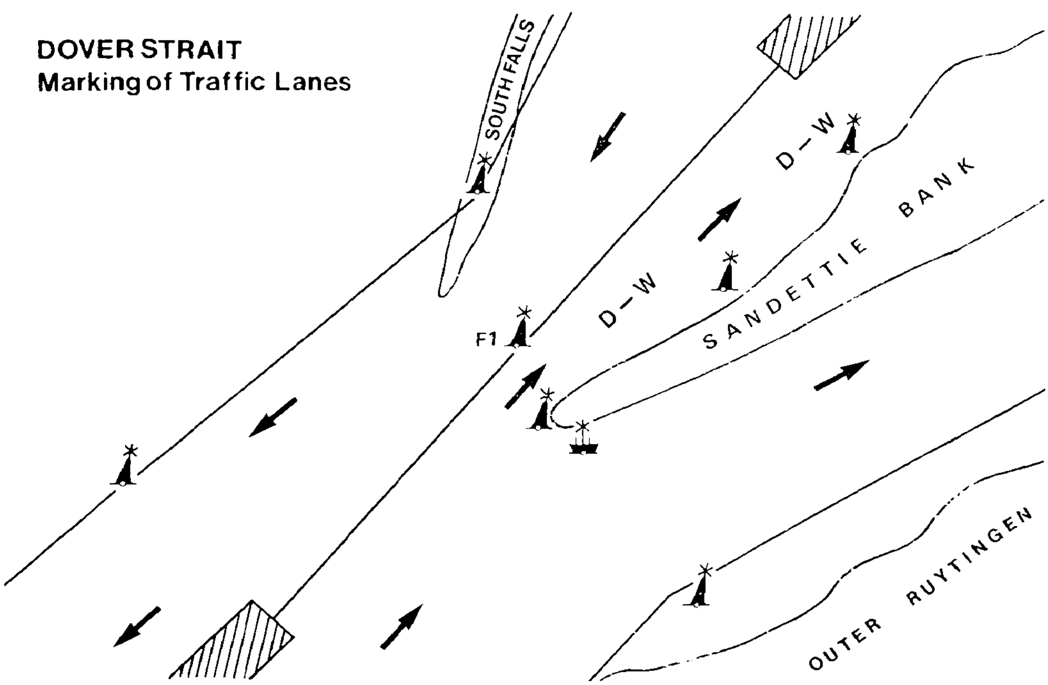
DOVER STRAIT
Marking of Traffic Lanes
SOUTH FALLS
D-W
D-W
F1
SANDETTIE BANK
OUTER RUYTINGEN

FIG. 8

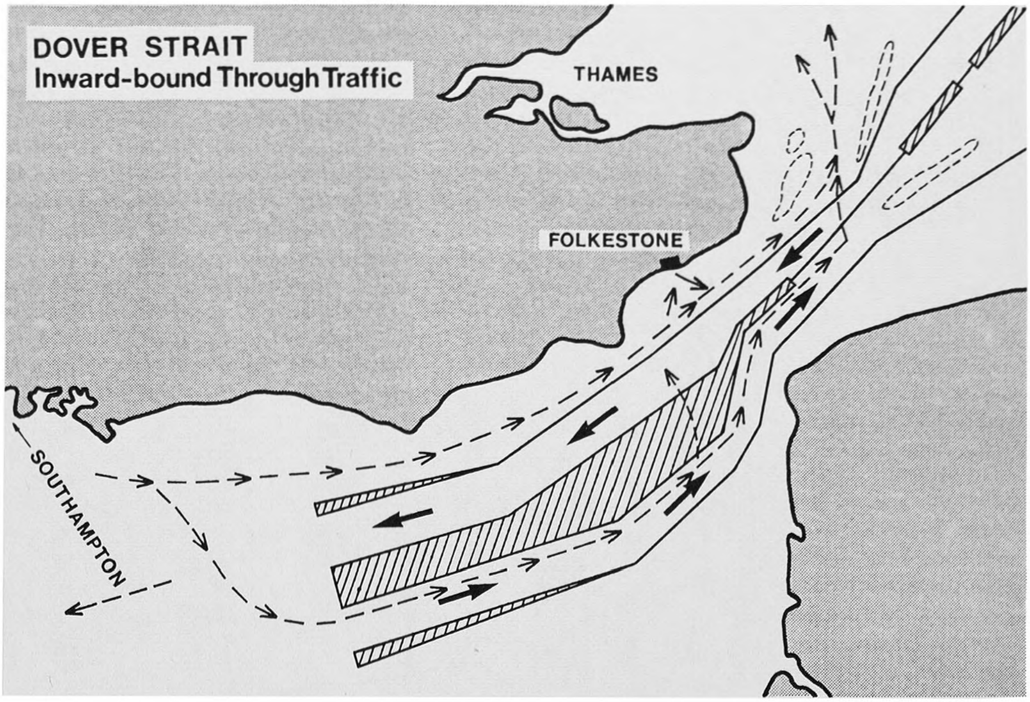
DOVER STRAIT
Inward-bound Through Traffic
THAMES
FOLKESTONE
SOUTHAMPTON

