CONTROL OF EXPERIMENTAL DECCA CHAIN NO. 4 (SOUTHERN FRANCE) AND POSSIBILITIES OF MARINE USE OFF MEDITERRANEAN COAST

by P. HUGON

The results of observations carried out between 11 January and 8 February 1956 by the *Cyclamen* off the Mediterranean coast, in order to check the stability, accuracy and repeatability of daylight indications supplied by Experimental Decca Chain No. 4 (Southern France), are submitted below and analysed from the aspect of marine use.

EQUIPMENT USED

Steps were taken to obtain two separate sets supplying Decca readings in order that they might exercise a mutual check on each other. On 11 January, the verification of a MARK V set of British manufacture showed that the Chain 4 crystals were not included. On 12 January, a special survey receiver set No. 374 (DRANOR) was installed on board the vessel berthed at Quai Noel, Toulon, and a series of tests from a fixed position were carried out on mooring-buoy No. 3 in the sheltered roadstead, resulting in an initial satisfactory stability check. A series of tests was moreover carried out at various headings with regard to the insulation of the aerial, and to interaction effects of the other aerials and parasitic reflectors. The grounding of such actual or parasitic aerials resulted in but insignificant differences in the readings, and the effect of heading or direction was likewise negligible following swings of the ship around the buoy.

On 13 January, a series of preliminary measurements were taken under average weather conditions on the outskirts of Toulon Roads. These operations were interrupted between 20 and 25 January in order to provide for the installation of the MARK V equipment following the addition of the required Chain 4 crystals and necessary adjustments.

On 26 January, both the DRANOR and MARK V receivers were working together satisfactorily at the Toulon quayside. A normal average difference of 3 hundredths was recorded as between the readings of the two sets.

The adjustment of the MARK V receiver equipped with the normal identification system enabled the regular operation of the identification signals to be tested. The DRANOR receiver, equipped with an attenuator circuit for these signals, reacted during passage of the Green channel identification signals by a blinking of the « Alarm » light, and by pulses of a few hundredths' amplitude in the Red and Purple decometers. With the ship under way, in the case of narrow passes and certain positions of the hundredths-needle in the centre section of a quadrant, the DRANOR indicator readings might, as a result of such pulses, be subjected upon passage of the identification signals to abrupt shifts of half a lane, and introduce an error of a whole lane. This difficulty was easily overcome by means of the MARK V identification, and both sets were in constant and simultaneous use during the entire series of the observations that followed.

Heures	ROUGE				VIOLET				ROUGE				VIOLET			
	Références	Tests	Lectures	Corrections	Références	Tests	Lectures	Corrections	Références	Tests	Lectures	Corrections	Références	Tests	Lectures	Corrections
9H.15	0	16	A 07 26	+4	0	18	D 60 61	-40	0	22	A 07 21	+9	0	24	D 60 55	-34
30	0		07 28	+ 2	0		60 71	- 50	0		07 23	+ 7	0		60 62	- 41
45	0		07 28	+ 2	0		60 72	- 51	0		07 23	+ 7			60 62	- 41
10h.00	0	15	07 28	+ 2	0	18	60 72	- 51	0	23	07 23	+ 7	4	22	60 64	- 43
15	0		07 28	+ 2	0		60 71	- 50	0		07 23	+ 7			60 65	- 44
30	0		07 29	+ 1	0		60 70	- 49	0		07 24	+ 6	0		60 62	- 41
45	0		07 28	+ 2	0		60 68	- 47	0		07 23	+ 7			60 61	- 40
11h.00	0	16	07 28	+ 2	0	18	60 69	- 47	0	23	07 23	+ 7	0	22	60 62	- 41
15	0		07 28	+ 2	0		60 69	- 47	0		07 22	+ 8			60 62	- 41
30	0		07 28	+ 2	0		60 69	- 47	0		07 22	+ 8	0		60 62	- 41
45	0		07 26	+ 4	0		60 70	- 49	0		07 21	+ 9			60 63	- 42
12h.00	0	16	07 26	+ 4	0	18	60 70	- 49	0	23	07 20	+10	0	22	60 63	- 42
15	0		07 27	+ 3	0		60 70	- 49	0		07 21	+ 9	0		60 63	- 42
30	0		07 27	+ 3	0		60 71	- 50	0		07 21	+ 9	0		60 64	- 43
45	0		07 28	+ 2	0		60 71	- 50	0		07 22	+ 8	0		60 64	- 43
13h.00	0	15	07 26	+ 4	0	18	60 71	- 50	0	23	07 21	+ 9	0	22	60 64	- 43
15	0		07 27	+ 3	0		60 71	- 50	0		07 21	+ 9	2		60 63	- 42
30	0		07 26	+ 4	0		60 70	- 49	0		07 22	+ 8	1		60 64	- 43
45	0		07 27	+ 3	0		60 71	- 49	0		07 23	+ 7			60 65	- 44
14h.00	0	16	07 27	+ 3	0	18	60 73	- 52	0	22	07 24	+ 6	0	22	60 66	- 45
15	0		07 26	+ 4	0		60 73	- 52	0		07 23	+ 7			60 66	- 45
30	0		07 28	+ 2	0		60 72	- 51	0		07 24	+ 6	0		60 65	- 44
45	0		07 26	+ 4	0		60 72	- 51	0		07 23	+ 7			60 65	- 44
15h.00	0	16	07 26	+ 4	0	17	60 73	- 52	0	23	07 22	+ 8	1	21	60 65	- 44
15	0		07 26	+ 4	0		60 74	- 53	0		07 22	+ 8			60 67	- 46
30	0		07 25	+ 5	0		60 73	- 53	0		07 21	+ 9	0		60 63	- 42
45	0		07 25	+ 5	0		60 77	- 56	0		07 20	+10			60 70	- 59
16h.00	0	16	07 24	+ 6	0	18	60 77	- 56	0	20	07 20	+10	0	21	60 70	- 59
15	0		07 25	+ 5	0		60 76	- 55	0		07 20	+10			60 69	- 48
30	0		07 26	+ 4	0		60 74	- 53	0		07 21	+ 9	0		60 68	- 47
45	0		07 29	+ 1	0		60 66	- 45	0		07 25	+ 5			60 61	- 40
17h.00	0	16	A 07 31	- 1	0	18	D 60 64	- 43	0	21	A 07 26	+ 4	0	20	D 60 59	- 39
	Récepteur DRANCR 374								Récepteur M.K.V.							

Decca readings (day) at Toulon. *Table* 1.

