A FEW REMARKS ON THE USE OF RADAR IN NAVIGATION

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As long as it is possible to obtain a definite fix, whatever the method used, the utilization of radar in navigation becomes a matter of the utmost ease and simplicity. This is especially true in cases where the shore has a distinctive character and is rocky and sheer, a condition that applies to most Mediterranean areas. These are always, or nearly always, reproduced with great accuracy on the radar screen, and the standard nautical chart is sufficient.

With a few minor exceptions, the above-mentioned features are prevalent in Greek waters, and there are not many instances requiring the use of special charts. The examples we shall give, which tend to prove that the use of special charts is occasionally necessary, are indeed rare.

The use of radar for making landfalls, however, requires particular care with regard to the correct recognition of the radar land picture, owing to the very frequent uncertainty of the fix.

The positive and accurate identification of at least one radar-conspicuous object is therefore essential, and it should clearly be shown on the chart. Recognition of all other targets is then made easy.

Radar should never be used, however, as the sole navigational aid, especially when navigating in dangerous waters, unless one is one-hundred per cent sure of proper recognition, as otherwise an error may easily be committed whose consequences can be disastrous.

No other method of navigation offers the possibilities of radar. On the other hand, no other method — if recognition is inaccurate — involves the risk of greater errors.

Under such circumstances, special charts must be used as in the following illustrations.

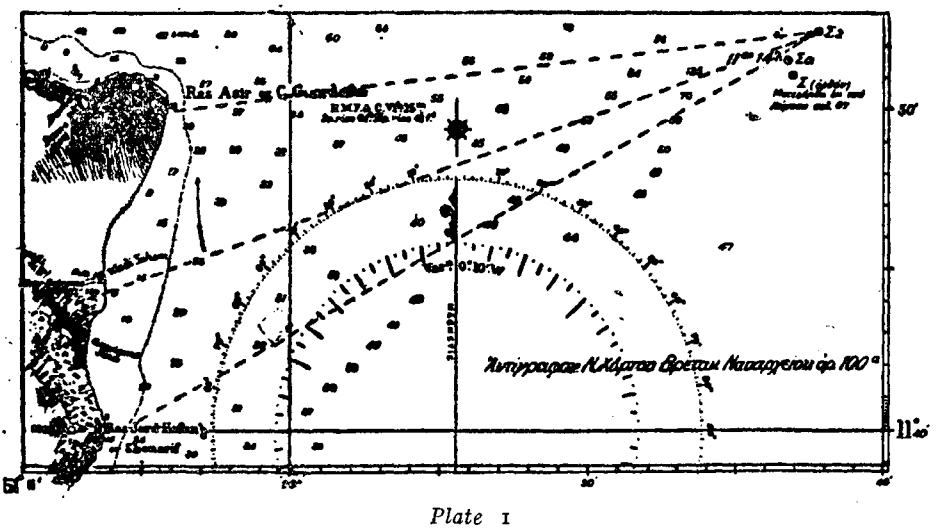

Plate I

A ship heading towards the east coast of Somaliland detected three conspicuous targets between 25 and 30 miles distant.

The captain, who did not have a hypsometric chart, made the mistake of identifying the village of Waldi Fuhom, which was under the horizon, as his conspicuous target, and fixed his position accordingly.

After discovering that he had erred by 4.5 miles when obtaining his fix, the captain came close to losing faith in radar. If he had used a hypsometric chart equipped with a diagram or table, such as British Chart n° 2469, the error would never have been committed.

Moreover, he would have been able to identify the three prominent targets with a certain amount of accuracy, as steep ravines were present, through use of the diagram data (distances and heights), and could even have obtained an accurate fix.

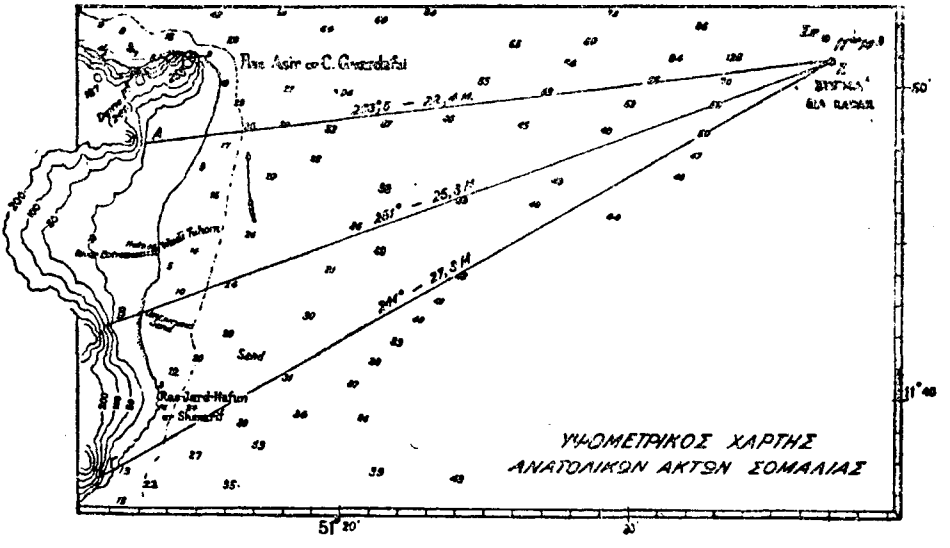

Plate 2

It is obvious, nevertheless, that fixes cannot always be acquired in this manner.

