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# EXERCISES LANTSUBEX II

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ACS: 1660-5 LANTSUBEX I-SS

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SECRET - GUARD

Office of Flag Officer Atlantic Coast  
H.M.C. Dockyard, Halifax, Nova Scotia  
14th September, 1954

ACS: 1660-5

EXERCISE LANTSUBEX 1 - 55

Enclosure (1) Report by Lieutenant Commander Bonner,  
R.N. on LANTSUBEX 1-55 dated 7th  
September, 1954.

Enclosure (1) is submitted for the information of Naval  
Headquarters.

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S E C R E T      G U A R D

REPORT

ON

EXERCISE LANTSUBEX 1-55

(A submarine versus submarine exercise  
carried out off Newfoundland during August 1954)

S E C R E T    G U A R D

REPORT ON EXERCISE LANTSUBEX 1-55

Exercise LANTSUBEX 1-55 was carried out off the east coast of Newfoundland from 1200Z on 18th August to 1200Z on 28th August 1954, by United States Naval forces under the direction of the Commander Submarines, United States Atlantic Fleet.

2. For the duration of the exercise the Staff Officer Submarines to the Flag Officer Atlantic Coast was embarked in U.S.S. CROAKER as Royal Canadian Naval observer.

U.S.S. CROAKER

3. U.S.S. CROAKER is a fleet submarine of the GATO class, launched in December 1943. In December 1953 she was recommissioned after conversion to SSK, a special-ist anti-submarine submarine.

4. The main points of this conversion were:

- (a) Removal of two upper forward torpedo tubes to make room for installation of BQR4A listening array round bow.
- (b) Removal of No. 2 main engine in order to make room aft for auxiliary machinery (ballast pumps, compressors, distillers, refrigeration machinery etc.).
- (c) The space vacated by this auxiliary machinery (the old pump room) has been converted into a sound insulated "sound room" containing all the listening stacks, and an electronics equipment room where all such equipment is gathered together comparatively free from damp.
- (d) The silent mounting of all machinery.
- (e) Removal of motor and pump drive from hydroplanes and steering. These are all direct hydraulic.
- (f) Streamlining of superstructure, with plastic casing in vicinity of BQR4A array.

5. The battery is of the standard fleet boat type, a GOULD 8460 amp. hour in two sections of 126 cells each with individual cell ventilation, operating at 250 volts. This battery has been fitted with agitator equipment, but this does not appear to be very effective, as gravity after a high discharge is still wont to read higher than before. This type of battery is rated for a top dived speed of 10 knots for 1 hour with 7 knots for 6 hours.

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## EQUIPMENT

### Masts

6. CROAKER has ten telescopic masts carrying equipment which may thus be exposed above the water when the ship is at periscope depth. These are:

- (i) AN/BPS radar antenna.
- (ii) Search periscope with ST. radar antenna.
- (iii) Retractable whip aerial.
- (iv) Directional ECM antenna (a).
- (v) UHF and IFF aeriels.
- (vi) VLF loop. (This only raises clear above top of sail, not above surface).
- (vii) ECM omni-directional antenna (c).
- (viii) Attack periscope.
- (ix) Snort induction, with omni-directional ECM antenna (b).
- (x) Snort exhaust (also below surface. Kept six feet below induction).

### Radar

7. AN/BPS is a combined air/surface warning set. It has been fitted as an improvement on SV but is not so popular, mainly because its minimum range is about 800 yards

8. ST is the periscope radar, the antenna for which is carried on top of the search periscope. The beam width is about sixty degrees and this is a very convenient short range set for quick sweeps round in bad visibility to ensure own safety, in addition to its primary function of attack.

### ECM

9. The BLR 1 search receiver is fitted with the three antennae marked (a), (b), and (c) in paragraph 6 above. Antennae cover following bands:-

- (a) has 2 horns, 2,500 m/cs to 5000 m/cs and 5,000 m/cs to 10,750 m/cs
- (b) 1,000 m/cs to 4,500 m/cs.
- (c) 4,500 m/cs to 10,750 m/cs.



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### Sonar

10. The main sonar set is the BQR4A listening array described in ACS: 1225-1 of 16 June, 1954. The stack for this set appears to be an exact copy of that for the German GHG, or "Balkon", hydrophone.

11. The fire control sonar is the JT, a passive listener with a split magnetostriction hydrophone. When in firm contact this can be switched to automatic target follow, giving a smooth rate of bearing change to the fire control computer.

12. The only other sonar set is the WCA equipment, a listening and transmitting set mounted on a bottomside lowering dome. It carries a JT on the port head and a QB on the starboard. This obsolete set is generally regarded as "worthless" but is presumably retained as the only means of echo ranging or of transmitting on S.S.T.

### Underwater Communications

13. The standard UQC underwater telephone is used.

14. Various equipments to increase the security of underwater speech are now under trial, and one, the XLF, is partially installed in CROAKER. This is an underwater telephone operating at 2.5 k/cs with a legend range of 70 miles. Transmission is all round and CW transmissions go out "in clear". Speech, however, is carried onto a tape which transmits it at  $\frac{1}{4}$  the speed it was received, the receiving tape bringing it back to normal speed in the loudspeaker. In transit, however, the quarter speed speech is alleged to sound more like fish noise than most fish noise.

### Passive Ranging Device

15. CROAKER is due to be fitted in September with a "passive ranging device". It was not possible to glean much information about this. It is said to work on the triangulation principle; that time of wave reception at three different points in the ship can, by time delay mechanisms, be represented as simultaneous arrival at the ship and two other points. The radius of the circle through these three points is the range.

## THE EXERCISE ORDERS

### The Aim

16. The primary aim of LANTSUBEX 1-55 was to:

"Test and develop submarine anti-submarine warfare doctrine while training forces in its use, and test the feasibility of employing SS/SSK type submarines in patrol areas close in off a U-boat base, in the face of moderate to extensive ASW Air and Surface opposition".

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# The Setting (See Appendix "B")

17. The concept of the exercise was that BLUE and totalitarian BLACK had been at war for one month. Trinity Bay, Newfoundland, was a BLACK base from which submarines operated in the mid-Atlantic and on the east coast of the U.S.A. BLACK had air and surface control of the exercise area, but waters inside the 100 fathom line had been made unpassable by BLUE minelaying. BLUE submarines were patrolling as close as feasible to BLACK's base in order to destroy his submarines in transit to and from their patrols.

## Forces Taking Part

### 18. BLACK

Submarines	U.S.S. TROUT (SS) U.S.S. HARDHEAD (SS) U.S.S. SABLEFISH (SS)
Aircraft	V.P. 18 (NEPTUNES) from ARGENTIA
Surface Ships	14th Escort Squadron (4 DE's) U.S.S. GILMORE (Depot Ship).

### 19. BLUE

Submarines	U.S.S. ANGLER (SSK) U.S.S. KI (SSK) U.S.S. TRIGGER (SS/SSK) U.S.S. CROAKER (SSK) U.S.S. CAVALLA (SSK).
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20. BLUE submarines were disposed in areas as shown in Appendix "B". Each submarine was given a normal patrol position in the centre of her area, which she was to endeavour to maintain, keeping at all times within 15 miles of this point.

