VUES DE CÔTES RADAR (S. F. 1)

Grande échelle : 16.000 yards

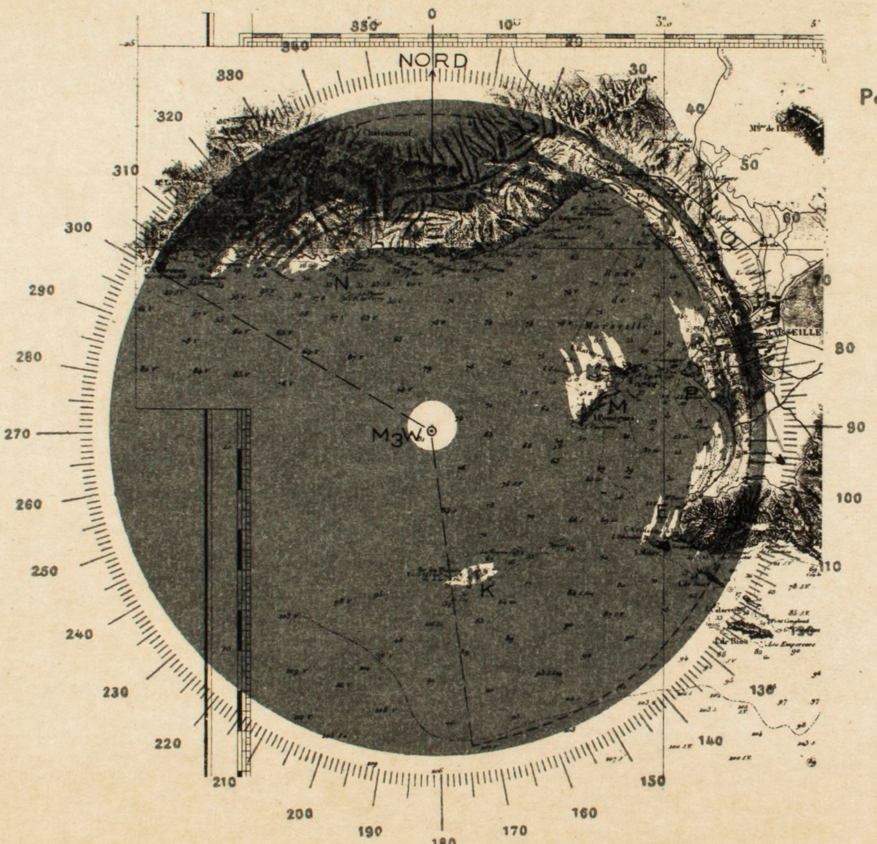
CÔTE SUD DE FRANCE

Zone de Marseille

Position : *M3 w : à 342° et 3,7 milles du Phare du Planier*

LÉGENDE

E. *Marseille Veyre*
K. *Planier*
M. *Pomègues*
N. *Carry*
P. *N.-D. de la Garde*
Q. *Cap Janet*



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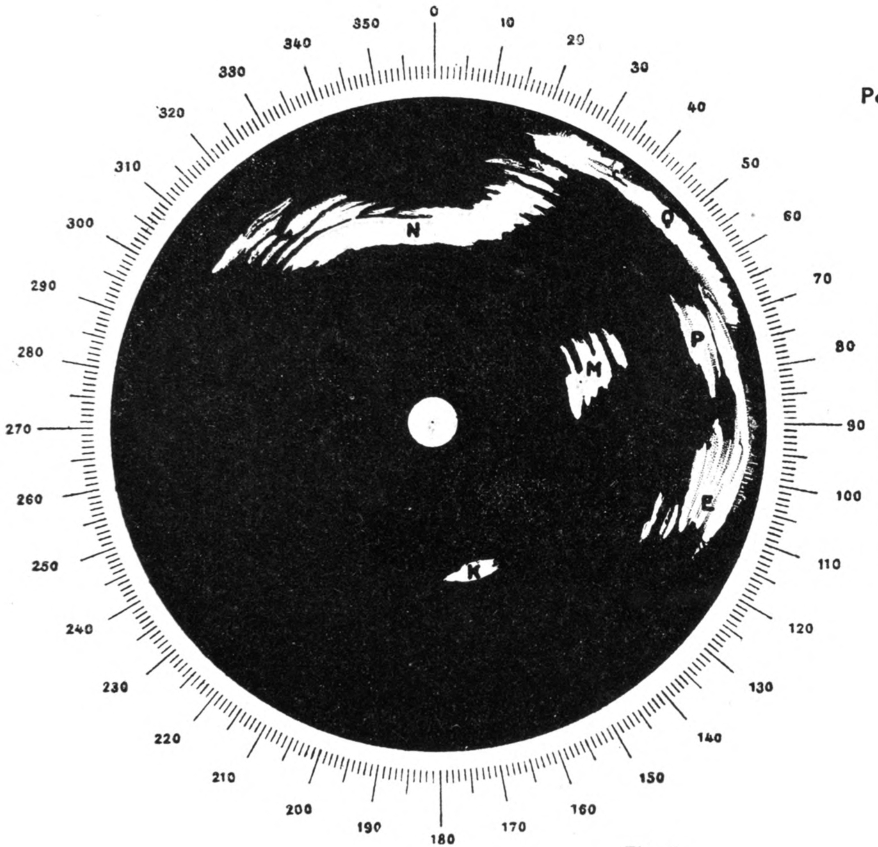

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VUES DE CÔTES RADAR (S.F. 1)