In the above-mentioned instance weather conditions were about average. But under certain circumstances distances at which radar-conspicuous objects become apparent differ widely from those assumed when the diagram is used.

As an illustration, an identical lightship was once seen at a distance of 4.5 miles and another time at a distance of 43 miles, while below the horizon.

Under average weather conditions, land areas become apparent at a distance of from 30 to 35 miles or more. This naturally depends on the shape and type of the land area. Land in the southern and western parts of Peloponnesus invariably show up on the radar screen at a great distance and with extreme clarity; when drawing near land, the shore line is always very clearly apparent, while land in Nova Scotia, although it is rocky, can only be seen with difficulty. Here a very weak echo is obtained from 20 miles away. The same land area at this distance could be seen clearly with

the naked eye. At a range of 20 miles, a detailed radar-image is usually obtained. And when approaching land from 15 miles away, it is possible to see the shore-line when the latter is rocky and steep, or when several structures are in evidence.

The Straits of Messina at a range of 8 miles give a very faithful portrayal of the chart. The same is true for the Straits of Gibraltar, especially when approaching from the Atlantic side.

The coastline is so clearly and so accurately apparent upon the screen when passing through these straits that it is not even necessary to obtain a fix, even under conditions of poor visibility provided a circle set at a reasonable radius on the PPI touches the extremities of the coast required.

This situation does not however apply in the case of other narrows, and one should not attempt to pass through them until certain of one's position. Errors are easily made, since the shoreline is not continuously apparent upon the screen.

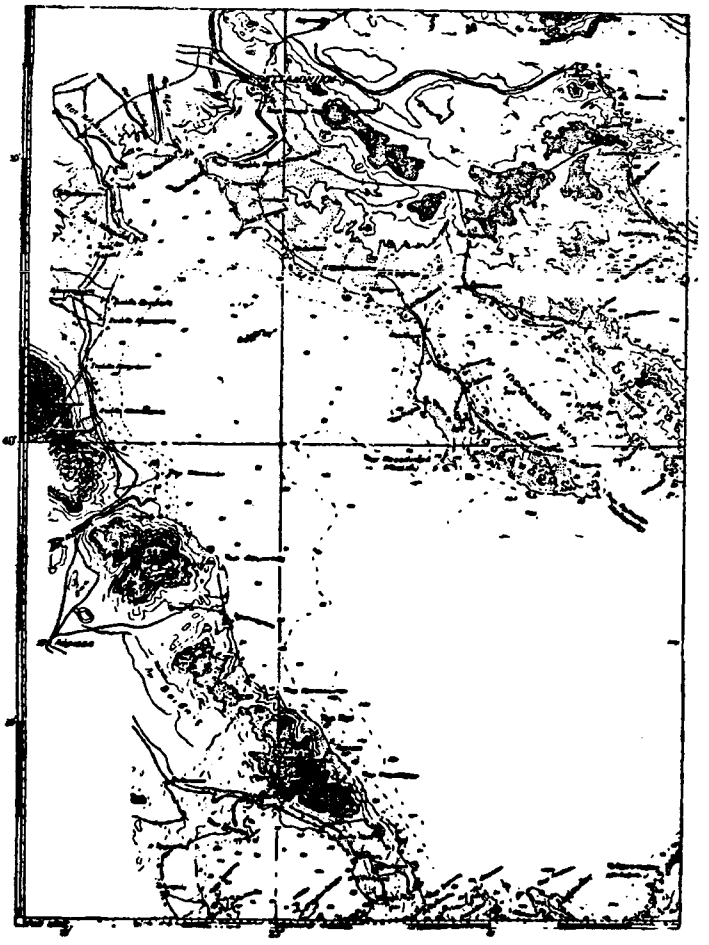

Plate 3

Such difficulties exist, for instance, at the entrance of the Gulf of Salonika, where heavy fog is frequent and where the shore line supplies a