## Exercise Artificialities

21. (a) Speed of advance of BLACK submarines was 5 knots minimum.
- (b) At least forty per cent of time of every transit was either surfaced or snorting.
- (c) When sea state was 5 or greater and during all scheduled charging periods BLACK submarines ran either surfaced or below 300 feet.
- (d) The period of the exercise was divided into two parts. Until 231200Z BLACK submarines transitted partly surfaced and partly submerged on main motors. During this period BLUE submarines charged as required. After 231200Z BLACK transits were conducted combining snorting and submerged main motor operation with limited surface running. During this period BLUE submarines had to charge during designated

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21. (d) Cont'd

charging periods as follows:

<u>PRIMARY</u>	<u>SECONDARY</u>
0400 - 0500	0000 - 0100
1200 - 1300	0800 - 0900
2000 - 2100	1600 - 1700

Any emergency charging required had to be carried out on the surface.

BLUE Aims

22. (1) Simulate destruction of BLACK submarines.
- (2) Test and develop submarine anti-submarine warfare doctrine and tactics.
- (3) Test feasibility of conducting SSK patrols off enemy bases in face of moderate to extensive ASW air and surface opposition.
- (4) Test communications, particularly the transmission of contact and amplifying reports among submarines in the operating area during scheduled charging periods.
- (5) Assign and test the accuracy and reliability of navigating by RAFOS units.
- (6) Test the reliability and security of single ping echo ranging.
- (7) Evaluate the ability of a small submarine to remain submerged for a prolonged period under simulated war conditions.
- (8) Exercise the relief of submarines on station and the avoidance of mutual interference between friendly forces.

23. The action taken to achieve these aims is described as follows:

Aims 1, 2, 3, and 6 under "Conduct of CROAKER's Patrol", paragraphs 25 - 54 and Narrative, Appendix "A".

Aim 4 under "Communications" paragraph 56.

Aim 5 under "Rafos" paragraph 57.

Aims 7 and 8 under "Operations of U.S.S. KI", paragraph 65.

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### Comment on the Exercise Orders

24. This is the first occasion on which a U.S.N. SSK exercise has had a strategic setting and an actual land base to be blockaded, but it is felt that the exercise largely failed through lack of imagination. The orders to the BLUE submarines to remain within 15 miles of a fixed point unless otherwise ordered by submarine control was unrealistic. There were no safety lanes or alternate areas to which a submarine could retire were her original patrol position compromised. CROAKER was discovered early on the second day of the exercise. After a four day's lull she was then systematically hunted by surface and air forces who knew both her position and the scheduled snorting periods laid down in the exercise orders.

### CONDUCT OF CROAKER'S PATROL

#### General Policy

25. Little thought appeared to have been given to the problem beforehand, and it was difficult at any time to elicit a firm policy from the Commanding Officer. In general the policy was to patrol continuously at slow speed, circling or weaving at 110 or 115 feet, listening on the BQR4A array, snorting for a charge for 1 hour in eight. W/T routines could be read at 80 feet, but the ship generally came to periscope depth for 15 minutes during each routine.

26. The ten days of the exercise were spent as follows:-

	<u>Hours</u>	<u>Minutes</u>	<u>Percentage</u>
Surfaced	4	54	2
Snorting	33	27	14
At periscope depth	19	33	8
Deep	182	06	76

#### Quiet Routines

27. Two stages of Quiet Routine, Patrol Quiet and Ultra Quiet were used. Ships' orders were detailed on what machinery was to be run in each state. No real attempt to achieve quiet was ever made however. Two or three cinema shows a day continued through the ultra quiet state and the one hundred record juke box (six selections for a nickel) was in constant use. The ultra quiet state which had been used for 15 minutes in each hour was abandoned on the third day of the exercise as it was considered that the boat became too cold and damp with heaters, blowers and air conditioning switched off.

#### Listening Conditions

28. Water conditions varied little throughout the exercise, a surface layer of about 55 degrees decreasing very rapidly to about 32 degrees at 100 feet. (See Appendix "C"). A normal array depth of 95 or 100 feet was used for listening.

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29. Maximum detection ranges of about 25 miles were achieved on a snorting submarine and on DES but it is stressed that this could only be ascertained by later analysis, as such contacts appeared and faded in the skip distances of the set and could not then be differentiated from the many other unclassified contacts gained.

30. This multiplicity of contacts appears to present the major problem in the use of the low frequency long range listening array. When four or five equally unattractive contacts are held simultaneously, the problem is whether to start tracking one immediately or to wait until a definite indication of propeller noise is heard when it may be too late to close to an attacking position. CROAKER gained 115 contacts on her BQR 4A. Of these, 16 were definitely identified either by sighting, by the fact that they were transmitting or on UQC after attack. Of these 16 contacts, 4 were developed into attacks. Two unidentified contacts were also attacked.

31. Of the tremendous number (99) of unidentified contacts gained it can only be assumed that the majority were schools of fish. Fish noise was a problem throughout the exercise, and could often be clearly heard through the hull. Although a number of contacts were classified as fishing vessels, no fishing vessel was ever sighted in the area.

32. Two sonarmen stood a 4 hour watch in tricks of about  $\frac{1}{2}$  an hour each.

#### Charging

33. A state of charge graph is attached as Appendix "D".

34. Although normal speed when deep was the minimum possible, there was no attempt to reduce the auxiliary load. Fresh water consumption was approximately 800 gallons a day, necessitating considerable use of the distillers. No control was placed on the use of heaters, lights, hot plates or the galley. Thus CROAKER was twice caught at what was considered to be a dangerously low state of charge. At 1252 on the 19th a surfaced submarine was allowed to pass as CROAKER had insufficient power available to close, and at 2010 on the 25th she was forced to surface in the presence of a DE, to put in a four and a half hour surface charge.

35. The policy was not to keep the battery as full as possible consistent with good listening, but to try to get by on three hours charging time a day. This routine of one hour's charging in eight had been so instilled into the Commanding Officer that when the R.C.N. observer suggested, towards the end of Part I of the exercise, that additional snorting periods should be taken to get the battery to a high state of charge before the "scheduled snorting periods" started, it was stated that snorting for more than one hour in eight was, unless absolutely necessary, "not playing the game".

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36. While snorting CROAKER was attacked by aircraft at 0354/19, 1223/23, 1627/24, and 0809/27. She was detected and reported by aircraft at 0537/23.

#### Use of ECM

37. CROAKER is fitted with a BLR 1 search receiver as described in paragraph 9.

38. This was not used during the first charge by day, but was closed up on every occasion of snorting after the submarine was attacked, during the first night charge.

39. At the beginning of the exercise there was no means of direct communication between the BLR 1 receiver in the forward starboard corner of the control room, and the conning tower. Thus at 1223/23 CROAKER was attacked by aircraft although the BLR 1 operator had been receiving "airborne racket", information of which did not reach the conning position. After this a temporary microphone was hooked up and CROAKER several times succeeded in getting deep safely on BLR 1 warning. CROAKER was, however, attacked three times by aircraft when BLR 1 was operating but had no contact.

40. After some experience the following routine was used when snorting. Antenna (b) on the snort induction was used, with continuous wave band sweep. When a contact was gained the receiver was locked on the received wave length and switched to the directional antenna (a), in order to get a bearing. This was only rarely achieved as policy was to secure snorting and go deep immediately on receipt of a "racket".

#### Use of Radar

41. CROAKER used her radar almost exclusively for self protection when snorting in bad visibility, when it was felt that there was a possibility of encountering a fishing boat lying to nets or some other type of silent obstruction.

42. Under these circumstances an all round ST sweep every five minutes, with a BPS4 sweep every 15 minutes was generally used. During one of these BPS sweeps the target subsequently attacked at 2332/21 was detected at 11350 yards before BQR4 gained contact.