26 Janvier 1956

COURBE DE STABILITE DE JOUR

Quai NOËL à TOULON

Lat. 43° 07'00" N.
Long. 05°54'55" E.

Coordonnées DECCA { ROUGE : A.07.30 / VIOLET : D.60.21

GRAPHIQUE 1

The two receivers were connected to two independent aerials some distance apart: the DRANOR aerial was of the telescopic whip type, and about 9 metres in length; and the MARK V aerial was of the single-wire type. Special groundings were devised on the armatures.

MONITOR CONTROL

The control of general performance at the selected fixed point and at sea was carried out by making contact at the end of the day with the chain's monitor station, located at Castries, near Montpellier. Chain No. 4 operated continuously on a twenty-four hour basis, and the monitor readings occurred at three-minute intervals. It was therefore possible to compare the monitor records with the ship readings. This enabled to some extent (no assumptions being made as to correlation), the discrepancies affecting both the ship and monitor observations to be separated from those affecting the ship readings alone and which may be attributed to the effect of the reflected wave.

FIXED POINT CONTROL

Continuous records of the two Purple and Red Decometer sets of readings were made whenever the ship was in a fixed position. It should be noted that according to the diagrams of DORPH-PETERSEN, the interval at this time of year during which night effect may be considered as negligible is greatly reduced. Actually, the maximum interval in which the observations could be regarded as being theoretically free from reflected wave effect, conventionally assumed as lasting from one hour after sunrise to one hour before sunset, did not on the average extend beyond the period between 0900 and 1630 hours. Such effects, however, which affected the synchronization path along the baselines, were mainly noticeable in the Purple pattern by 1430 hours, and were characterized by more or less permanent reading discrepancies amounting to 8-10 hundredths.

The table and graph No. 1 are examples of average daytime stability at this season, shown in the form of the successive readings and their differences during the day of 26 January at Quai Noel, Toulon. Maximum differences are of the order of 4 to 5 hundreths on the Red pattern and 8 to 10 hundredths in the Purple pattern.

The reduction of 22 readings on mooring-buoy No. 3 in the sheltered roadstead shows differences of 4 and 7 hundredths respectively for the same patterns. 12 readings taken on a buoy at Carqueiranne show differences of 6 and 8 hundredths. At the same time, the maximum discrepancies recorded at the Monitor station were respectively 6 and 9, 4 and 7, 3 and 8, i.e. entirely comparable in value.

Table No. 1 also supplies an idea as tho the similarity in readings in both sets, in which differences remained stabilized around 3 to 4 hundredths on the Red and 5 to 6 hundredths on the Purple set.

PROCEDURE USED

(a) *Readings.* The purpose of the operation was to determine the repeatability and accuracy of the Decca lattice in sight of land, i.e. to ascertain the corrections applicable to the readings in order to obtain the precomputed or temporarily plotted theoretical Decca coordinates. The procedure used was as follows:

Upon a signal being given by the observers taking sights by hydrographic circle, with the ship stopped along a hyperbola in the vicinity of the station prescribed, the DRANOR and MARK V indicators were read off simultaneously. (Before each set of observations and particularly in the Toulon area, a series of fixed-point readings enabled a check to be made of receiver operation. A new check was made upon return to the ship's berth).

References were checked every 30 minutes by the goniometer of the DRANOR receiver and on the indicators. No abnormal drift was noted during the three weeks of operation.

Approximately 80 stations were occupied in sight of land off the Mediterranean coast. The uncertain weather, characterized by frequent rain and squalls, and by the appearance of cold and snow during the latter stage of operations, prevented the ship from proceeding beyond a low seasonal limit of visibility. Almost all the stations are consequently affected by considerable local deviations, which are characteristics of the particular coastal area and are due to the crossing of an extremely irregular and jagged mountainous coast, especially in the eastern part of the Gulf.

The more distant stations (S) required to be occupied gave more trouble. Although few in number, analysis enabled residual corrections to be definitely stabilized beyond ranges approximately 10 to 15 miles offshore.

Each station was subjected to a minimum of three observations, but no opportunity was neglected to return to the stations at different times and on different days in order to test system repeatability. The number of observations carried out in narrow waters and in Toulon Roads, for instance, was higher.

(b) *Control of position.* At each « mark » the station was checked by three simultaneous measurements by hydrographic circle. Due to often limited visibility, to unavoidable deck and ship movements, the final uncertainty as to the observed postion should not be estimated as less than 20 metres. The procedure involving the use of land-based theodolites following the ship should be made compulsory, if it is desired to obtain a maximum accuracy check of systems supplying readings to within one-hundredth of a lane, since such accuracy, as in the Red and Purple patterns of the present chain, may fall below 1,000 metres.

(c) *Utilization.* The stations were plotted on Charts 2358, 2454, 2681, 2682 and 5477 to scales reaching $1/50 \times 103$.

The theoretical Decca coordinates were obtained in two ways:

(1) From Admiralty Chart No. 2608, scale 1 : 73,000, overprinted with the Red and Purple patterns;

(2) By means of a precomputed table supplying the theoretical values for each station: Decca coordinates, direction of nearest hyperbola, and lanewidth. The locus of the ship was thus determined according to the most probable position method, either by a large-scale graph or on a nautical chart. The velocities of propagation selected in computing the table were the following:

— Red pattern: 299,290 km./s;

— Purple pattern: 299,750 km./s.

The error due to plotting may be assumed not to exceed 20-30 metres. It should however be noted that the corrections deriving from such theoretical diagrams of course contain an error due to lack of conformity of the actual velocity of propagation value.

ANALYSIS OF OBSERVATIONS

The main result of the operation was to adopt a mean value of the most likely correction for each station, with due regard to the number and insofar as possible to the value of the observations carried out.

The fact that the number of observations was relatively small and that there was no uniformity of control ashore between one station and the next excluded the use of the least squares method, left in the field clear for a certain amount of adjustment.

The systematic range of such corrections could moreover only be defined to within a value equivalent to the uncertainty resulting from the various causes of random error expressed in terms of metres.

Thus in the zones where the lanewidth did not exceed 1,000 metres, the correction could only be given to within 5 hundredths of a lane; and where the Purple lanes were approximately 400 metres wide, the correction could only be obtained to within 10 hundredths, on the basis of the presently available facilities for observation and analysis.

In view of the fact that the correction inshore varies rapidly and changes unpredictably over slightly different paths, the final choice should not be based on a false assumption as to continuity.

However, as regards the group of stations occupied off the Iles Sanguinaires and Corsica, the corrections should be appreciably constant owing to the similarity of wave paths over the sea.