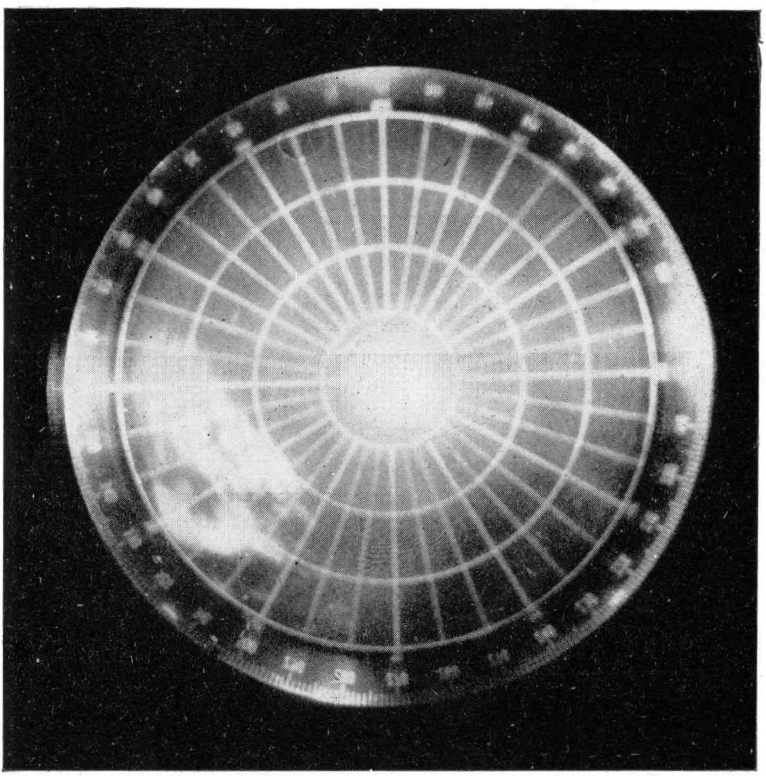

Plate 4

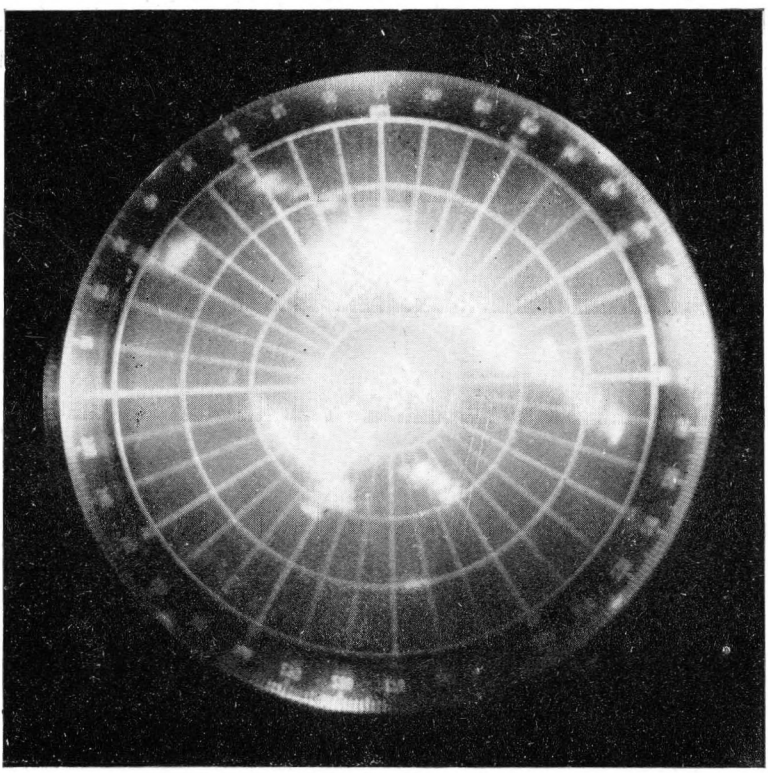

Plate 5

very poor echo. Identification of the radar land picture consequently becomes very difficult. In such cases the radar chart proves extremely useful, as the following example will show.

The display shown on Plate 4 was obtained from a ship south of the entrance to the Gulf at a range of 20 miles, under very poor conditions of visibility.

The doubtful fix obtained did not permit recognition of details of the radar-image, or even of the part of the coast it represented.

In order to obtain a reading, a picture of a larger land mass had to be acquired. The radar equipment was set at a range of 60 miles, and the image shown on Plate 5 was obtained.

Comparison at first sight of the image with the chart, which gives inland topography, immediately shows the resemblance between the two. Not only is it possible to recognize extensive areas such as mountain ranges, but the exact position of isolated targets can be checked with the aid of the diagram.

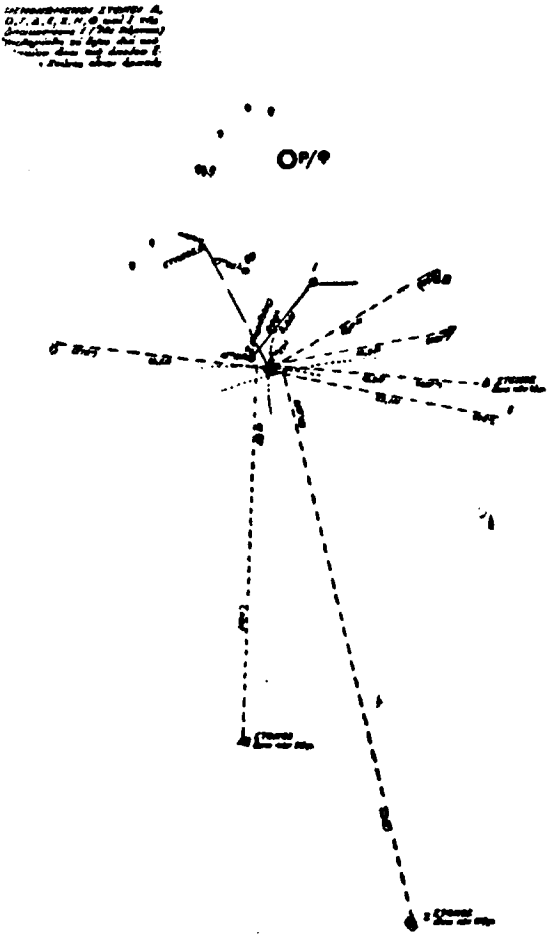

Plate 6

By measuring the distance from the targets that have been identified and by plotting appropriate circles, we obtain a position whose radius of uncertainty has been fixed at approximately 2 miles owing to the discrepancies between the different resections of the circles.