43. No aircraft contacts were made on radar and there was no evidence to suggest that CROAKER's radar was ever detected by BLACK forces.

#### Maintenance of Equipment

44. The general technical knowledge of the enlisted men and of the junior officers was of an enviably high standard, but this failed to replace the ability of a qualified engineer officer. On several occasions no attempt was made to investigate a defect or to attempt running repairs.

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45. Throughout the patrol the following were defective: steering, both L.P. blowers, A.C. lighting circuits, snort head valve.

46. The following failed intermittently: one main engine, one main motor, battery agitator, retractable whip mast, fan to main transmitter.

47. The electronics technicians maintained a somewhat higher standard. Radar and W/T sets were all got back into commission fairly quickly after breakdowns, and the two main A/S sets, the BQR4A and JT were kept in continuous operation.

#### Attacking

48. The attack team layout was as follows:-

Conning Tower: Captain  
3rd Officer on T.D.C.  
6th Officer, assistant T.D.C.  
5th Officer, local hand plot.

Control Room: 4th (engineer) officer.

Wardroom: Executive Officer in charge.  
7th Officer, time bearing plot.  
8th Officer, navigational plot.  
Chief Q.M., relative plot.

49. The plotting organization in the Wardroom was good, an automatic plot and permanent perspex relative and rate of change of bearing plots being built into the table. Direct communication by intercom was maintained with the conning tower and the sound room.

50. There was, however, no officer in the sound room, and lack of co-ordination between sound room and conning tower was marked. On two occasions bearings of the wrong target were being passed to the plotting team, and it was felt that too much was being left to the sonar-men on the set. There was no means whereby the conning tower could listen direct to the reception at the set, and the command had to rely upon reports from the operators. These were inclined to be altogether too clever with such statements as "Confirmed submarine, snorting at 7 knots, range 25,000 yards. We're thirty degrees on the starboard bow", added to the bearing.

51. Early in the exercise the ship went to Battle Stations Torpedo on each occasion of a promising contact, but after a few unproductive approaches this practice was dropped and approaches and attacks were carried out "on the watch". Thus of the six attacks completed the plotting organization was closed up for only one, in which it was not used.

52. Six attacks were carried out, as follows:  
(See Appendix "A", Narrative)

- (i) At 0048/21 from deep on unidentified target. Probably successful.

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52. (Cont'd)

- (ii) At 2332/21 from deep on unidentified surface target detected by radar.
- (iii) At 0400/23 from deep on submarine HARDHEAD on the surface. Possibly successful.
- (iv) At 0236/25 from deep on unidentified BLACK snorting submarine. Successful.
- (v) At 1110/27 from deep on unidentified D.E. Probably successful.
- (vi) At 1132/28 from periscope depth on unidentified surfaced submarine. Probably missed.

53. There was always reluctance to coming to periscope depth for a look to clarify the situation, and this cost CROAKER the chance of a submarine sinking during attack (v). But where the attack policy from deep is to get directly under the target the wish to keep the layer between the submarine and a possible A/S vessel is understandable.

54. Single ping echo ranging was used on only one occasion. No range was obtained.

#### Communications

55. Apart from one failure of the main transmitter no communication difficulties were experienced. CROAKER read the FOX V.L.F. schedule from Radio Washington without difficulty at 80 feet, and transmitted exercise traffic to shore on the retractable whip.

56. Inter-submarine communication (aim 4 of the exercise) was not attempted on the orders of the Squadron Commander.

#### RAFOS

57. RAFOS (so called as being the opposite of SOFAR) is a system of navigation whereby 55 lb. charges are exploded in known positions at known times. The time of arrival of the explosion noise is taken in the submarine, the travel time of the noise giving a range from the firing station which may be plotted as a position line. The Hydrographic office have produced RAFOS charts on the same lines as those for LORAN.

58. During this exercise three stations were in operation:

<u>STATION ABLE</u>	<u>STATION BAKER</u>	<u>STATION CHARLIE</u>
USS PENGUIN	USS PRESERVER	USCGC McCULLOGH
51 30'N	59 30'.2N	52 45'N
53 42'W	44 47'.5W	35 30'W



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59. Firing times were arranged so that signals were received in the order ABLE, BAKER, CHARLIE at approximately 5 minute intervals once every four hours. Ranges of stations from the patrol area were approximately 200, 650 and 800 miles. The nearest station was always heard through the hull, occasionally all three. A signal was only very occasionally missed on the hydrophones, and it seems probable that these shots were not fired due to firing ship being out of position, or a misfire. At least three misfired shots were heard to explode some 30 minutes late.

60. A scientific officer from Wood's Hole Oceanographic Institute was embarked in CROAKER to investigate the problem of taking accurate bearings of a RAFOS shot in order to obtain a fix from a single explosion.

61. The system used was as follows:-

One of the rod hydrophones of the BQR4A array was cut out of the array circuit and connected to a pen and ink recorder in the sound room. A moving coil hydrophone was fitted on the after casing and connected to another pen on the same recorder. A third pen on this recorder was driven by an accurate timing device measuring in milliseconds. The recorder was started just before a RAFOS shot was expected (the paper ran at 230 feet per minute) and the time difference of reception at the two hydrophones noted. The distance between the two hydrophones was known, and a cosine triangle would therefore theoretically give the relative bearing of approach of the sound front.

62. In fact, due to the varying response, of the two types of hydrophone in use and the rumbling nature of the explosion it was found extremely difficult or sometimes impossible to match the recorded sound waves. Thus no acceptable accuracy could be obtained by this method.

63. In general RAFOS fixes appeared to give an accuracy of about 6 miles.

64. Thus with fixed shore stations giving additional accuracy this appears to be a feasible method of submarine navigation in peacetime. To escape enemy interference in time of war short transmissions at high power on varying frequencies may possibly take the place of the explosive charges.

#### OPERATIONS OF U.S.S. KI

(U.S.S. KI is described in the report forwarded under cover of ACS:1225-1 of 16 June, 1954).

65. In order to prove the ability of the K class of small specialist anti-submarine submarine to carry out a patrol under simulated war conditions KI sailed from New London at 0800Q on 10th August, diving later that day off the Nantucket Shoal Lightship. She then proceeded dived to the exercise area, took part in the exercise, and is, at the time of writing of this report, returning dived to New London, E.T.A. 8th September. She will thus have remained submerged for approximately one month.

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66. In order to test the relief of submarines on station and the avoidance of mutual interference between friendly submarines, she passed westward to her patrol position through friendly submarine areas on 19th August. A moving haven was established around her, this message being received in CROAKER at 0225Z/19th. She passed through CROAKER's area as expected being spoken on XLF at 0724Z on 19th.

APPENDIX "A"

NARRATIVE OF U.S.S. CROAKER'S PATROL

ALL TIMES ZEBRA

Unless otherwise stated all contacts made by Sonar BQR 4A

Sunrise 0820 Sunset 2230 throughout

Wednesday 18th August

- 0700 - In patrol position 48° 35' North 51° 04' West.
- 1028 - Dived. Battery reading 1246.
- 1200 - Exercise LANTSUBEX 1-55 commenced. Wind SSW Force 5. Sea and Swell 53. Sea conditions: 20° negative layer between 45 and 80 feet.

POLICY: Stated policy is to patrol beneath layer at array depth 110 feet. BQR 4A manned continuously, JT and WCA at standby. 15 minutes of each hour in ultra-quiet state. Remainder at patrol quiet. Speed normally 40 turns for 1-2 knots on broad weave or circling. No fixed policy for charging. This will be carried out as required mainly by night.