CHARACTERISTICS AND POSSIBILITIES OF CHAIN 4 (Plates 1 and 2)

The characteristics of Decca Chain No. 4, which was set up in Southern France for experimental purposes, are as follows:

Position	Master Station	Red Slave	Green Slave	Purple Slave
	Restinclières (Hérault) near Montpellier	Manne (B.-Alpes) near Forcalquier	Aurillac (Cantal)	St-Cyprien (Pyr.-Or.) near Perpignan
Latitude	43°43'01" N	43°54'46" N	44°58'09" N	42°37'00" N
Longitude	4°02'02" E	5°46'00" E	2°22'48" E	3°01'22" E
Frequency	6 f=84.820 Kc/s			
Comparison wavelength		441.066 m.	587.714 m.	353.395 m.
Baseline		114.102 km.	191.719 km.	147.314 km.

This arrangement should enable the Red and Purple patterns of the chain to supply, throughout the Gulf of Lions, a high rate of graphic accuracy, over

and above that required for navigational purposes up to the parallel of the Balearic Islands, and at an adequate level south of this parallel (Plate 2). Owing to the lack of checking facilities out of sight of land, however, the scope of the *Cyclamen's* assignment did not include accuracy tests at sea and was restricted to checks, within sight of and in contact with the shore, regarding discrepancies between readings and indications of a roughly computed theoretical pattern. Aside from checks off Corsica and the Balearic Islands, only coastal checks were possible, and in addition to giving evidence of remarkable repeatability, these emphasized both the discontinuous and stable aspect of local corrections, knowledge of which enables the position to be fixed with accuracy.

No. of fix	Positions	Appr. distances in km.			Angle of cut of hyperb.	Red Lane (in m.)	Purple Lane (in m.)	
		Master	Red Slave	Purple Slave				
1	43°04'33"N 5°59'32"E	170	95	250	45°	970	1153	Toulon Roads.
42	43°19'32"N 6°46'30"E	230	112	320	26°	1888	1621	From Baie de Cavalaire to Cap d'Antibes.
50	43°39'15"N 7°22'30"E	265	153	363	15°	4851	2123	From Cap d'Antibes to Cap Martin.
10	43°13'53"N 5°05'25"E	105	95	187	73°.5	608	779	From Cap Sicie to Golfe des Saintes-Maries.
16	43°24'34"N 4°13'38"E	33	142	130	98°.3	625	440	do.
21	43°20'26"N 3°41'40"E	48	175	95	106°.9	1454	353	From Golfe des Saintes - Maries to Cap Creux.
26	42°57'55"N 3°10'40"E	100	228	42	67°.9	2212	360	do.

The positions of 81 stations close to the mainland were those adopted by the *Vigilant* for testing Chain No. 8. The choice was based on limits of visibility, land-approach conditions, and to a certain extent coastal relief.

In addition to such stations located inshore, 6 sets of observations were carried out in an area within sight of land located southwest of the Iles Sanguinaires lighthouse, at the entrance of Ajaccio Bay. These stations, numbered from 1C to 6C, showed the following average characteristics:

No. of fix.	Positions	Master	Red Slave	Purple Slave	Angle of cut of hyperb.	Red Lane (in m.)	Purple Lane (in m.)
1 C	41°45'31"N 8°35'17"E	419	320	460	16°,7	3333	2234