FIG. 9

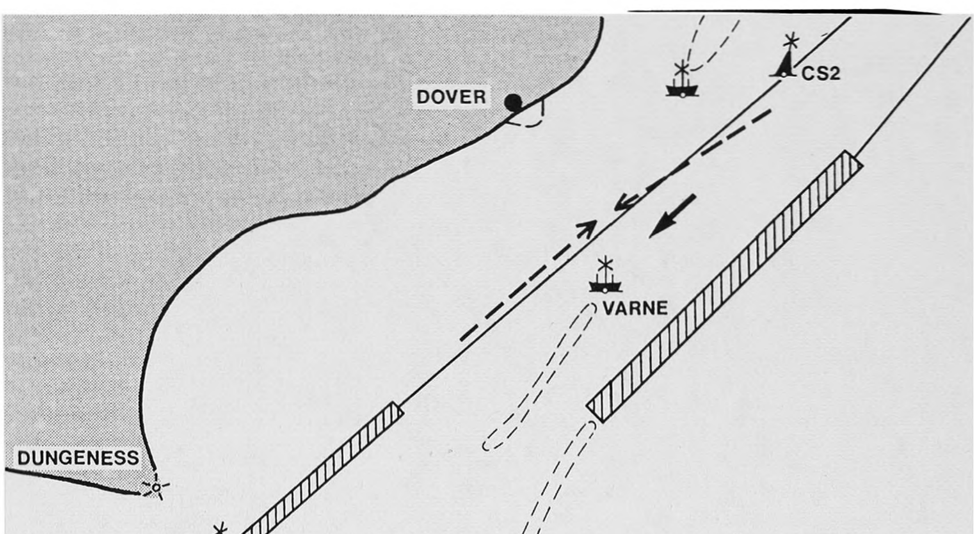
DOVER
CS2
VARNE
DUNGENESS
CS1
DOVER STRAIT
Encounters at Inshore
Zone Boundary

FIG. 10

Dr. LEWISON, in an unpublished note, has drawn particular attention to this danger, and has suggested that in such cases a separation zone at least a mile wide should be established along the boundary, even at the expense of narrowing the mid-channel separation zone. Even so, geographical constraints may prevent such a solution, in which case boundary buoyage may be a help, particularly in discouraging ships in the lane from crossing into the Inshore Traffic Zone.

TRAFFIC LANES

Often, particularly in straits, the width of traffic lanes is restricted by physical features in the area; the narrower parts of the Dover Strait provide a prime example. If, however, there is plenty of sea-room, and accepting that traffic separation schemes should not take up more space than is strictly necessary for the safety of navigation, are there any criteria which can be used in arriving at the optimum lane width ?

Clearly the volume of traffic is a relevant factor; and so also must be the degree of precision with which it is possible to fix the ships' position within the traffic lane. With the latter point in mind, it would, for instance, seem perfectly reasonable with headland schemes to make the seaward lane wider than the inshore lane, on the basis that fixing accuracy will be higher closer to the land. A further factor, particularly related to headland schemes which incorporate a dogleg, is that there is little point in having very wide lanes if ships are going to hug the inside of the bend rather than spread themselves across the full width of lane provided.

There is another and most important point. By separating traffic, we have reduced the incidence of head-on encounters; but we have also thereby highlighted overtaking situations and the collisions they can give rise to. CURTIS, in a paper on overtaking in fog [4], has pointed out the necessity of ensuring where possible that traffic lanes are designed to accommodate overtaking. He suggests that the lane width should be great enough to allow for ships to overtake each other at a minimum safe distance; this minimum distance must allow for unexpected manœuvres by the overtaken ship – due to crossing traffic or "rogues" in the lane – and also the slow response time of the overtaking ship when in fog and relying on her radar. Where lanes cannot be made wide enough to comply with this criterion, the mariner should be warned accordingly, and by the same token lanes should perhaps also be widened where the volume of crossing traffic is high.