The degree of accuracy of the position is definitely not sufficient for entering the narrows, but it suffices to define the radar land picture obtained at a 20-mile range.

After it was learned that prominent target I represented structures in the village of Irakleia, an accurate fix was obtained, suitable for passing through the narrows.

It is doubtful whether the land picture would have been accurately defined without the use of the special chart showing inland topography.

Circumstances exist, however, where use cannot be made of a special radar chart even if available, as presentation of the radar display is extremely vague and confused

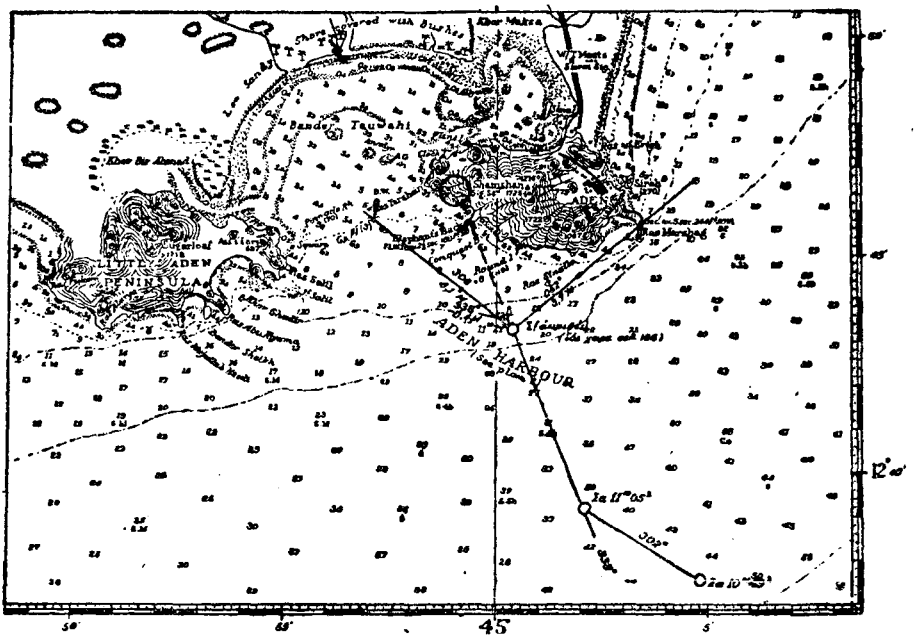

Plate 7

In the case of a ship that planned to call in at Aden under conditions of extremely poor visibility during a sandstorm, use of the radar land picture could not be made until an accurate fix had been obtained with the help of the radiobeacon and of precise soundings (corrected even for tide).

No fix could be obtained based on use of the PPI, as no continuous display of coast or land area was apparent. The image merely produced

countless numbers of small traces due to echoes from the land and from boats, especially fishing-boats massed together in the area. It was only possible, therefore, to distinguish the lighthouse and light buoys from among these following the obtaining of an accurate fix. Regardless of this exceptionally unfavourable case, largely due to the sandstorm, anomalies caused by the presence of groups of vessels and above all by small fishing-craft often do occur. Under these circumstances it is preferable, for instance, not to attempt the recognition of a small island surrounded by a large number of such craft, but to regard it as a dangerous hazard - such as a shoal - after naturally succeeding in obtaining an accurate fix based on other radar conspicuous targets that have been identified with absolute certainty.

It should also be realized that where fishing-boats exist in large quantities, all do not show up on the PPI. At a range of 20 miles, only about 30 % of them are visible within that radius on the screen, and 80 % are apparent within a 4-mile range; while it rarely occurs that within a range of half-a-mile or one mile, the echo from a boat is so weak that it escapes notice.

Sighting on isolated targets ashore usually presents no problem. At Malta, for instance, the highest fortified structure can first be seen at 39 miles, and the one farther south at 35-36 miles. Minikoi Island (Maldive I), although low-lying, wooded and damp, likewise almost invariably supplies an echo at 25-27 miles, owing to the structures located on the south side of the island.

Initial determinations are far harder to effect in other areas, however, and caution must be exercised until ultimate definition.

A vessel, for instance, desiring to make a landfall on the southwestern extremity of England runs the risk of taking the first prominent target that appears on the PPI as the echo from Longships (unless he consults British Admiralty Special Chart n° 2649), while the echo is actually reflected from an inland area, as is evident upon examination of the height contours and table of the chart mentioned, as well as from the rotation of the echo as being radar conspicuous.

This was later checked by a ship using the fix it had obtained by taking the foregoing into account as a basis, and after advance calculation of the time Lizard Point was scheduled to appear on the PPI according to these height contours and height of the radar antenna. Weather conditions were average.

It should be mentioned that before Lizard Point appeared another radar conspicuous target located behind it and at a higher elevation became visible. But this had been foreseen with the help of the special chart and its accompanying table.