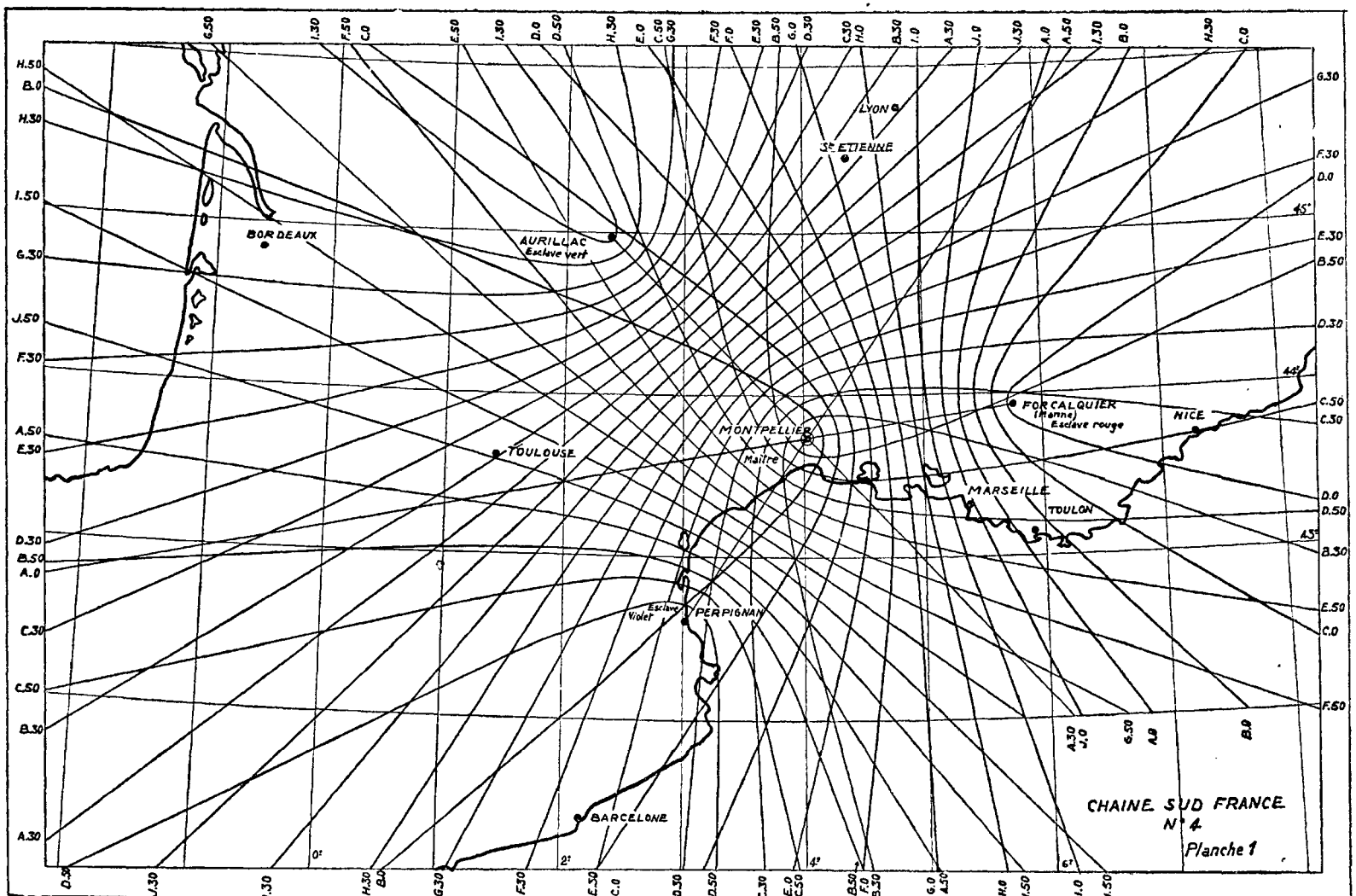
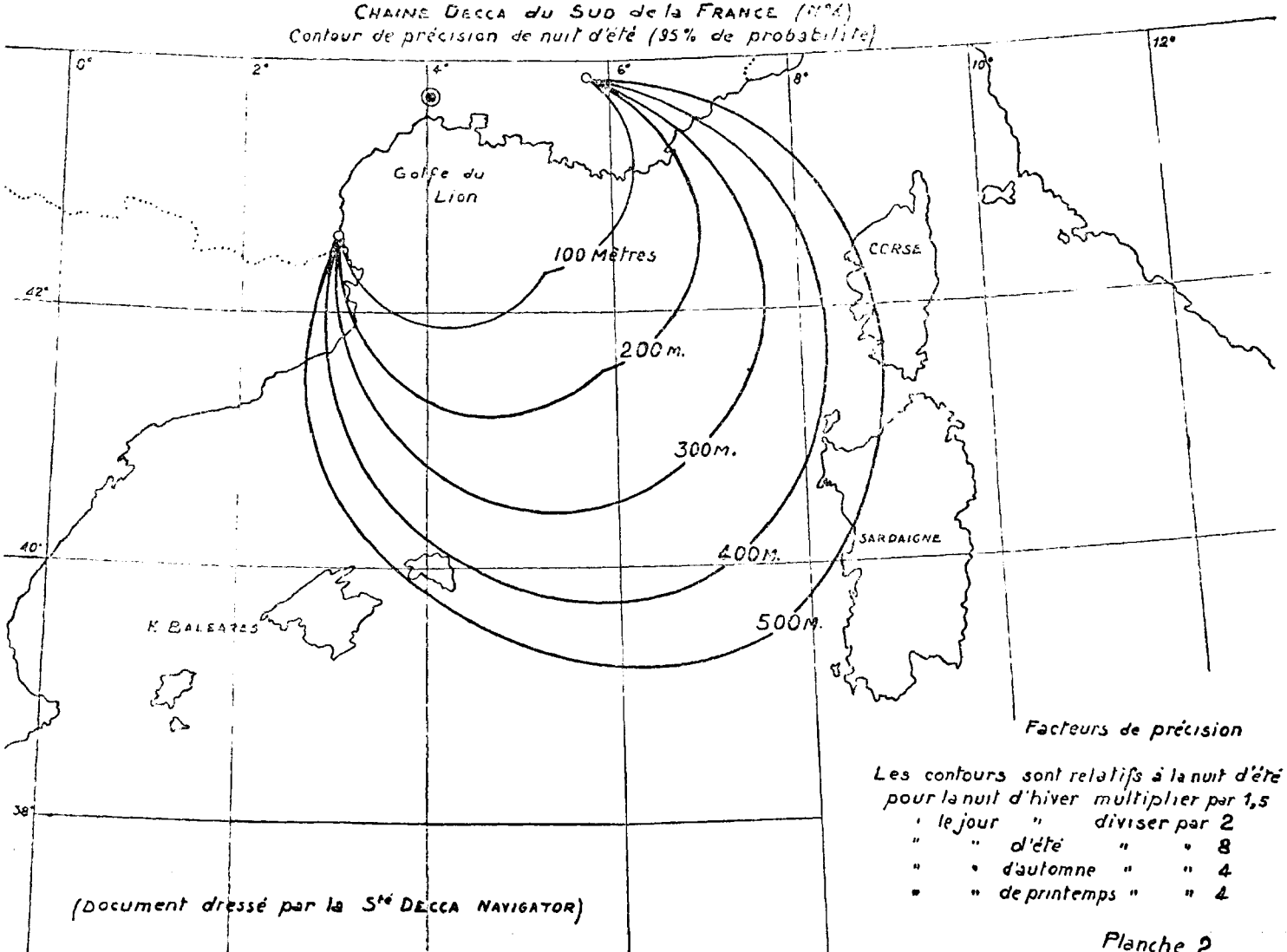

BORDEAUX
AURILLAC
Esclave vert
LYON
St ETIENNE
FORCALQUIER
(Manne)
Esclave rouge
NICE
MONTPELLIER
Maître
TOULOUSE
MARSEILLE
TOULON
Esclave
Violet
PERPIGNAN
BARCELONE
CHAINE SUD FRANCE
N° 4
Planche 1

Plate 1.

CHAINE DECCA du SUD de la FRANCE (N°4)

Contour de précision de nuit d'été (95% de probabilité)