- 1545 - BQR contact No. 1. This contact was tracked and eventually sighted at
- 1714 - Identified as DE. Range about 9,000 yards. CROAKER 2,000 yards off track.
- 1720 - Another DE sighted about 2,000 yards beyond first. Ship then returned to 115 feet. Intention to pass deep between the two DES in the hope that if they were escorting a submarine this would be picked up when the DES had passed.
- 1721-
- 1804 - After going deep only one contact, the first DE, was regained. This passed close ahead.
- 1804 - Periscope depth. Nothing in sight.

COMMENT

This was probably a surface attack unit of two ships sweeping west through the area. CROAKER at no time held the initiative as she was deep, receiving too little information to form any idea of what was going on. She was saved from detection by the layer. Initial detection range of DES was about 24 miles.

- 1913 - Commenced snorting for charge. Battery reading 1189. Visibility good. Wind South Force 4. Sea and Swell 43. 3/10 cloud. BLR 1 was not operated as "visibility was good enough".
- 2014 - Secured snorting. Battery reading 1199. Depth 115 feet to listen.

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- 2027 - BQR contact No. 4.
- 2033 - Lost contact.
- 2218 - BQR contact No. 5, bearing 330°.
- 2227 - BQR contact No. 6, bearing 057.
- 2232 - Contact No. 5 lost.
- 2302 - BQR contact No. 7 bearing 005.
- 2320 - BQR contact No. 8 bearing 043.
- 2331 - BQR contact No. 9 bearing 160.
- 2338 - Contact No. 6 strength increasing, No. 7 faded,  
No. 9 fading, No. 8 held. No appreciable bearing  
movements. After fluctuations of signal strength  
all contacts had faded by 0018.

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Thursday 19th August

- 0037 - Contacts 6, 8 and 9 having been regained spasmodically were classified as fish.
- 0054 - BQR contact No. 10 bearing 269, classified as fish.
- 0149 - BQR contact No. 11 bearing 340.
- 0156 - BQR contact No. 11 growing right, classified as screw noise. Started approach.
- 0211 - Broke off approach as CROAKER had reached limit of her area.
- 0258 - BQR contact No. 12 bearing 011.
- 0303 - Contact No. 11 faded, possibly masked by No. 12.
- 0311 - No. 12 classified as fish. No. 11 not regained.
- 0316 - Periscope depth. Wind force 4 from SSW. Sea State 4. Clear sky. Moonlight.
- 0343 - Started snorting to charge. Battery reading 1186. BLR 1 manned, operating on directional antenna.
- 0354 - Two grenades. On looking through periscope found flare overhead and aircraft's navigation lights visible.
- 0355 - Secured snorting. Went deep.
- 0417 - Returned to periscope depth. White flare sighted about 3 miles away.
- 0418 - BQR contact No. 13 bearing 065.
- 0430 - Aircraft sighted approaching but stayed up as W/T routine was being read. Aircraft is circling vicinity dropping flares and possibly sonobuoys but no contact can be made on BLR 1. Periscope and whip antenna are up but aircraft appears to have no contact. Whip antenna mast jammed slightly below right up position.
- 0457 - Went deep on completion of W/T routine.
- 0459 - BQR contacts No. 13 bearing 065, No. 14 bearing 160, No. 15 bearing 015.
- 0514 - No. 15 faded.
- 0517 - No. 16 bearing 080, reported as range closing, classified possible submarine.
- 0556 - No. 14 faded.

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- 0724 - Established XLF communication with K 1 transitting northern portion of our area. She was contact No. 16.
- 0726 - No. 13 faded.
- 0738 - No. 16 faded.
- 1025 - Contact No. 17 bearing 360.
- 1053 - No. 17 faded.
- 1128 - Contact No. 18 bearing 243.
- 1143 - Regained No. 13 bearing 080. This and another contact bearing about 160 appear to be ghosts appearing intermittently.
- 1200 - Previous 24 hours have been spent:  
Periscope depth 2 hours 45 minutes.  
Snorting 1 hour 12 minutes.  
Deep 20 hours 3 minutes.
- Clear sky, good visibility, wind south force 4, sea state 3. Water conditions same.
- 1219 - Sighted DE bearing 205 about 5 miles. This is contact No. 18. Transmissions heard.
- 1230 - Sighted surfaced submarine astern of DE. Identified as USS SABLEFISH by reading hull number. (Contact No. 19).
- 1232 - Went deep, dead slow, to commence tracking.
- 1252 - Broke off attack as battery now low (gravity 1140) and distance off track estimated as 7,000 yards.

COMMENT

Whip antenna being jammed in up position forced decision to make submerged approach but this was not started until 1240 although bearing movement had been evident since 1150.

- 1355 - Commenced snorting for charge. Battery reading 1127. Clear sky, sea state 4, wind west by south force 4.
- 1410-
- 1450 - BLR 1 held intermittent contact on 2.35 KMC. No known U.S. radar.
- 1802 - Stopped snorting. Battery reading 1212. Went deep, 115 feet.
- 1805 - BQR contact No. 20 bearing 020.
- 1835 - No. 20 faded.
- 2031 - Contact No. 21 bearing 292.

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- 2035 - No. 21 faded.
- 2050 - Contact No. 22 bearing 152.
- 2058 - Contact No. 23 bearing 324.
- 2146 - All contacts faded. Battery reading 1213.
- 2205 - Commenced snorting for charge. Visibility good with 9/10 cloud cover. Sea state 3. Wind SSW force 4.
- 2306 - Secured snorting. Battery reading 1220.
- 2324 - Contact No. 24 bearing 097.
- 2345 - Contact No. 25 bearing 072.
- 2348 - Echo ranging heard on bearing of No. 24. Appreciation was that No. 25 was a surfaced submarine escorted by No. 24.
- 2349 - Commenced sound approach.

- 6 -

Friday 20th August

- 0011 - Lost contact No. 25.
- 0013 - Contact No. 26 bearing 163. Commenced tracking. No appreciable change of bearing for 20 minutes, although BQR reported closing.
- 0045 - Bearing still steady, but contact fading. Broke off approach as it was appreciated that target had reversed course.

COMMENT

Probably one DE passed through area, but it is possible that it was surfaced submarine pinging. Contact No. 26 was probably distant fishing boat.

- 0115 - Contact No. 26 faded still bearing 165.
- 0233 - Contact No. 27 bearing 258.
- 0244 - Contact No. 28 bearing 210.
- 0317 - No. 28 faded.
- 0403 - No. 27 faded.
- 0422 - Contact No. 29 bearing 065.
- 0437 - Contact No. 30 bearing 170.
- 0521 - Contact No. 31 bearing 000.
- 0815 - All contacts faded.
- 0900 - Started snorting for charge. Battery reading 1179. Weather: good visibility, Wind S by W force 4. Sea 4 Swell 3. Sky 4/10 covered by cloud.
- 1029 - Secured snorting. Battery reading 1158. (Pilot cells had been watered during charge. No true reading was taken) Went deep.
- 1100 - Contact No. 32 bearing 070.
- 1140 - Contact No. 33 bearing 140.
- 1143 - Lost No. 33.
- 1147 - Regained No. 33.
- 1152 - Lost No. 32.
- 1157 - Lost No. 33.
- 1200 - Previous 24 hours have been spent:

Deep	15 hours 27 minutes
Snorting	6 hours 38 minutes
Periscope depth	1 hour 55 minutes.