Forest-covered and sandy areas when covered with sand hills are even harder to recognize, as they sometimes supply an echo owing to their steep gradients. In such cases the PPI shows traces lacking in continuity. It was thus impossible to identify the shore north of the Red Sea port of Massawa until a Marcq St. Hilaire position line had been taken on the

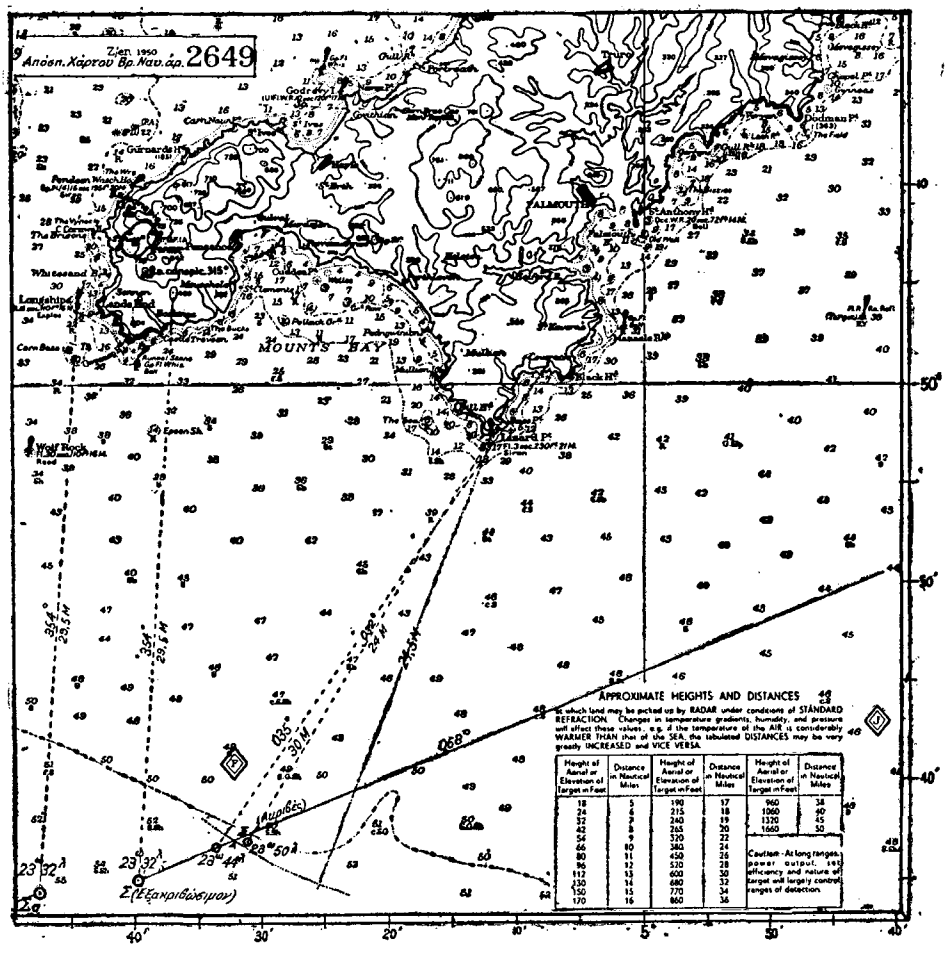
Ζ/εη 1950
Ανσωπ. Χάρτου Βρ. Ναυ. αρ. 2649
MOUNTS BAY
Wolf Rock
Longships
Σ (ΕΞΑΚΡΙΒΩΣΕΙΡΑΙ)
APPROXIMATE HEIGHTS AND DISTANCES
Caution - At long ranges, power output, efficiency and nature of target will largely control ranges of detection.

Plate 7 a

Sun at a 90°-angle from the peak that could be seen with the naked eye, as the radar only reflected an unidentifiable image. This was due to the fact that the PPI presented no continuous trace, but only isolated echoes of various steep slopes or of structures located inland, with no variations as to distances between one another, and in general none with respect to their relative positions.