Finally, thought has been given to the possibilty of sub-dividing the one-way lanes, so that faster and larger ships can be segregated from the slower and smaller ones. A research project by the Department of Maritime Studies of the University of Wales Institute of Science and Technology postulated a routeing system on these lines for the English Channel. This is an interesting concept which clearly merits further study, but there are difficulties in planning the lane sub-divisions so that the larger ships have use of the deeper water, and there is perhaps a fallacy in attempting to relate ships' speed to ships' size.

CROSSING TRAFFIC

There are almost as many ships crossing the Dover Strait as are passing through it. And by Rule 10 (c) of the International Collision Regulations they are required to cross the traffic lanes as nearly as possible at right angles. OUDET has made some pertinent comments on the way in which this Rule should be applied [5], the most important of which I would summarize as :

a) The interpretation placed on this Rule should not be too literal, bearing in mind that it cannot be considered in isolation from the other Steering and Sailing Rules, and in particular Rule 8 concerning action to avoid collision.

b) Rule 10 (b) (iii) requires that vessels should join or leave a traffic lane at as narrow an angle to the general direction of traffic flow as possible. Although at first sight this might seem to be incompatible with Rule 10 (c), the two principles are in fact complementary rather than contradictory, provided again that the Rules are not interpreted in too literal a way.

c) Traffic crossing a lane always has the option of joining the lane in the direction of traffic flow, and transferring across it as and when suitable gaps in the flow of through traffic occur. This allows for the situation where through traffic is dense and gaps in the traffic flow infrequent.

Applying these concepts to a ship crossing a traffic lane, I would suggest (Fig. 11) that while track A is in strict accord with Rule 10, track B is also in accord with the spirit of the Rule and may be preferable when traffic in the lane is heavy. But on one point I must disagree with OUDET ; I do not think that track C represents a safe manœuvre or would under any circumstances be acceptable under the Rules.

The undesirability of interpreting Rule 10(c) too literally is given force by BARRATT [6] who has demonstrated that the optimum crossing angle to keep the potential number of encounters to a minimum, though clearly dependent on the relative speeds of the crossing ship and the traffic in the lane, is invariably less than a right-angle – for example, if the crossing vessel is proceeding at only half the speed of the through traffic, the optimum crossing angle on this basis would be in the region of 60° to the direction of traffic flow in the lane.

Quite apart from random crossings of traffic lanes, we also have to deal with crossing situations which arise at traffic lane junctions. Often the geographical constraints are such that the route junction cannot be designed to incorporate right-angled crossings and thus avoid potential narrow-angle encounters.

A method which is often used at lane junctions is the roundabout. But I believe that this treatment has drawbacks, in that it tends to impose a traffic flow pattern which does not sufficiently allow for the operation of Rule 15 of the Collision Regulations in encounter situations. I feel that a more flexible approach to this problem is preferable. There is, for instance, the method much used in the U.S. of establishing Precautionary Areas to cover the waters where encounters between routed traffic might occur. Within a Precautionary Area there are no fixed directions of traffic flow, and thus the chart presentation makes it clear to the mariner that only the Steering and Sailing Rules other than Rule 10 are applicable.