Petite échelle . 48 000 yards

CÔTE SUD DE FRANCE

Axe Est Toulon

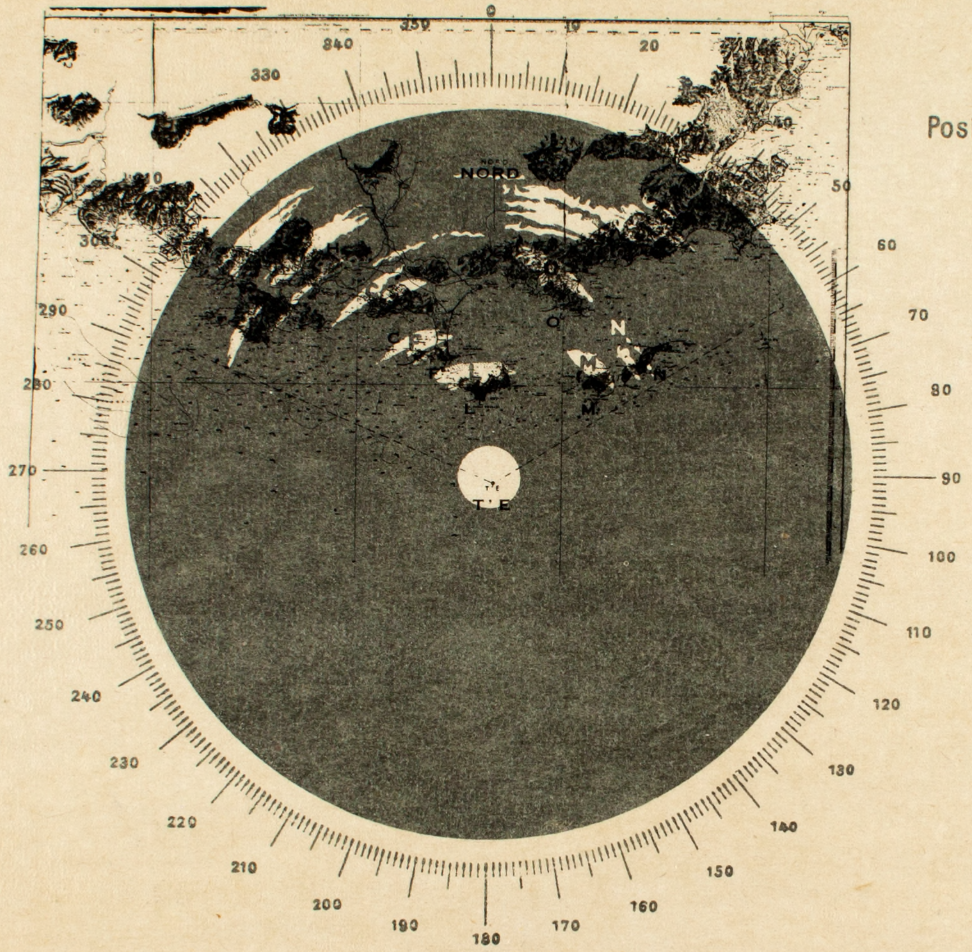


Fig. 2

Position : *T' E : à 172° et 6,1 milles du phare du Cap d'Armes*

LÉGENDE

C. *Colle Noire*

F. *Giens*

H. *Faron*

L. *Porquerolles*

M. *Port Cros*

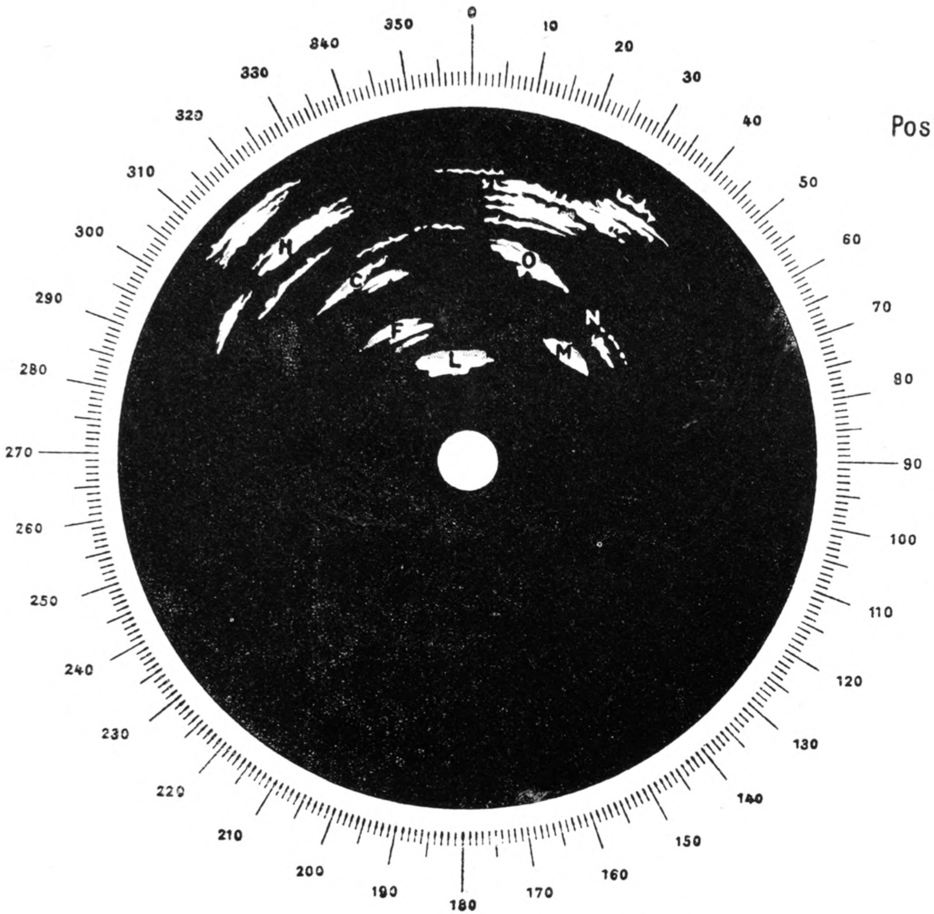
N. *Ile du Levant*

VUES DE CÔTES RADAR (S.F. 1)

Petite échelle . 48.000 yards

CÔTE SUD DE FRANCE

Axe Est Toulon



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Position : *T' E : à 172° et 6,1 milles du phare du Cap d'Armes*

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LANDSCAPE DETECTION BY MEANS OF RADAR

Summary of and Extracts from an article entitled :
Carnets de détection panoramique « Une nouvelle représentation des côtes »
(*Folios of panoramic detection* « New figuration of the Coasts »),
by Professor in Chief of Hydrography P. HUGON :
La Revue Maritime, No. 20, Paris, December, 1947, pages 675-702.