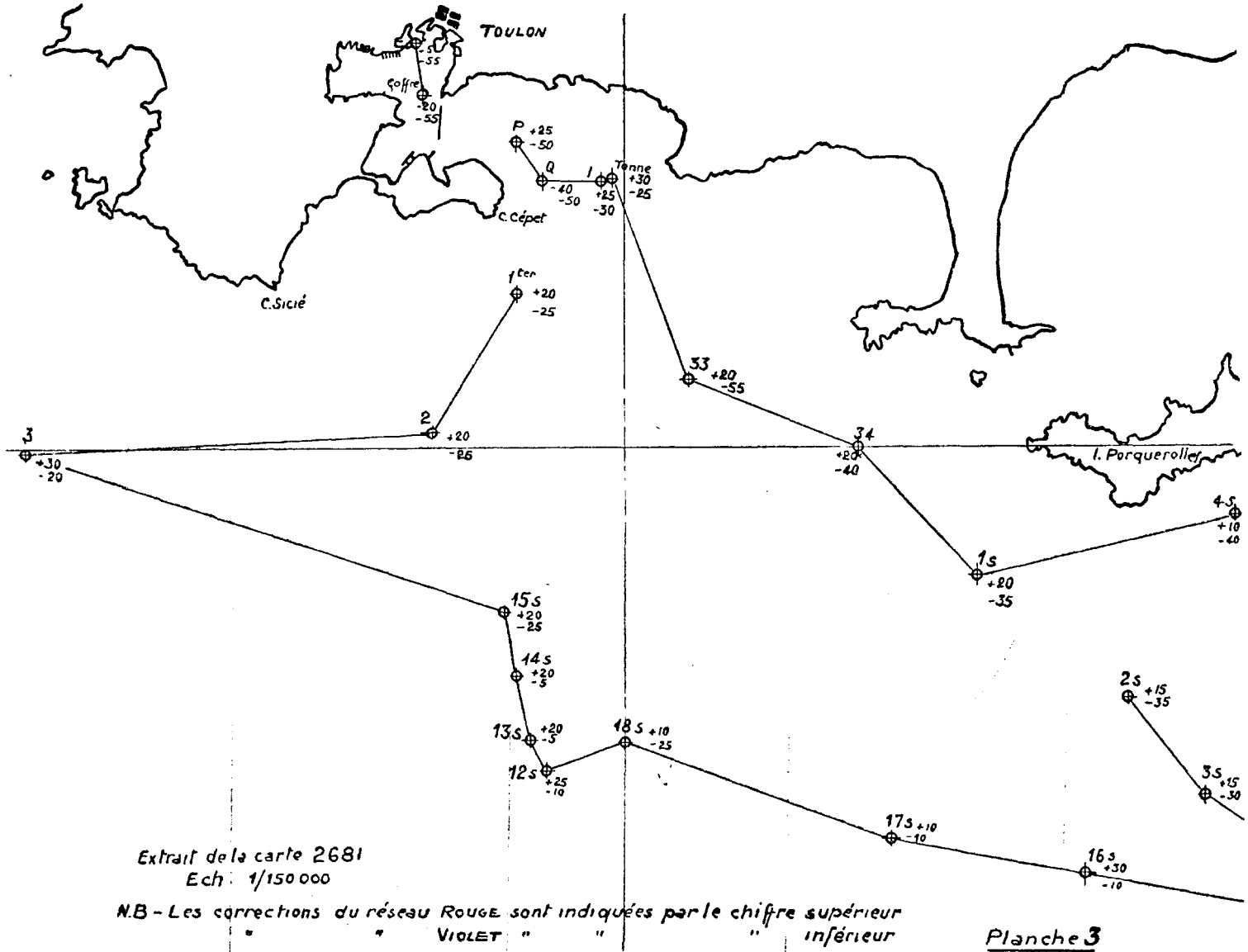
(Document dressé par la Sté DECCA NAVIGATOR)

Facteurs de précision

Les contours sont relatifs à la nuit d'été
pour la nuit d'hiver multiplier par 1,5
" le jour " diviser par 2
" " d'été " " 8
" " d'automne " " 4
" " de printemps " " 4

Planche 2

Plate 2.



Extrait de la carte 2681
Ech : 1/150 000

N.B - Les corrections du réseau ROUGE sont indiquées par le chiffre supérieur
" " VIOLET " " " inférieur

Planche 3

Plate 3.

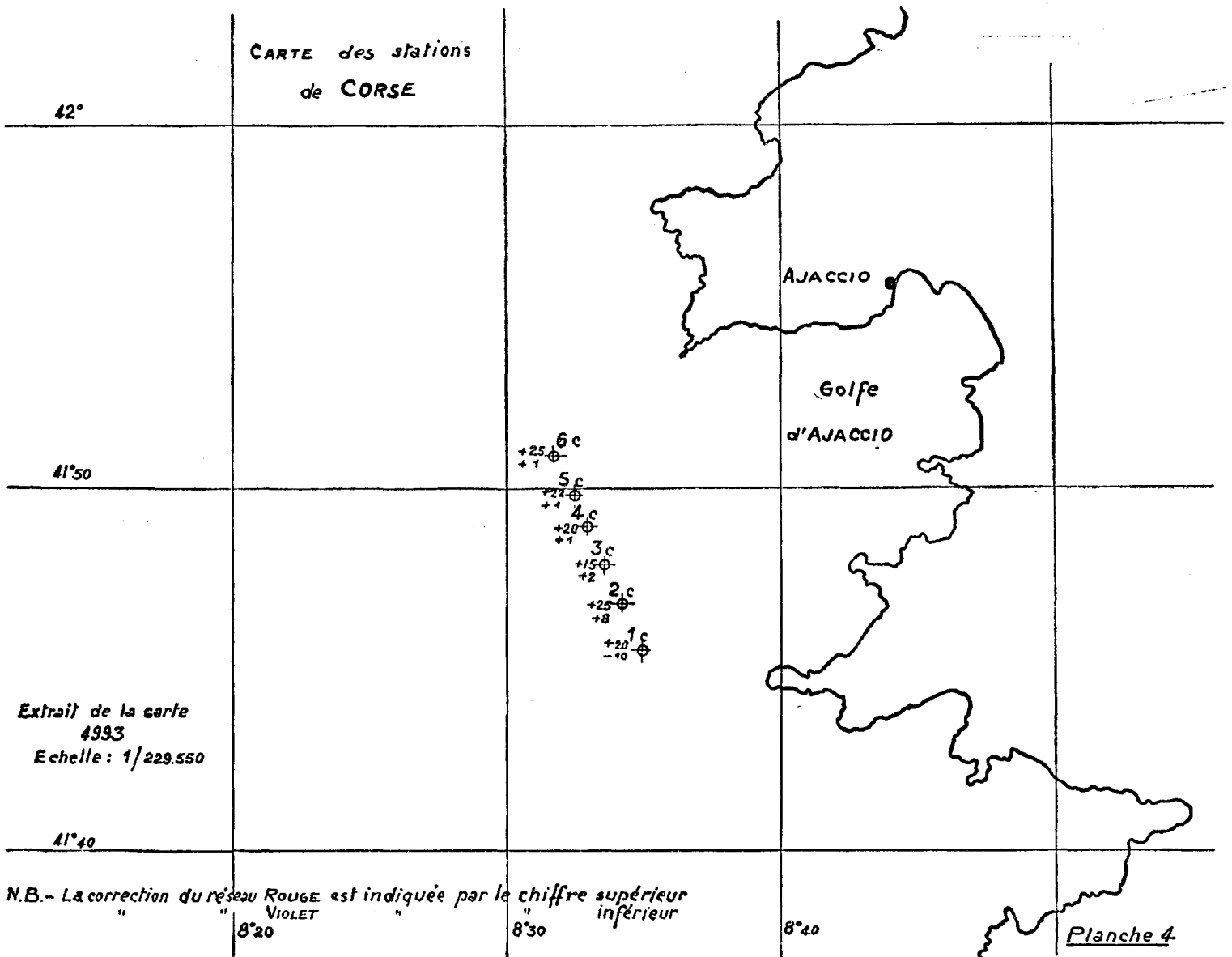

CARTE des stations de CORSE
42°
41°50
41°40
8°20
8°30
8°40
AJACCIO
Golfe d'AJACCIO
6 c
+25
+1
5 c
+22
+1
4 c
+20
+1
3 c
+15
+2
2 c
+25
+8
1 c
+20
−10
Extrait de la carte 4993
Echelle : 1/229.550
N.B.– La correction du réseau ROUGE est indiquée par le chiffre supérieur
" " VIOLET " " inférieur
Planche 4.