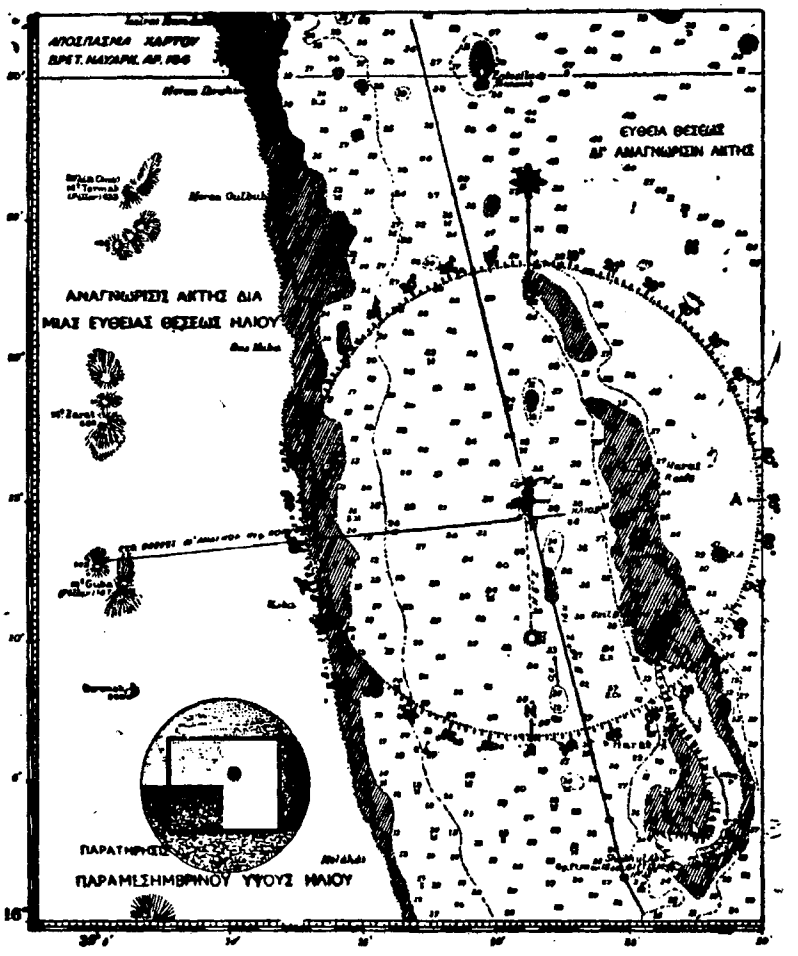

Plate 8

By this method, as soon as the radar land picture was identified with the help of the St. Hilaire position line on the Sun, a reliable fix was obtained.

As the master could predict a decrease in visibility, and as he feared that the sandy point of Entesila would not appear on the PPI, he decided to determine in advance, with the help of the accurate fix previously obtained, a number of radar conspicuous targets that would be useful for the remainder of the voyage.

He marked various targets along his course on the chart by means of bearings and distances based on the acquired accurate fix, thereafter checking them continuously.

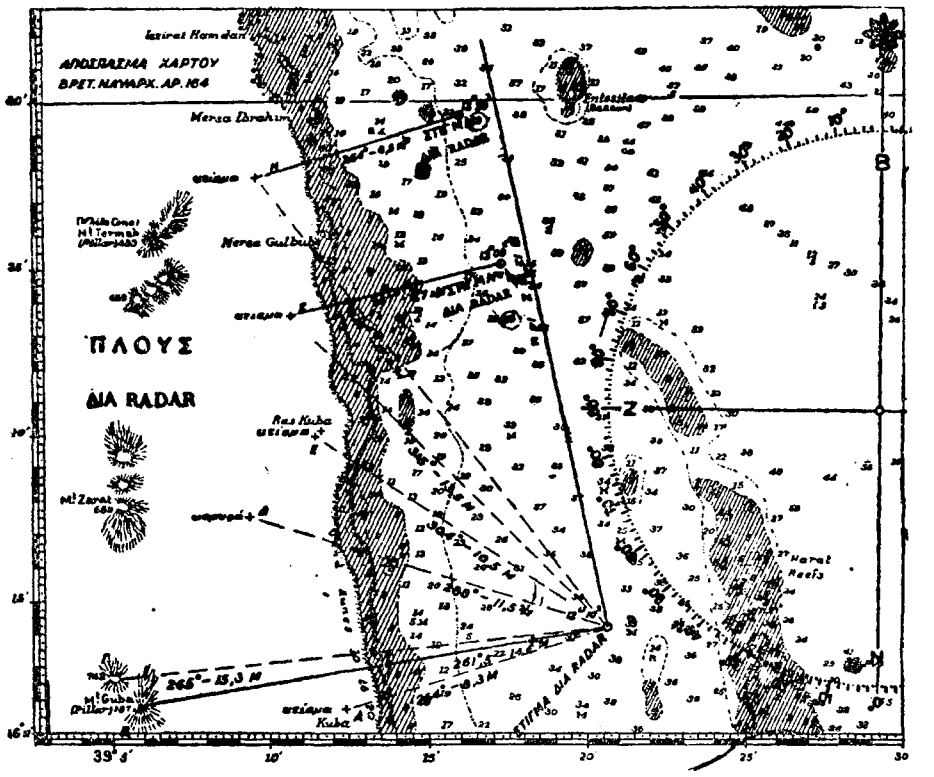

Plate 9

The captain stated that most of these targets disappeared or could not be used because of considerable changes in shape. Two of the targets were, however, used to advantage, as he had been able to obtain fixes within less than a 2-mile radius of uncertainty, while the width of the fairway between dangerous waters was in excess of 5 miles. We are not, however, in a position to recommend this method, as no further experience regarding the subject is available to us. We nevertheless believe it possible that use might be made of it in certain exceptional cases, although with extreme caution and only if it is decided that other navigational methods cannot adequately supply an accurate fix. It may be that the selected targets can only be used when they form regular geometric patterns, as otherwise a change in the vessel's position often causes presentation of the echo on the PPI to undergo considerable variation.

In any case, while investigating dunes and difficult coast-lines, one is easily apt to interpret them wrongly. It is therefore essential that a

great deal of caution be exercised and that checks be controlled constantly by means of other conspicuous targets during each process of identification, even if the latter seems certain.