-7-

- 1203 - Regained No. 33.
- 1206 - Lost No. 33.
- 1215 - Regained No.'s 32 and 33.
- 1220 - Lost No. 33.
- 1240 - Lost No. 32. No contacts.
- 1539 - Contact No. 34 bearing 015.
- 1601 - Contact No. 35 bearing 112.
- 1613 - No. 34 faded. New contact No. 36 bearing 085.
- 1628 - No. 35 faded.
- 1703 - Contact No. 37 bearing 295.
- 1802 - Contacts 36 and 37 still hold. Nothing in sight from periscope depth. Started snorting. Battery reading 1163. Visibility 2 miles in rain. Sea and swell 33 from South.
- 1905 - Lost depth control deep. Enforced secure snorting. Battery reading 1172. Steadied at 1115 feet.
- 1916 - Contact No. 38 bearing 228.
- 1930 - Decision taken to no longer use ultra quiet state. Too cold and damp.
- 1941 - Contact No. 39 bearing 250.
- 1950 - Contact No. 40.
- 2016 - Contact No. 41 bearing 292.
- 2055 - No. 41 faded.
- 2108 - No. 40 faded.
- 2122 - No. 39 faded. No contacts.
- 2158 - Started snorting for charge. Battery reading 1174.
- 2308 - Secured snorting. Battery reading 1184.
- 2336 - Contact No. 42 bearing 065.
- 2351 - Contact No. 43. Firm contact with screw beat bearing 190.
- 2355 - Commenced tracking No. 43.

-8-

Saturday, 21st August

0007 - Lost contact No. 43.

0015 - Contact No. 44 bearing 150.

0028 - No. 44 firm contact giving screw beat bearing left.

0032 - Manned Battle Stations Torpedo. CROAKER on course 060 at 2 knots holding bearing steady at 135. No other contacts. High pitched screw noise about 200 revs. Bearing held steady until target was very close (TDC gave 250 yards from track at 600 yards range) when at

0046 - CROAKER swung with full right rudder under target on approximately opposite course. TDC solution of enemy course 335 at 11 knots held as bearing changed rapidly left and at

0048 - CROAKER fired two simulated mark 28 Mod. 2 torpedoes from stern tubes at 520 yards range.

COMMENT: Target unidentified. Sounded too light for submarine. Attack unconventional by our doctrine but seemed very effective if intelligent torpedoes co-operate. No reply was received to calls on UQC and QB.

0116 - Contact No. 45 bearing 045.

0123 - Contact No. 46 bearing 170.

0126 - Contact No. 44 (target of the attack) appeared to be closing again, then steady, finally fading by 0155.

0206 - Lost contacts 45 and 46. No contacts.

0240 - No. 45 regained.

0308 - No. 45 faded.

0350 - Contact No. 47 bearing 304.

0402 - BQR4A reports engine noises on bearing.

0412 - No. 45 regained bearing 065.

0422 - No. 45 growing right, appears to be closing, bearing 071.

0438 - No. 46 regained bearing 189.

0449 - CROAKER turned to course 304 to investigate No. 47.

0454 - BQR4A reports No. 45 closing from 075.

0501 - Regained No. 43 bearing 190.

0507 - Contact No. 47 suddenly ceased.

COMMENT: No. 47 was probably USS CAYALLA, patrolling in area to North West of us, on a snorting charge.

- 9 -

- 0512 - Contact No. 48 bearing 252, is now only contact held by BQR 4A.
- 0548 - Contact No. 49 bearing 114.
- 0557 - Contact No. 50 bearing 009.
- 0614 - Contact No. 51 bearing 082.
- 0731 - No. 49 faded.
- 0740 - No. 50 faded.
- 0757 - No. 51 faded. No contacts.
- 0835 - Started snorting charge. Battery reading 1170.  
Weather: Wind SSW - 2. Sea 1 Swell 3. Haze.  
Visibility about 3 miles.
- 1000 - Visibility 1000 yards.
- 1025 - Operating ST radar. Visibility 2 cables. No contact.
- 1035 - Secured snorting. Battery reading 1191.

COMMENT: After our unfortunate experience of being sunk ten minutes after the start of our first night charge, stated charging policy is now to charge mostly by day for three hours out of the 24. This is influenced by the fact that no aircraft have been sighted by day and possibly only night patrols are being flown.

1044 - Regained No. 45, bearing 070.

1200 - Last 24 hours spent as follows:

Deep	18 hours 30 minutes
Snorting	4 hours 12 minutes
Periscope Depth	1 hour 18 minutes.

- 1256 - Contact No. 52 bearing 080.
- 1312 - No. 45 faded.
- 1342 - No. 52 faded. No contacts.
- 1634 - Contact No. 52 bearing 021.
- 1712 - Regained No. 51 bearing 085.
- 1721 - Regained No. 45 bearing 062.
- 1735 - Contact No. 53 bearing 042.
- 1831 - No. 53 reported growing left and closing.
- 1921 - No. 53 after remaining steady at 025 for 50 minutes reported closing and growing left.
- 1930 - Commenced tracking.

- 10 -

1948 - To periscope depth. Visibility 500 yards. Nothing in sight. Returned deep.

2028 - Contact No. 54 bearing 110.

2031 - Contact No. 55 bearing 065, turn count 180. Started tracking.

2040 - Echo ranging heard from Nos. 54 and 55, bearings growing left. Both contacts passed to northward, nearer between 800X and 1000X. No other contact.

COMMENT: Probably two ship S.A.U. Layer saved us from detection again.

2120 - Contact No. 56 bearing 157.

2130 - Periscope depth. Visibility 1000 yards. ST radar sweep. No contact.

2149 - All contacts faded.

2150 - Started snorting for charge. Battery reading 1157. ST radar sweep every 5 minutes, and BPS4 radar sweep every 15 minutes. Weather: Wind NNW force 3. Sea 2 Swell 3. Visibility 500 yards.

2245 - BPS-4 radar contact No. 57 bearing 030, 11350 yards.

2254 - Secured snorting. Battery reading 1161. Went deep. Started tracking. Target appeared to be heavy single screw about 95 revs., reciprocating.

2332 - Simulated firing. Made B's on SST and UQC.

2336 - Received UQC transmissions from USS TROUT (a target submarine) requesting range check. Range proved to be 20,000 yards. TROUT made "Attack was not made on me".

2344 - Contact No. 58 bearing 060.

2351 - No. 58 faded.

- 11 -

Sunday, 22nd August

- 0408 - Contact No. 59 bearing 330.
- 0417 - Started snorting for charge. Battery reading 1163.  
Wind S force 3. Sea and Swell 22. Visibility 1000  
yards in fog. BPS radar sweeping every 10 minutes.
- 0517 - Contact No. 60 bearing 058.
- 0530 - Secured snorting. Battery reading 1172.
- 0544 - No. 59 faded.
- 0618 - Contact No. 61 bearing 180.
- 0657 - Contact No. 62 bearing 091.
- 0835 - All contacts faded.
- 1010 - Contact No. 63 bearing 287. Regained No. 60 bearing  
032.
- 1200 - Last 24 hours spent as follows:
  - Deep 18 hours 20 minutes
  - Snorting 2 hours 20 minutes
  - Periscope depth 3 hours 20 minutes.
- 1214 - Started snorting. Battery reading 1174. Wind north  
west force 1. Sea and Swell 21. Visibility  $2\frac{1}{2}$  miles.
- 1314 - Secured snorting. Went deep. Battery reading 1177.
- 2000 - Started snorting for charge. Battery reading 1161.  
Wind ESE force 2. Sea and Swell 22. Visibility  
8,000 yards.
- 2100 - Secured snorting. Went deep. Battery reading 1167.
- 2130 - Retractable whip found to be free to lower.