Plate 4.

The paths of the Master and Purple Slave signals were located almost entirely over water. Only one-third of the Red Slave signal path was over land, but slave-control transmissions along the baselines were invariably over land owing to the siting of the transmitters.

An examination of the preceding tables shows that geometrical accuracy is highest in the areas between stations 10 and 16, from La Ciotat to Golfe d'Aigues-Mortes, both as regards the angle of cut of the hyperbolae and lanewidth. It is lower east of Toulon, and decreases east of Cap d'Antibes, near the Red baseline.

In the area of Toulon and the salt-flats of Hyères, the application of corrections to within 5 hundredths limits uncertainty to about 60 metres. This amount might be decreased by using more accurate visual control methods and special large-scale plotting charts.

West of the Gulf of Lions, the theoretical accuracy of the Purple pattern was considerable and amply fulfilled measurement and operational requirements, since the width of one-hundredth of a lane here amounts to less than 4 metres.

ANALYSIS OF OBSERVATIONS AND MEASUREMENTS

Table 2 shows the average corrections adopted to within 5 or 10 hundredths and used systematically following adjustment for the 81 station positions. Any systematic behaviour is difficult to detect, since discrepancies are mainly attributable to crossing the coast, yet the Purple pattern appears to show, with regard to overall measurements and throughout the extensive area subjected to investigation, a systematic difference of an extra half-lane. This discrepancy is too large to be attributed to the inaccuracy of the velocity of propagation figure used in the computations, nor does it appear to arise from a difference in the Purple lane-count along the baseline. This lane-count was checked by a plane flying at low speed along the Purple baseline, and found to correspond to within two hundredths with the computed value of 416.853 lanes. A difference of half a lane in the the adjustment of Purple hyperbola A 50.000 at the Master station might be the cause. It is difficult to apportion the effect of scattered relief and that of crossing an extremely jagged coastline. Theoretically, it is possible to prove that in the simple case of a homogeneous path over water for one signal, and a path, however short, over land for the other signal, a relatively sudden change in the velocity of propagation takes place upon crossing the coastline, with a local and appreciable distortion of the equiphase lines. It is moreover immediately realized in this case that the particular zero-phase line — which is a straight line in the theoretical case of a single velocity of propagation — becomes a circle of large diameter when each signal is propagated at a different rate of speed.

Calculation also shows that if the distance of the position is increased offshore, with a rapid decrease in the ratio between the paths travelled by one of the signals over land and water, and with a path travelled entirely over water by the other signal, the equiphase lines become hyperbolic again with a constant correction. It is thus possible to make an approximate prediction of the inshore equiphase lines by using two velocities of propagation : land and sea over both paths.

COASTAL AREA

The table of corrections (Table 2a) drawn up following analysis of the observations shows the lack of consistency of local winter daylight differences in the Red and Purple patterns inshore, i.e. within the limit of visibility which barely exceeded 5 miles. On the other hand, the use of this type of table had the great advantage of enabling the ship's position to be fixed at intervals — even though it does not ensure direct tracking of the ship along a line over the bottom — owing to the constancy in time of such corrections, whose residual uncertainties may be estimated as follows:

(a) A systematic error due to the empirical character of the plotting of the grids. This error would tend to disappear following an improved estimate of the velocity of propagation and readjustment of the grids.

(b) A scattering factor due to the irregular value of observations by hydrographic circle, which is variable according to locality and observation conditions. A mean scatter of about 20 metres may be attributed to this cause, or about 2 hundredths in the Toulon area. This error would disappear if accurate check methods were used.

(c) A scattering factor due to lack of stability of both the Red and Purple patterns. This lack of stability, which varies according to season, the time of day and the solar cycle, may be measured during summer daylight by the maximum difference in twenty-four hours, i.e. 3 hundredths in the Red pattern and 4 to 5 hundredths in the Purple pattern.

(d) An extremely slight scattering factor in the readings of the indicators, i.e. a maximum of one hundredth in the DRANOR receiver, and 2 hundredths in the MARK V receiver. By using a rectified pattern, and assuming the worst summer daylight conditions, the overall corrections in the Toulon area are valid to within 6 hundredths in the Red pattern and 7 hundredths in the Purple pattern, with a DRANOR receiver, i.e. to within approximately 60 m. and 100 m. respectively in the two patterns. Following the amendment of these corrections by accurate and reliable observations, this uncertainty would be reduced to about one-half its present value.

OFFSHORE AREA (Table 2 b)

It is known that depths increase considerably away from the Toulon coastal area. Most of the stations within sight of land were within the one-hundred metre depth limit.

The S-station series, which extended out as far as visibility permitted, confirmed, as in the case of the Chain 8 *Vigilant* observations, the theoretical assumption that corrections became stabilized at lower values than along the coast.

It thus appears that at distances above a ten-mile average offshore, the uncertainty in the positions fixed by Chain 4 now solely depends on progressive and continuous phase shifts with distance, and on instability of the pattern, i.e. is reduced to slight amounts varying by daylight according to the time of year. It also appears that at such distances, maintenance of the ship at a constant Decometer reading actually results in its following a hyperbola of the chart.