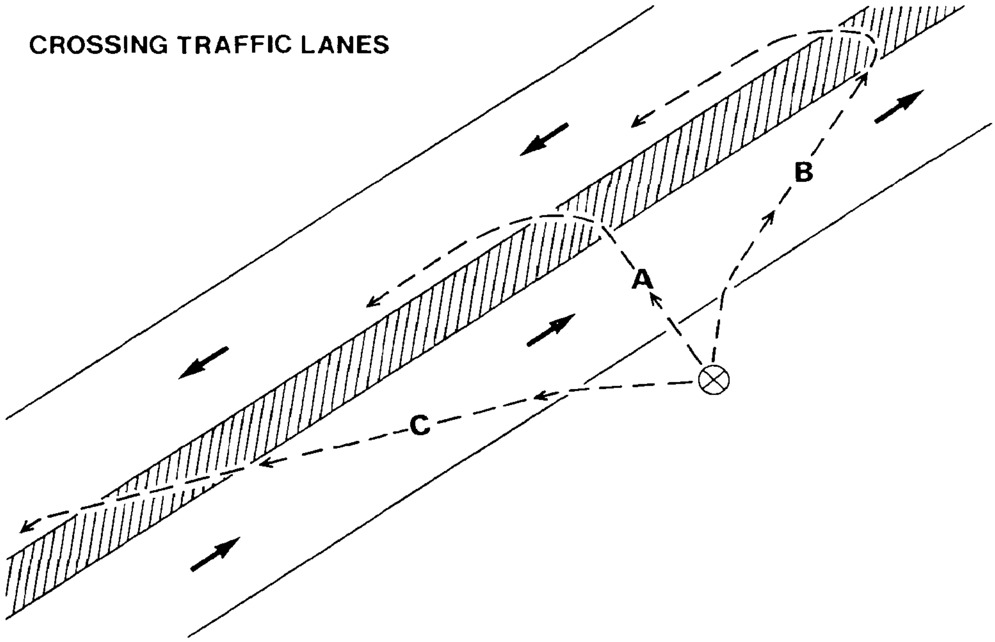

FIG. 11

The principle is well illustrated in the separation scheme within San Francisco harbour (Fig. 12) – but it could be applied to other situations, such as for instance the difficult junction between the traffic separation schemes "at North Hinder", "at West Hinder" and "in the Dover Strait" which lies north-eastward of the Sandettie Bank (Fig. 13).

PRESENTATION TO THE MARINER

By and large, the ships' routeing systems which are adopted by IMCO are outside pilotage waters; although pilotage services may be available, their use is not compulsory. It is therefore essential that these systems be presented to the mariner in nautical documents in a simple but comprehensive way ; this particularly applies to extensive routeing and traffic management systems established in busy international waterways where navigational problems abound. Among the particularly complex areas where comprehensive routeing systems exist or are planned are the Malacca and Singapore Straits, the entrances to the Baltic and the English Channel and Dover Strait.

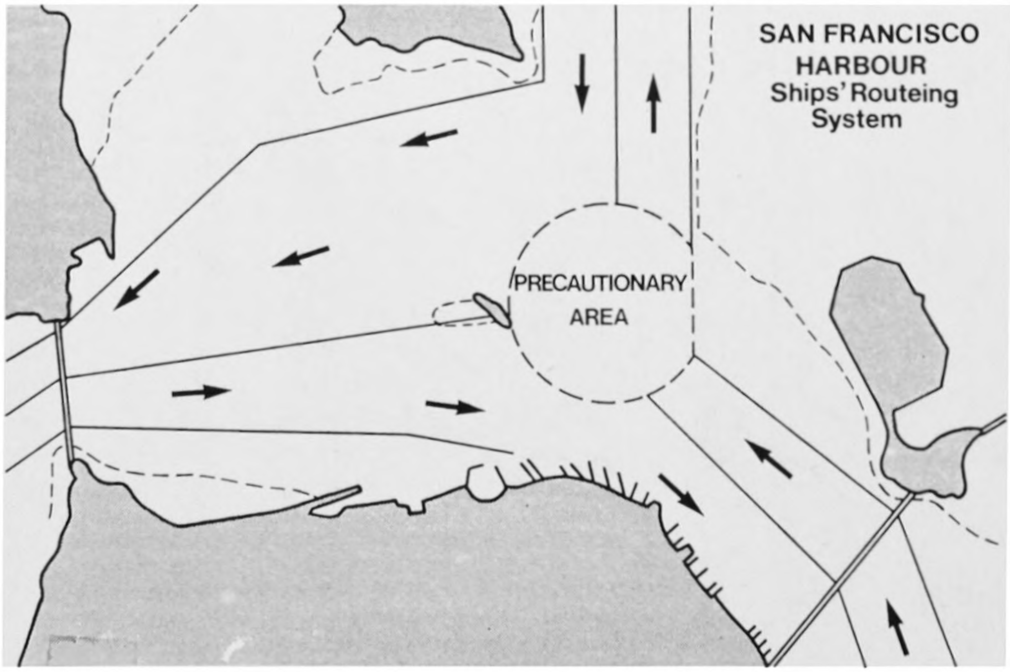
SAN FRANCISCO
HARBOUR
Ships' Routeing
System
PRECAUTIONARY
AREA