If radar were similar to a television objective instrument, it would offer on its screen the appearance of the landscape well-known to the mariner in the form of " Views of the Coast " with which the volumes of Sailing Directions are frequently illustrated.

However, the " landscape " produced on the radar screen is quite different from the " landscape or visual panorama ", the latter being formed directly, instantaneously, on the retina and in a very wide field. Radar, on the contrary, sprays the horizon intermittently with centimetric waves by means of a beam, the horizontal aperture of which does not exceed a few degrees, rotating around the vertical axis of its stand at comparatively low velocity of the order of 20 revolutions per minute, just sufficient for maintaining on its screen the remanent of the successive appearances of the reacting target; so that an obstacle offering a surface favourable to reflexion will appear on the screen only if it is bombarded by a sufficient number of pulses and so that, if the pulses occasionally miss their target, certain parts of the obstacle might escape detection.

It may even happen that for each successive round of the horizon, some of the targets may alternately appear and disappear as a consequence of the very slow changes in sweeping velocity or because of the ship's rolling.

This discontinuance in the sweeping and, to a still greater extent, the limits of sensitiveness of the fluorescent layer on the screen cause the forms of the target to be in general different from those to which the eye is accustomed. The image of any single spot target is not a point but always a small smudge. This inaccuracy diminishes more and more with high-grade definition radars.

The general appearance of the radar image depends on the reflecting power of the surface swept, on its extent, on its inclination (slope) and on its very nature: metallic surfaces, constructions in reinforced cement, and probably soil with ores content, have proved to be good reflectors. Further, experiments made in June, 1946, in the Norwegian fjords and along the coast between Stavanger and Bergen by the British Man-o'-war *Fleetwood,* have proved that irregular rocky surfaces show a great absorption, while coasts with scattered smooth-surfaced constructions such as houses, breakwaters or storehouses, provide very good echoes. On the other hand, detection of wooded surfaces or of surfaces covered with luxurious vegetation is generally poor.

Without entering into abstract considerations, it seems that the normal reflexion is that which provides the better result. Now, the incident beam striking the obstacle in the vicinity of the sea in subject to a " grazing " incidence, either by direct impulse or resulting from a reflexion almost " grazing " the surface of the sea.

If it is a question of obtaining an image of the coast, it is therefore a priori evident that the coastal line will not be obtained in every case, the coast being either low or gently sloping, in which cases a large proportion of the beam is reflected upwards and so misses the receiver. In the image of a mountain on the panoramic screen, the most clearly-cut spots are obtained from the steep parts of the profile. Consequently, just as for the image of the coast, it is not from the material mass of the visual target that the appearance of its physionomy on the screen is given, but uniquely from the steepest parts of the target profile. Therefore, an unbroken mountain mass will appear on the screen in the form of successive islets representing the images of the steepest slopes.

With given dimensions of the antenna, the value of the wave-length used will determine the horizontal and vertical aperture of the beam. As soon as the horizontal aperture has a certain value, the definition of the bearing on the image becomes weak and appears on the screen in the form of a dash drawn-out laterally. In the S.F.I. radar, the beam aperture of which is 12°, this effect renders the coastal line and the profile of the cliffs unrecognisable when compared with the visual appearance or with the figuration on the chart.

This radar instrument transmits " pulses " of 1 microsecond and consequently does not separate targets situated less than 150 metres apart on the same bearing: as a result the latter will appear on the screen in the form of a single spot extended in a radial direction. The image obtained, therefore, depends on the system of radar instrument used, on its power of definition, briefly speaking on a kind of " visual acumen " resulting from a more or less developed or possible improvement in the detector-recorder unit used.

Radar Charts :

The faithfulness of the images obtained with modern navigational radars is such that the comparison of the screen with the navigational chart is always possible. With 3 cm. wave-lengths, horizontal apertures of the beam of the order of the degree, and with pulse lengths of 0.25 MS, the lateral circular deformations are much reduced; the spot representing a " dot " obstacle is altered particularly in the radial direction, which does not render the coastline unrecognisable.