- 12 -

Monday, 23rd August

0101 - Contact No. 64 bearing 115. Reported drawing right and closing. Started tracking.

0142 - Target had grown right to 140 and now fading.

COMMENT: Sounded like fishing vessel. Probably distant on broad track.

0223 - Lost No. 64.

0306 - Contact No. 65 bearing 287. High noise level. Turned towards. Started approach.

0322 - Bearing of 65 drawing slowly right. Adjusted course and speed to steady bearing.

0346 - Evaluated contact as submarine.

0400 - Target passing through stern from right to left. Simulated firing of one Mark 28 Mod 2 from stern tubes.

0414 - Target identified herself as U.S.S. HARDHEAD (Submarine) doing 16 knots on surface.

COMMENT: CROAKER did not go to battle stations. No tracking plot was made. Firing data was taken from speed by turn count (5 knots slow) and "tracking solution" from T.D.C. Error in gyro angle of one torpedo fired was 25°. Range about 1000 yards. Possible hit towards limit of actuation range of torpedo homing.

0454 - Started snorting for charge. Battery reading 1148. Very dark. Sea calm. Operating BLR 1.

0536 - BLR 1 contact closing bearing 200. Aircraft. Secured snorting. Battery reading 1149.

0537 - Observed flare close. No charges dropped. Went deep. (Rebroadcast of aircraft contact report subsequently intercepted).

0545 - Contact No. 66 bearing 030. Reported closing.

0600 - No. 66 faded.

0626 - Contact No. 67 bearing 172.

0857 - Started snorting for charge. Battery reading 1154. Operating BLR 1.

0953 - Emergency secure snorting when aircraft sighted closing. No attack. Went deep. No ECM contact.

1110 - Contact No. 68 bearing 208, and No. 69 bearing 355.

1130 - Started snorting for charge. Battery reading 1172. Wind NE 2. Sea and swell 22. Heavy overcast. Raining.

- 13 -

1153 - ECM contact bearing 345 drawing left.

1158 - Lost ECM contact. Nothing in sight. No contact on ST radar.

1200 - PART 2 OF EXERCISE STARTS

Spent last 24 hours as follows:-

Deep	18 hours 10 minutes
Periscope depth	2 hours 44 minutes
Snorting	3 hours 6 minutes.

1215 - Regained contact on BLR 1.

1221 - Contact closing.

1223 - Two charges. Emergency secure snorting. Aircraft sighted banking out of cloud for another run. Went deep. Battery reading 1181.

1550 - Started snorting for charge. Battery reading 1186. Wind ENE 3 Sea 4. Overcast with rain. Visibility 4 miles.

1657 - BLR 1 contact. Secured snorting. Went deep. Battery reading 1192.

1702 - Contact No. 70 bearing 020.

1812 - No. 70 faded.

1957 - Started snorting for charge. Weather as at 1550. Battery reading 1189.

2100 - Secured snorting. Battery reading 1199.

- 14 -

Tuesday 24th August

- 0001 - Started snorting for charge. Battery reading 1198.  
Wind NNE 3. Sea 3. Visibility 4 miles. Overcast.
- 0100 - Secured snorting. Battery reading 1200.
- 0400 - Started snorting for charge. Sky now clear. Wind  
NE 4. Sea and Swell 33. Visibility estimated 7  
miles. Battery reading 1200.
- 0500 - Secured snorting. Battery reading 1208.
- 0539 - Contact No. 71 bearing 190.
- 0544 - No. 71 faded. Probably fish.
- 0559 - Contact No. 72 bearing 100.
- 0737 - No. 72 faded.
- 1038 - Contact No. 73 bearing 270.
- 1120 - Contact No. 74 bearing 240. 73 and 74 possible  
warships.
- 1127 - 73 and 74 assessed as same echo (74 sidelobe of 73).
- 1135 - No. 73 bearing 265 assessed as snorting submarine.
- 1153 - Started tracking No. 73 - definite submarine.
- 1200 - No. 73 faded. Probably snorting submarine gone  
deep for scheduled BLUE charging period. CROAKER  
intends to forego this charging period in order to  
continue approach on snorter at end of period.  
Therefore turned to parallel course at 3 knots.  
Last 24 hours spent as follows:-
- |                 |                     |
|-----------------|---------------------|
| Deep            | 18 hours 12 minutes |
| Snorting        | 4 hours 30 minutes  |
| Periscope depth | 1 hour 18 minutes.  |
- 1203 - Temporarily regained No. 73 bearing 272, but this  
was lost in dead arc astern as CROAKER turned to  
parallel course.
- 1240 - Swing to port to open dead arc astern. Nothing  
heard.
- 1253 - No. 73 bearing 320.
- 1258 - Heard DEEP, DEEP, DEEP, distant on UQC. This is  
the warning for a BLACK submarine coming to sur-  
face or snort depth from 300 feet.
- 1307 - Lost No. 73.
- 1315 - Regained No. 73 still bearing 320.
- 1327 - No. 73 bears 327. Does not sound very convincing.



- 15 -

1353 - Periscope depth. Nothing in sight.

COMMENT: This was certainly a submarine before 1200. She probably turned off track on going deep, and although we heard her DEEP, DEEP, DEEP, at 1258, the noise picked up at 1253 (when BLACK submarines should still have been deep) and subsequently tracked without success was probably a ghost.

1434 - No. 73 faded.

1452 - Contact No. 75 bearing 173.

1458 - No. 75 classified fish.

1534 - Contact No. 76 bearing 154.

1548 - Contact No. 77 bearing 274.

1556 - Started snorting for charge. Battery reading 1161. Wind N force 3. Sky clear. Visibility good. Sea and Swell 22.

1627 - Aircraft sighted overhead. No BLR 1 contact. Secured snorting. 2 charges dropped close before ship could go deep. Went deep.

1730 - Contact No. 78 bearing 166. Possible submarine. Began tracking.

1740 - Lost No. 78.

1747 - Contact No. 79 bearing 306. Regained No. 78 classified as fishing vessel.

1751 - Contact No. 80 bearing 110.

1802 - Lost No. 80.

1844 - Contact No. 81 bearing 205.

1852 - Lost No. 81.

1855 - Regained No. 81 bearing 204.

1906 - Lost No. 81.

1922 - Contact No. 82 bearing 175.

1937 - No. 82 faded.

1957 - Started snorting for charge. Battery reading 1145. We badly needed charge at this stage. Early morning secondary had been missed as not required. Midday primary was missed as were tracking snorter. Afternoon secondary was mostly missed when we were put down by aircraft. Weather: 1/10 scattered cloud. Good visibility. Wind force 3 from SW. Sea and Swell 22. Sky coulded to 7/10 by end of charge.

2020 - Number 3 engine out of action.

- 16 -

- 2100 - Secured snorting. Went deep. Battery reading 1195.
- 2105 - Regained No. 78 (fishing vessel) bearing 155.
- 2200 - Contact No. 83 bearing 310.
- 2240 - Lost Nos. 78 and 83. No contacts except one of our regular ghosts at 055.
- 2332 - Contact No. 84 bearing 270.
- 2352 - No. 84 possible submarine. Began tracking.
- 2354 - No. 84 faded suddenly. Possible snorter gone deep for charging period. Decided to miss charging period to await developments.