FIG. 12

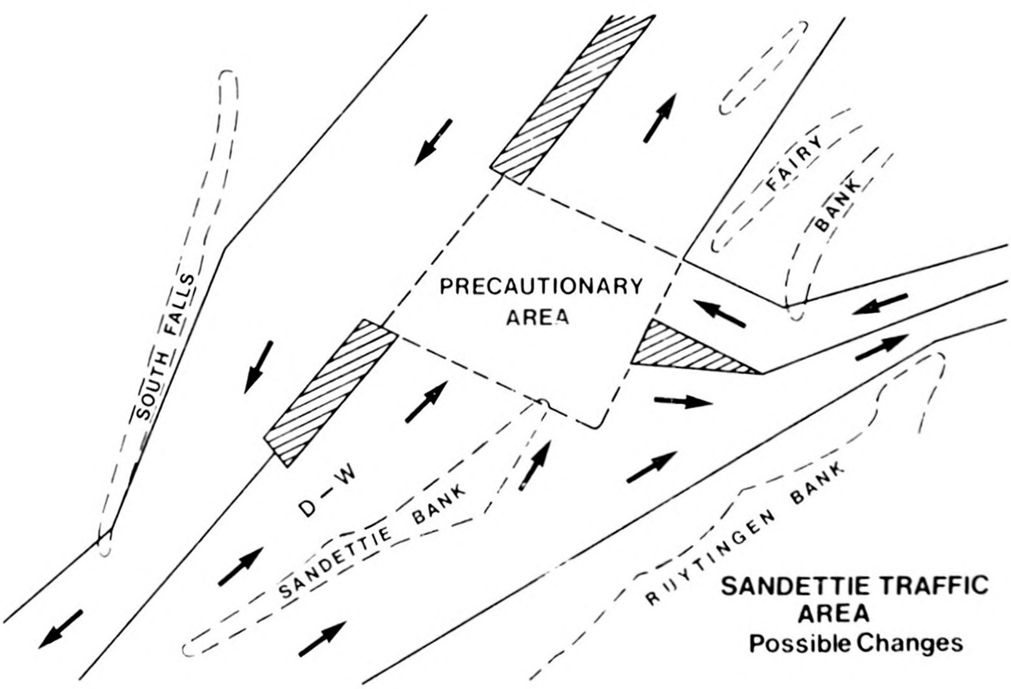
SOUTH FALLS
FAIRY
BANK
PRECAUTIONARY
AREA
D-W
SANDETTIE BANK
RUYTINGEN BANK
SANDETTIE TRAFFIC
AREA
Possible Changes

FIG. 13

Hydrographic Offices, on which responsibility for informing the mariner devolves, have only recently been giving this subject the attention which it deserves. The difficulty is that although the nautical chart can show the configuration of the routeing systems, it cannot include the related and diverse regulations and recommendations. For these the navigator must consult a variety of ancillary publications such as Sailing Directions and Lists of Radio Signals if he is to get the whole picture. While these other publications can never be dispensed with, there is also, I think, a place for special ships' routeing or passage planning guides for these particularly difficult transit routes.

In 1977, the International Chamber of Shipping jointly with the Oil Companies International Marine Forum produced such a guide for use by deep-draught ships passing through the Malacca and Singapore Straits [7]. This pioneer effort was paralleled by the Danish Hydrographic Office booklet on Route "T" [8], the transit route for deep draught ships entering the Baltic. This year, the English Channel has received attention, with the publication by the U.K. Hydrographic Office of a new Passage Planning Chart for the area, so good progress is now being made. Indeed, the International Hydrographic Organization has now established a Working Group on Special Routeing Guides which is considering the content and format of such guides with a view to encouraging some standardization.

CONCLUSION

In this paper I have tried to indicate some of the factors which need to be allowed for in the design of ships' routeing systems, and have also highlighted a few of the main problems which still need to be resolved. I would summarize these as:

(*a*) The difficulties of traffic separation off headlands, with particular reference to the routeing of laden tankers, the prevention of coastal pollution and the provisions of adequate navigational aids.

(*b*) The problems associated with crossing traffic, including the routeing of traffic at lane junctions and in convergence areas.

(*c*) The correct interpretation of "through traffic" in relation to the use of designated Inshore Traffic Zones.

In attempting to resolve these difficulties, we will have to review the options which are open to us, which include possible revisions to Rule 10 of the International Regulations for preventing Collisions at Sea. But the fact that we still have problems should not detract from the undoubted contribution which ships' routeing has made to safety at sea since its inception only fifteen years ago.

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