However, it has not yet been possible to evolve any ideal solution for the radar chart; this should lead to the direct superposition of the P.P.I. images with the lines drawn on the chart, by a system of optical projection. Apart from the feeble luminosity of the P.P.I., which scarcely lends itself to this kind of projection, the principal stumbling-block continues to be the inaccuracy of the coastline which latter, in spite of improvements in the instrument, is still not apparent. It would also be necessary to show on those charts the limits of the spots produced by the relief or isolated reflectors. We come rapidly, then, to the necessity for a special chart duplicating the standard representation delivered to the mariner, in order to avoid the overcrowding of a document already much encumbered.

It seems that it is by means of drawing numerous contours of the coastal and inland relief that radar images may be rendered more clearly-defined, and already a better representation may be had by the use of the French coastal charts issued by the National Geographical Institute in the series of " Etat-Major " maps on which a preponderant part is assigned to relief.

Radar views of the Coast (Carnets de détection panoramique) :

Towards the end of February, 1947, the French Hydrographic Service made a systematic examination of the coasts along the French littoral with a view to obtaining characteristic images from S.F.I. radar.

The stations were made on board escort-vessels coming from seaward along standard landfall routes leading to the port or in the vicinity of the coast in order that soundings might also provide a valuable means of checking.

A standard S.F.I. radar screen was photographed at each station. The results obtained (see fig. 1-2, pages 10-11) are not of course of an accuracy which can be compared with that which would have been furnished by a modern radar instrument specially designed for navigation. In particular, the inaccuracy in bearing definition of S.F.I. radar instruments contributes towards altering the shape and confusing the images; at the same time, however, the latter remain an efficient aid since at the same place the appearances reproduce themselves, identical.

On the completion of this examination, the French Hydrographic Service drew up for the use of vessels fitted with S.F.I. radar, its *Ouvrage n° 13-951 — Carnets de détection panoramique*. These folios, drawn up for the different landfall areas or channels, contain in the first place a plain outline index chart showing, when coming from seaward, the position of the different stations where radar views have been obtained, with indication of the principal reflecting targets; in the second place, a numbered series of photographs showing the successive appearances as given by the P.P.I. for the different view-points along the channel. The latter are selected in such a way that the successive static appearances leave no doubt concerning the divergence of position from one view to the next.

Stations made using the small-scale image (48,000 yards) cover an uninterrupted chain situated approximately ten miles distant from the coast and covering the landfall area. They consist generally of one station only along each axis and are intended only for *making the contact*, experience having proved that at greater distances the radar " landscapes " offer but slight differences.

In order to facilitate the *approach*, a succession of large-scale stations (16,000 yards) were distributed along each leading axis at distances apart of from one to three miles according to the "cinematic" qualities of the landscape.

In conclusion, attention is invited to the fact that the images obtained on the screen generally differ from the shoreline contours and even from those of the visual relief. They are chiefly in relation to the reflecting power proper to the various obstacles or targets and no endeavour should be made to obtain systematically a similarity with the chart.

As might be expected, tides have an influence on the appearances of the radar landscape and this also should be taken into account by the mariner.

Moreover, the various objectives, in order to be radar conspicuous following on their reflecting power for centimetric waves, should be able to throw back towards the transmitter-receiver antenna, the waves according to bearing and elevation. It has therefore become customary to fit certain buoys situated at the entrance to landfall channels with tetraedrical surfaces, or pentagonals known as "corner reflectors" assuring the return, after total reflexion, of the incident beam of rays. This would lead to fitting the cylindrical surface of lighthouse towers and beacons, for instance, with a kind of prismatic fluting having vertical generatrix in order to obtain an almost complete reflexion of incident radar rays, while, in order to render a buoy undetectable by means of radar, it is sufficient to give the buoy a very-much-sloping conical form assuring the upward reflexion of the incident rays.

Experiments carried out along the coasts of Brittany gave the following average results for ranges of detection by means of S.F.I. of the various radar-conspicuous targets :

Lighthouses	11 to 16 miles
Beacons	5 to 8 —
Buoys	3 to 5 —