TABLEAU 2a

TABLEAU des corrections moyennes observées de jour sur la Chaine 4 (Sud France) avec un récepteur type 374 (DRANOR)

Numéros des stations	Latitude	Longitude	ROUGE		VIOLET		Observations
			Largeur du chenal	Correction	Largeur du chenal	Correction	
Q	43°04'43"	05°58'03"		+ 30		- 50	
1	43°04'43"	05°59'27		+ 25		- 30	
P	43°05'24"	05°57'24"		+ 25		- 50	
2	43°00'15"	05°55'18"		+ 20		- 25	de l'ile des
1 ter	43°02'46"	05°57'28"		+ 20		- 25	EMBIEZ
33	43°01'16"	06°01'42"		+ 20		- 55	à la baie
34	42°59'59"	06°05'38"		+ 20		- 40	de
36	42°56'47"	06°18'42"		+ 15		- 35	CAVALAIRE
36 bis	42°57'37"	06°17'44"		+ 15		- 35	
35	42°55'18"	06°11'24"		+ 10		- 25	
37	43°03'37"	06°20'57"		- 10		- 45	
38	43°06'22"	06°27'45"		+ 10		+ 10	
39	43°03'33"	06°37'45"				+ 35	
40	43°08'08"	06°41'28"		- 30		- 85	
40 bis	43°08'35"	06°40'46"		- 30		+ 35	de la baie de
40 ter	43°08'38"	06°38'42"		- 35		-70	CAVALAIRE
Bouée	43°10'53"	06°42'05"		- 35		- 60	au
41	43°11'00	06°47'42"		- 20		- 55	Cap d'ANTIBES
42	43°14'37"	06°50'53"		+ 5		- 45	
43	43°19'53"	06°48'38"		- 5		- 30	
45	43°24'43"	07°01'54"		+ 5		- 15	
46	43°27'26"	07°03'48"		- 20		- 20	
46 bis	43°26'57"	07°04'06"		- 20		- 20	
47	43°27'28"	07°13'08"		+ 5		- 25	
Bouée	43°33'42"	07°08'47"		+ 10		- 25	
48	43°35'27'	07°13'31"		+ 15		- 25	du Cap d'ANTIBES
49	43°36"47"	07°18'22"		+ 10		- 40	au
50	43°39'21"	07°22'28"		+ 7		- 70	Cap MARTIN
51	43°41'00	07°26'08"		+ 5		- 10	
3	42°59'54"	05°45'23"		+ 30		- 20	
4	43°05'17"	05°39'16"		+ 20		- 20	
4 bis	43°06'44"	05°35'13"		+ 25		- 3	
5	43°05'17"	05°33'13"		+ 20		- 3	du Cap SICIE
6	43°06'01"	05°26'32"		+ 60		- 20	
6 bis	43°07'42"	05°23'57"		+ 35		- 15	au Golfe des
7	43°08'16"	05°19'17"		+ 25		- 10	
8	43°17'38"	05°15'53"		+ 5		- 10	SAINTES-MARIES
10	43°13'50'	05°05'20"		+ 10		- 25	
10 bis	43°14'58"	05°04'27"		+ 5		- 15	
11 bis	43°16'18"	04°58'23"		- 5		- 15	
12	43°16'07"	04°47'49"		+ 5		- 20	
12 bis	43°16'18"	04°46'41"		0		- 20	
13 ter	43°17'16"	04°36'57"		- 5		- 35	

Table 2 a.

TABLEAU 2a (Suite)

TABLEAU des corrections moyennes observées de jour sur la chaine 4 (Sud France) avec un récepteur type 374 (DRANOR)

	Latitude	Longitude	ROUGE		VIOLET		Observations
			Largeur du chenal	Correction	Largeur du chenal	Correction	
14	43°20'27"	04°32'38"		+ 5		- 45	
15 bis	43°23'02"	04°20'07"		- 25		- 35	
15 ter	43°22'31"	04°27'37"					
16	43°24'39"	04°13'14"		- 20		- 25	
17	43°25'37"	04°07'53"		- 40		- 25	du Golfe des
19	43°28'24"	03°56'27"		- 25		- 20	
20	43°21'16"	03°47'38"		- 20		- 30	SAINTES-MARIES
21	43°20'27"	03°41'26"		+ 5		- 20	
22	43°19'41"	03°40'17"		+ 10		- 50	au Cap
23	43°15'19"	03°35'11"		+ 10		- 35	
23 bis	43°15'32"	03°35'47"		+ 10		- 35	de CREUX.
24	43°12'23"	03°30'27"		+ 10		- 70	
26	42°57'33"	03°10'28"		+ 5		- 30	
27	42°49'48"	03°08'31"		- 5		- 40	
28	42°29'50"	03°12'42"		0		- 60	

Table 2 a (cont.).

TABLEAU des corrections moyennes observées de jour sur la Chaine 4 (Sud France) avec un Récepteur type 374 (DRANOR)

TABLEAUX 26 " 2c

Numéros des Stations	Latitude	Longitude	ROUGE Largeur du chenal	ROUGE Corrections	VIOLET Largeur du chenal	VIOLET Corrections
1 C	41°45'29"	08°35'06"		+ 20		- 10
2 C	41°46'56"	08°34'10"		+ 25		+ 8
3 C	41°48'01"	08°33'32"		+ 15		+ 2
4 C	41°48'58"	08°33'03"		+ 20		+ 1
5 C	41°49'58"	08°32'23"		+ 22		+ 1
6 C	41°50'56"	08°31'49"		+ 25		+ 1
1 S	42°57'42"	06°08'34"		+ 20		- 35
2 S	42°55'26"	06°11'50"		+ 15		- 35
3 S	42°53'44"	06°13'51"		+ 15		- 30
4S	42°58'57"	06°14'48"		+ 10		- 40
5 S	42°51'26"	06°16'37"		+ 20		- 35
6 S						
7 S						
8 S						
9 S						
10 S						
11 S						
12 S	42°54'10"	05°57'57"		+ 25		- 10
13 S	42°54'55"	05°57'39"		+ 20		- 5
14 S	42°55'58"	05°57'18"		+ 20		- 5
15 S	42°57'03"	05°57'03"		+ 20		- 25
16 S	42°52'16"	06°11'07"		+ 30		- 10
17 S	42°52'57"	06°06'11"		+ 10		- 10
18 S	42°55'00	06°00'07"		+ 10		- 10

TABLEAU 2c

TABLEAU 2b

Tables 2 b and 2 c.

CORSICA AREA (Table 2c)

The only possibility of determining the value of Decca observations far from the mainland lay in carrying out checks within sight of the coast of Corsica, about 400 km. from the Master station. About twenty such observations were thus taken on 7 February 1956, at the entrance to Ajaccio Bay. In this location, only the Red Slave path involved travel over land amounting to 100 km. out of a total distance of 320 km. The regularity of the Red pattern corrections is evidenced by the observations, and bears witness to the consistency of the definite locus formed by the Red and Purple hyperbolae, where the angle of cut decreased to 16°.

The inconsistency of corrections obtained for the Purple pattern at stations 1 and 2C can only be attributed to reflected wave effects following sunrise.