- 17 -

Wednesday 25th August

- 0019 - Regained No. 84 bearing 258.
- 0023 - Contact No. 85 bearing 345.
- 0030 - Contacts No. 86 and 87 bearing 210 and 050.
- 0102 - All contacts faded.
- 0153 - Regained No. 84 bearing 250. Sounds good. Began tracking.
- 0217 - JT holding No. 84 in ATF. No plotting team closed up. Target data from TDC.
- 0236 $\frac{1}{2}$  - Simulated firing one Mk 28 Mod 2 and one Mark 27 Mod 4. Target data course 080, 10 knots, range 1200 yards.
- 0237 - Spoke BLACK submarine on UQC. Her data course 090, speed 10.5, range 1300, snorting.
- COMMENT: Good and successful attack. Initial range about 25 miles.
- 0255 - Contact No. 88 bearing 276.
- 0302 - No. 88 faded.
- 0306 - Regained No. 88.
- 0353 - Started snorting for charge. Sea calm. Visibility good. Battery reading 1164.
- 0440 - BLR 1 contact bearing 160 strong. Emergency secure snorting. Battery reading 1165.
- 0444 - Contact No. 88 bearing 298. Started tracking.
- 0449 - No. 88 bearing 291. Classified submarine.
- 0458 - No. 88 bearing 278. Growing left.
- 0501 - No. 88 reported opening, then closing at 0507, then opening at 0514.
- 0515 - Classified non submarine. Secured tracking. Contact No. 89 bearing 185.
- 0525 - No. 88 faded.
- 0528 - Contact No. 89 bearing 150.
- 0531 - Contact No. 90 bearing 065.
- 0554 - Contact No. 91 bearing 077.
- 0559 - Lost No. 91.
- 0601 - Nos. 89 and 90 faded.
- 0630 - No. 91 bearing 064 classified submarine.
- 0635 - Regained No. 89.

- 18 -

- 0645 - Contact No. 92 bearing 165.
- 0710 - No. 91 faded.
- 0730 - Regained No. 91 bearing 040.
- 0802 - Started snorting for charge. Battery reading 1169.  
All contacts lost. Wind SSW force 3. Sea and Swell  
22. Overcast. Good visibility.
- 0900 - Secured snorting. Battery reading 1180.
- 0938 - Contact No. 93 bearing 020.
- 0957 - No. 93 classified submarine. Started tracking.
- 1051 - Contact No. 94 bearing 260.
- 1115 - No. 93 faded.
- 1200 - Spent previous 24 hours as follows:-
- |                 |                     |
|-----------------|---------------------|
| Deep            | 19 hours 12 minutes |
| Snorting        | 3 hours 18 minutes  |
| Periscope depth | 1 hour 30 minutes.  |
- 1202 - Started snorting for charge. Battery reading 1180.  
No contacts.
- 1213 - Sighted DE bearing 276 (this was contact No. 93).  
Range 4 miles. Emergency secure snorting. DE  
approaching but not in contact. Went deep and  
manoeuvred to open range.
- 1243 - DE passed about 3000 yards astern. No contact on us.
- 1254 - Contact No. 94, another DE, not sighted, sweeping in  
company with No. 93 passed about 750 yards astern.  
Did not gain contact.
- 1320 - Lost all contacts.
- 1544 - To periscope depth to prepare to snort. DE in sight  
about 4 miles away, searching the area. BLACK forces  
know our charging periods. We have been sunk by air-  
craft during this period on the last two days, so  
they know both where and when. So here is a DE.  
Another lost charging period. (DE allotted contact  
No. 95).
- 1606 - Went deep. Retired to southward.
- 1705 - No. 95 faded.
- 1920 - Contacts No. 96 bearing 325, No. 97 bearing 183.
- 1938 - Lost contact No. 97.

- 19 -

1950 - Periscope depth. Sighted DE (No. 96) range 8,000 yards, searching at slow speed. Appeared to be hove to. Battery reading now 1146 so endeavoured to raise DE by SST to inform him that we were about to surface for emergency charge. Weather: wind S force 5. Sea 5 Swell 4. Visibility 5 miles, sky overcast.

2010 - Surfaced after dive of 177 hours 42 minutes.

COMMENT: Although C.O. in his narrative remarked that DE was sitting target and would have been attacked in war, I would like to have seen this simulated.

2020 - Started charge, informing DE by light of situation. DE retired.

- 20 -

Thursday 26th August

- 0001 - Weather as before except visibility down to 2 miles in mist.
- 0103 - Dived. Battery reading 1189.
- 0349 - Contact No. 98 bearing 055.
- 0355 - Contact No. 99 bearing 020.
- 0411 - No. 99 classified possible submarine.
- 0415 - Transmissions heard from No. 99 bearing 040. Classified DE.
- 0430 - Lost contact No. 98.
- 0442 - Contact No. 100 bearing 095.  
The DE (contact No. 99) continued to sweep out the area, twice passing close to CROAKER, and retired at the end of the snorting period, 0500.
- 0549 - Lost No. 99.
- 0550 - Lost No. 100.
- 0610 - Regained No. 100 bearing 024.
- 0755 - Started snorting for charge. Battery reading 1189.
- 0813 - Contact 100, a DE closing. Secured snorting. Battery reading 1191. Went deep.
- 0823 - Contact No. 101. Bearing 290.
- 0904 - Lost No. 100.
- 0910 - No. 101 passed close ahead. Classified DE.
- 0915 - Retired to southern part of area.
- 0928 - No. 101 faded.
- 1200 - Last 24 hours spent as follows:-
- |                 |                     |
|-----------------|---------------------|
| Deep            | 17 hours 13 minutes |
| Snorting        | 0 hours 29 minutes  |
| Periscope Depth | 1 hour 24 minutes   |
| Surfaced        | 4 hours 54 minutes. |
- 1202 - Started snorting for charge. Battery reading 1182. Wind S force 4. Sea and Swell 54. Fog.
- 1300 - Secured snorting. Battery reading 1190.
- 1555 - Started snorting for charge. Battery reading 1195. Sea state 3 from south. Visibility 1 cable in fog.

- 21 -

- 1700 - Secured snorting. Battery reading 1199.
- 1702 - Contact No. 102 bearing 045. Fishing vessel.
- 1836 - Contact No. 103 bearing 090.
- 1902 - No. 103 faded.
- 1915 - Lost No. 102.
- 1938 - Contact No. 104 bearing 125.
- 1955 - Started snorting for charge. Battery reading 1191.  
Weather: wind force 5 from SW. Sea and Swell 54.  
Overcast. Visibility 4 cables.
- 2100 - Secured snorting. Battery reading 1207.
- 2113 - Contact No. 105 bearing 096.
- 2210 - No. 105 faded.
- 2239 - Contact No. 106 bearing 345.
- 2248 - No. 106 faded.
- 2350 - Periscope depth. Very dark. Intermittent ECM  
contact about 9150 kcs.
- 2359 - Started snorting for charge. Battery reading 1207.  
Too dark for weather observation.

- 22 -

Friday 27th August

- 0030 - ECM contact faded.
- 0033 - New ECM contact (9475 kcs) distant.
- 0100 - Secured snorting. Battery reading 1209.
- 0345 - Contact No. 107 bearing 350. A DE sweeping the area echo ranging as our snorting period approaches.
- 0426 - DE passed about 1800 yards to westward. Continued to sweep back and forth and was not lost until 0639.
- 0731 - Regained No. 107 bearing 336, distant.
- 0805 - Started snorting for charge. Battery reading 1197. Wind WSW 3. Sea and Swell 22. Visibility good. Sky clear.
- 0809 - Sighted aircraft closing. Emergency secure snorting.
- 0811 - Went deep. 1 charge. Probable successful attack.
- 0836 - Contact No. 108 bearing 310.
- 0845 - No. 107 faded.
- 0850 - No. 108 faded.
- 1001 - Regained No. 107 bearing 230. Closing.
- 1007 - Started tracking No. 107, the DE.
- 1110 - Simulated firing one Mark 28 Mod 2 from aft. Transmitted firing data on UQC. Answered by submarine SABLEFISH 1200 yards on beam.