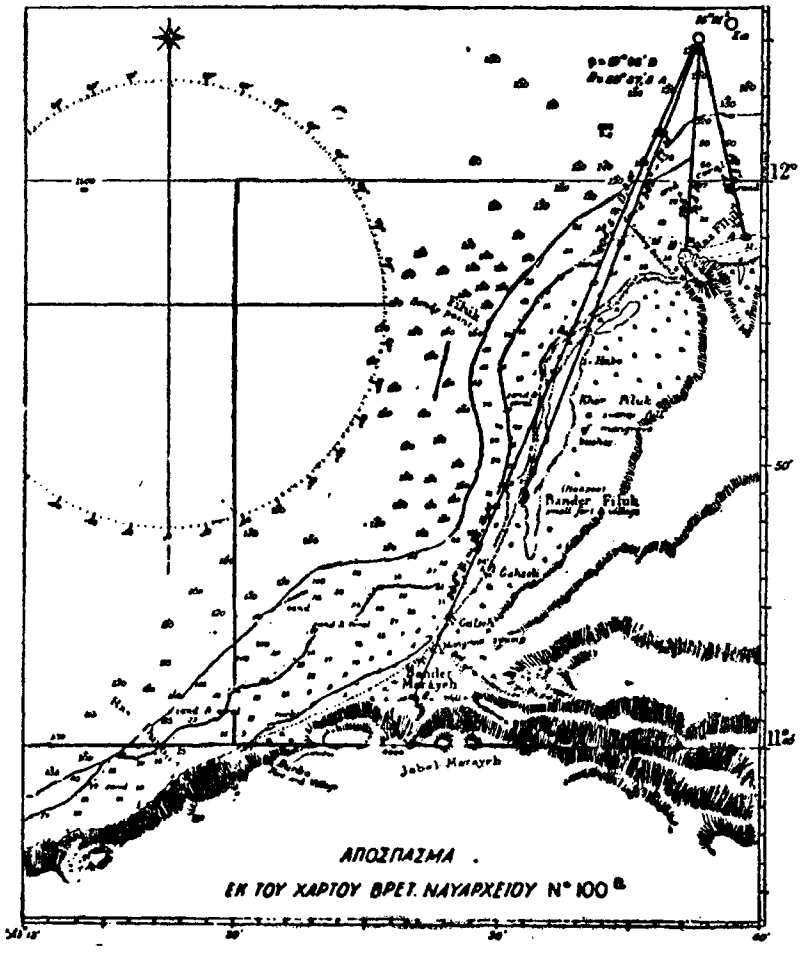

Plate 10

Thus a vessel proceeding along the North coast of Somaliland which detected a conspicuous target 7 miles away first took it for Ras Filuk Cliff. But it soon realized that the target was another vessel. It should here be mentioned that the small vessel made its appearance on the PPI earlier than the cliff, which owing to its shape appears as a radar conspicuous object, although both were at approximately the same distance.

Another difficulty encountered in radar recognition consists in the nuclei of cold fronts, which bear a strong resemblance on the PPI to the portrayal of land masses. It is true that their position and shape change

very rapidly, but where there is a continuous accumulation of them, a certain amount of confusion ensues.