NIGHT STATIONS (for information purposes)

Two series of observations from a fixed position were carried out at night on 16 and 18 January at Golfe Juan anchorage and in the roads of Salins d'Hyères (Graphs 2 and 3), correcting the observations for swing.

The readings taken at 15-minute intervals for the Red and Purple patterns have been plotted against time on the graphs. Night effect is apparent, and is considerably more in evidence in the Purple pattern than in the Red, where it is limited to less than half a lane. No definite lane-skipping was observed during either of these two nights. The resulting conclusion is that the chain could be used at night for coastal navigation purposes to within an accuracy far in excess of one-half lane.

CONCLUSIONS

Although Experimental Decca Chain No. 4 does not have the characteristics of a chain for sea-going purposes, its Red and Purple patterns nevertheless enable a high rate of navigational accuracy to be achieved throughout the western basin of the Mediterranean beyond a 10-to 15-mile range from the coast, with a constant, single correction over extensive areas.

Within these limits, the stability of the Red and Purple patterns ensures, during daylight and well within the limits of sunrise and sunset, the obtaining of a highly accurate fix of a hydrographic order, provided the extremely variable corrections as between individual points have been determined.

The accuracy of the corrections supplied herewith is limited by winter observation conditions and by the expeditious character of their determination, which could be improved considerably by methodic and more specialized operations.

COURBE DE STABILITE

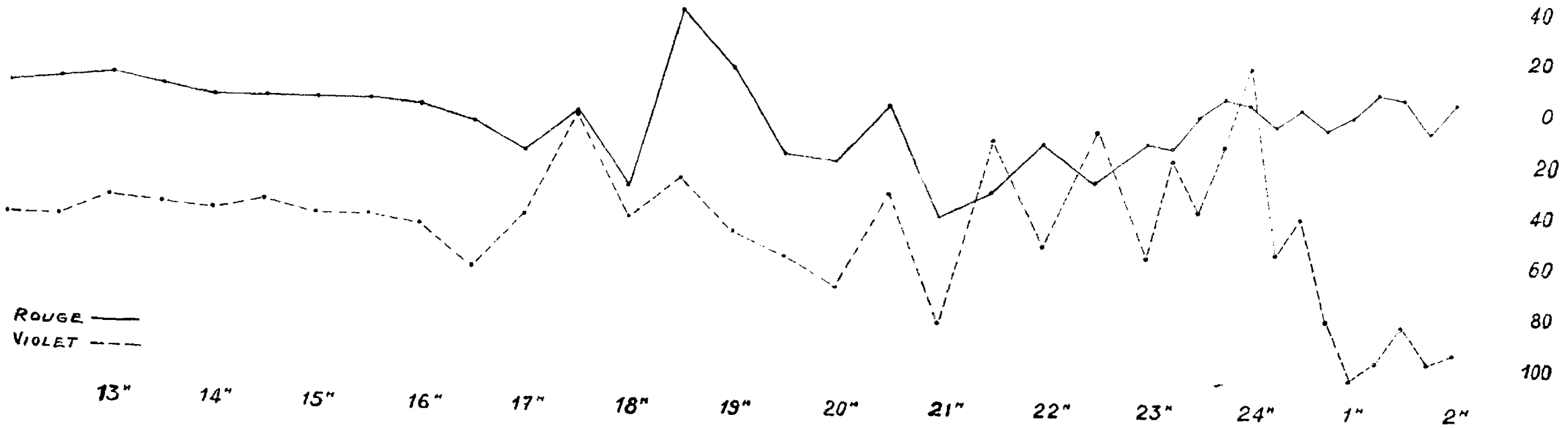
18 JANVIER 1956

Coffre de GOLFE-JUAN

Poste N° 1

Latitude : 43°33'18" N.
Longitude : 07°06'36" E.

Coordonnées DECCA { ROUGE : C. 23.37
VIOLET : C. 57 07



GRAPHIQUE 2

16 Janvier 1956

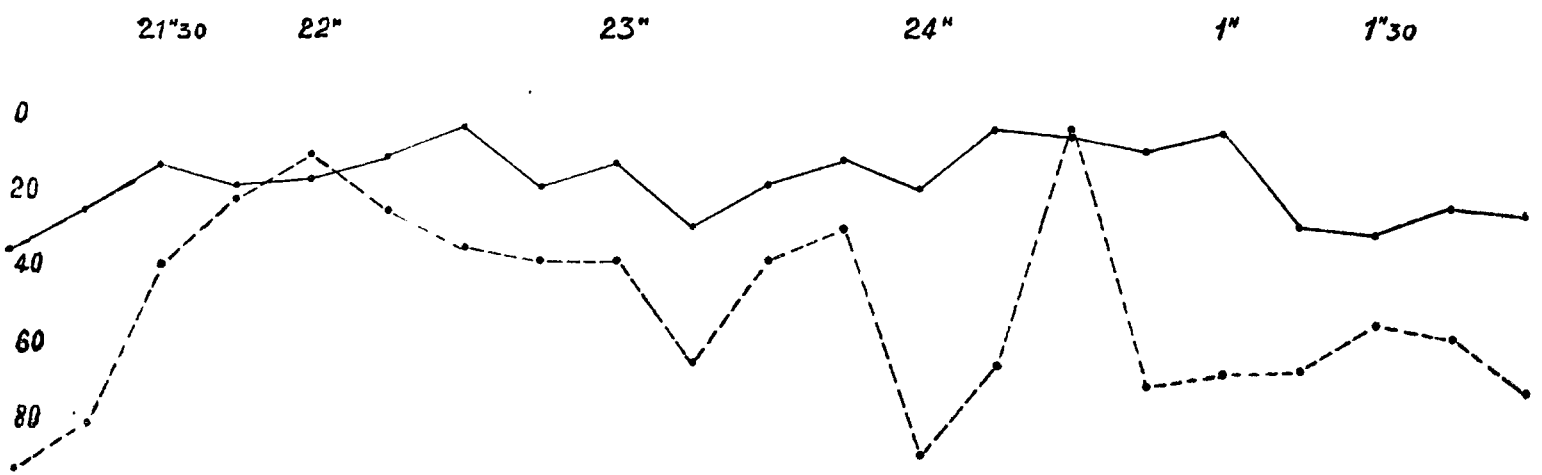
COURBE DE STABILITE

Rade des SALINS

Poste N° 2

Lat. 43°04'19 N.
Long. 06°14'58" E

Coordonnées DECCA { ROUGE : A. 23.38 / VIOLET : D. 62.00



ROUGE ——
VIOLET - - -

Graphique 3