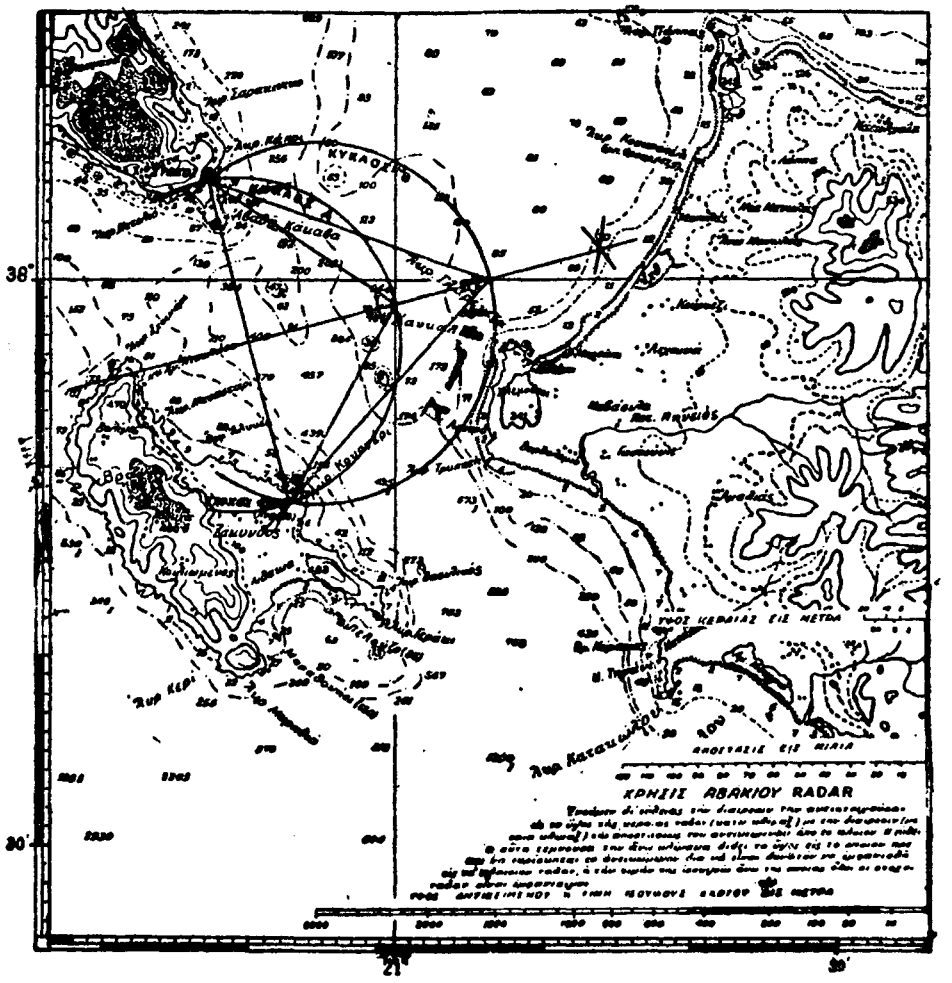

Plate II

A vessel opposite the Gulf of Patras, for instance, was unable to obtain a radar fix, although numerous and obvious radar conspicuous targets were present to the North and West, because of continual storms coming in from the same direction. The vessel in question was nevertheless able to obtain a fix by radar through the recognition of targets on the low-lying wooded coast of Peloponnesus, even though they are difficult of detection, by using the special chart.

The usefulness of the radar chart is again proved by this illustration.

It cannot be denied, however, that insufficient experience has as yet been acquired in the use of the radar chart, or proof that it is other than a means for future experimentation. Our own brief familiarity with the chart has shown that its useful features consist in the representation of land relief, utilization of the diagram and the indication of as many targets as

possible recognized as being radar conspicuous. We have not yet reached any definite conclusions as to symbols that could desirably be used for this purpose. We had thought that all radar targets might be indicated by a different colour, including inland as well as coastal targets, by replotting them in this particular colour according to whether they appear on the PPI. In order that confusion may be avoided, however, only those visible under any and all circumstances should be indicated, with due regard to all types of radar equipment, weather conditions, etc... This would require work of an extremely exacting nature, and could only come as a result of lengthy observations. It is difficult, in any case, to venture an opinion as to whether the representation consequent upon such a task would provide satisfactory results, as radar equipment is subject to peculiarly freakish action and occasionally unaccountable behaviour on several counts.

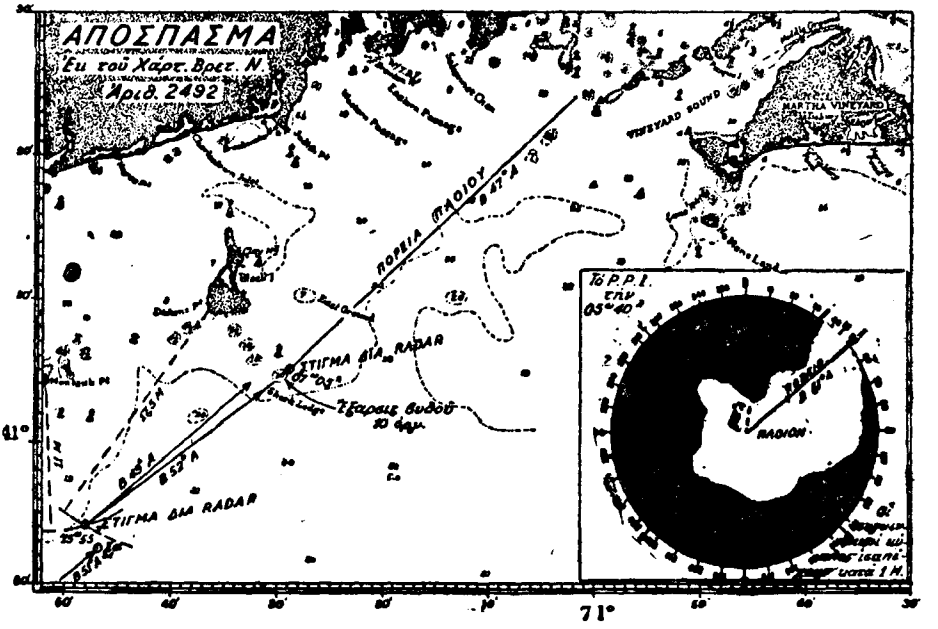

Plate 12

Another case involving serious irregularities due to a cold front is that of a destroyer desiring to make a landfall on the south side of Block Island and needing a radar fix. A storm suddenly arose, blanking out all radar visibility. A large spot appeared on the PPI, covering its centre, that is the position of the ship itself. The destroyer thereupon changed its course, emerging from the cold front area as soon as it could, and then succeeded in obtaining its radar fix. Later it ran into fog. The captain's report here becomes significant, as he states that while navigating in Vineyard Sound he encountered a large freighter that only showed up on the PPI at a distance of 800 metres, or just as it was becoming visible through the fog.

These cases consist of those presenting certain unusual features, and have been selected from among observations carried out by both naval and merchant vessels. Their reports covering other regular uses made of navigational radar thoroughly bear out the general concept that radar, in

view of its possibilities, ease of operation, speed, safety and efficiency, is extremely useful equipment for coastal navigation and landfalls, as well as for the security of the ship.

We hold the belief that the difficulties mentioned, quite apart from their rarity, can be overcome. It may be argued that some are due to the lack of experience necessary in the handling of radar on the part of those using it; but we are of the opinion that these difficulties must be taken into consideration, since they are now prevalent.

We have observed that captains in the Merchant Marine, even those with a great deal of experience, first show a certain amount of distrust when using radar, but this attitude generally disappears after fairly long usage.

In closing, we may be certain that only long years of study and practice will enable conclusions to be reached with regard to radar.