COMMENT: This was hard luck. A DE has been prowling round our area just before every snorting period, we've always let him go. This time the decision was taken to teach him a lesson and we attacked. The attack was carried out on the same principle of keeping the bearing steady, then turning underneath him on opposite course and firing from the stern tubes. This seems very dangerous to me against a DE. On this occasion the DE was escorting a surfaced submarine whose HE was masked by the DE. But as the DE did not gain contact the result of this action was probably 1 DE sunk. 2 submarines escaped.

1200 - Spend last 24 hours as follows:

Snorting	4 hours 12 minutes
Deep	18 hours 35 minutes
Periscope Depth	1 hour 13 minutes

- 1205 - Started snorting for charge. Battery reading 1177. Wind WSW 3. Sea and Swell 43. Sky clear. Visibility good.



- 23 -

- 1300 - Secured snorting. Battery reading 1178.
- 1422 - Contact No. 109 bearing 150. High noise level.  
Closing.
- 1440 - No. 109 faded.
- 1507 - Contact No. 110 bearing 338. Reported closing, angle  
on the bow starboard 30, range about 15,000 yards,  
classified submarine. Started tracking.
- 1527 - Periscope depth. Sighted DE. Let him go.
- 1611 - Started snorting for charge. Battery reading 1181.  
Lost No. 110. Wind SW force 4. Sea and Swell 33.  
Sky clear with 1/10 scattered cloud. Visibility  
8 miles.
- 1700 - Secured snorting. Battery reading 1186.
- 1705 - Contact No. 111 bearing 053, fishing vessel.
- 2000 - No. 111 faded. Started snorting for charge. Battery  
reading 1186. Wind SSW 3. Sea and Swell 23. Sky  
clear.
- 2100 - Secured snorting. Battery reading 1193.
- 2201 - Contact No. 112 bearing 328. Regained No. 111  
bearing 048.
- 2220 - No. 112 faded.
- 2342 - Lost No. 111.

- 24 -

Saturday 28th August

0403 - Started snorting for charge. Battery reading 1181.  
Wind SW 3. Sea and Swell 33. Sky 5/10 clouded.  
Visibility 7 miles.

0500 - Secured snorting. Battery reading 1189.

0524 - Contact No. 113 bearing 172.

0645 - Lost No. 113.

0702 - Contact No. 114 bearing 180.

0713 - Lost No. 114.

0811 - Contact No. 115 bearing 148.

0902 - No. 115 faded.

1054 - Contact No. 116 bearing 275. Classified submarine.  
Started tracking.

1127 - Periscope depth. Sighted contact No. 116, surfaced  
submarine.

1132 - Simulated firing 2 Mark 16 torpedoes, range  
estimated 2800 yards on 114 track. Failed to make  
contact with target on UQC.

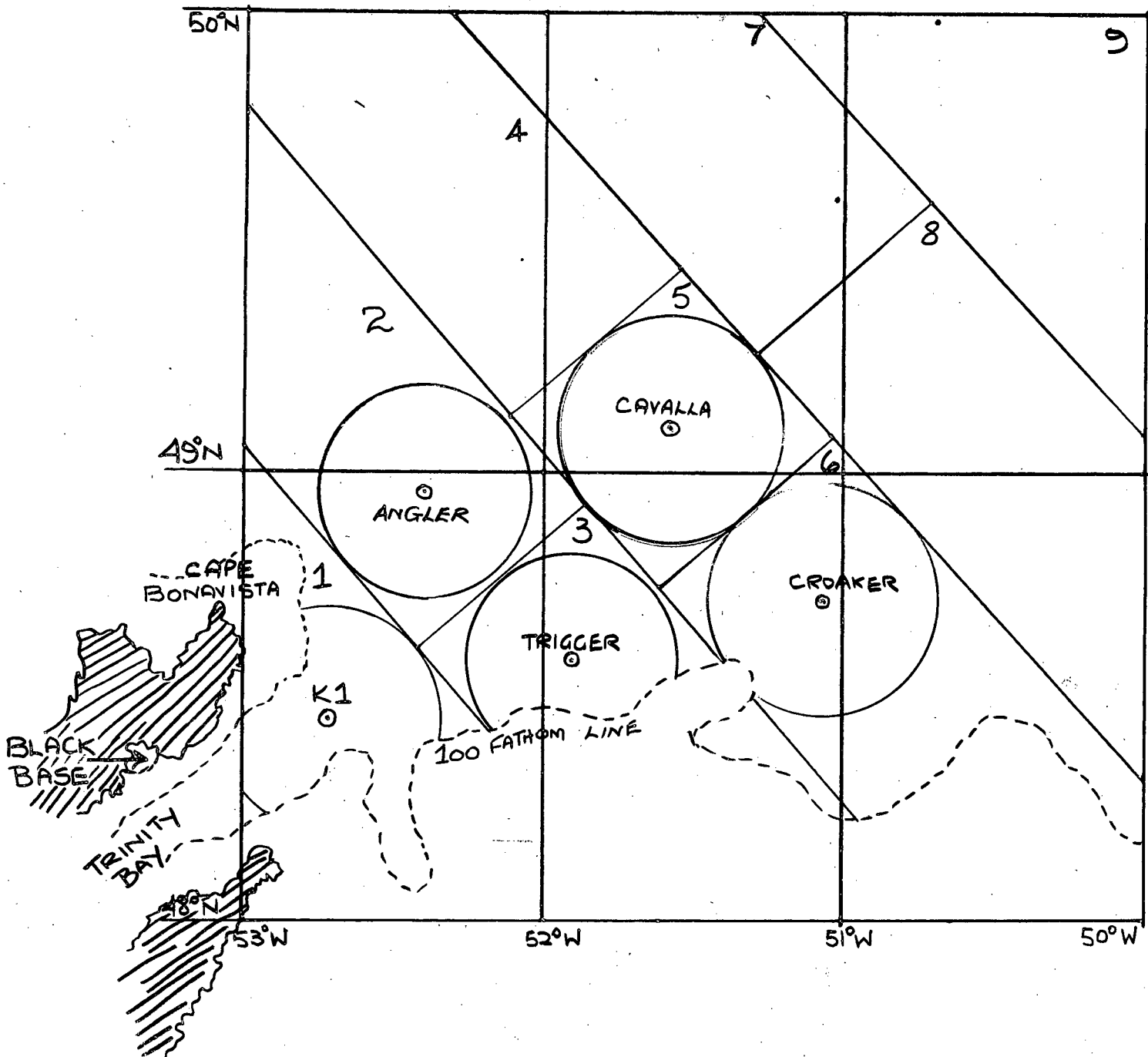
COMMENT: Only two straight running torpedoes at 3,000  
yards range in a heavy sea seems a very false  
economy.

1200 - EXERCISE LANTSUBEX - 1 COMPLETED. Battery reading 1181.

Last 24 hours spent as follows:-

Periscope depth	2 hours 6 minutes
Snorting	3 hours 30 minutes
Deep	18 hours 24 minutes.

# APPENDIX "B"

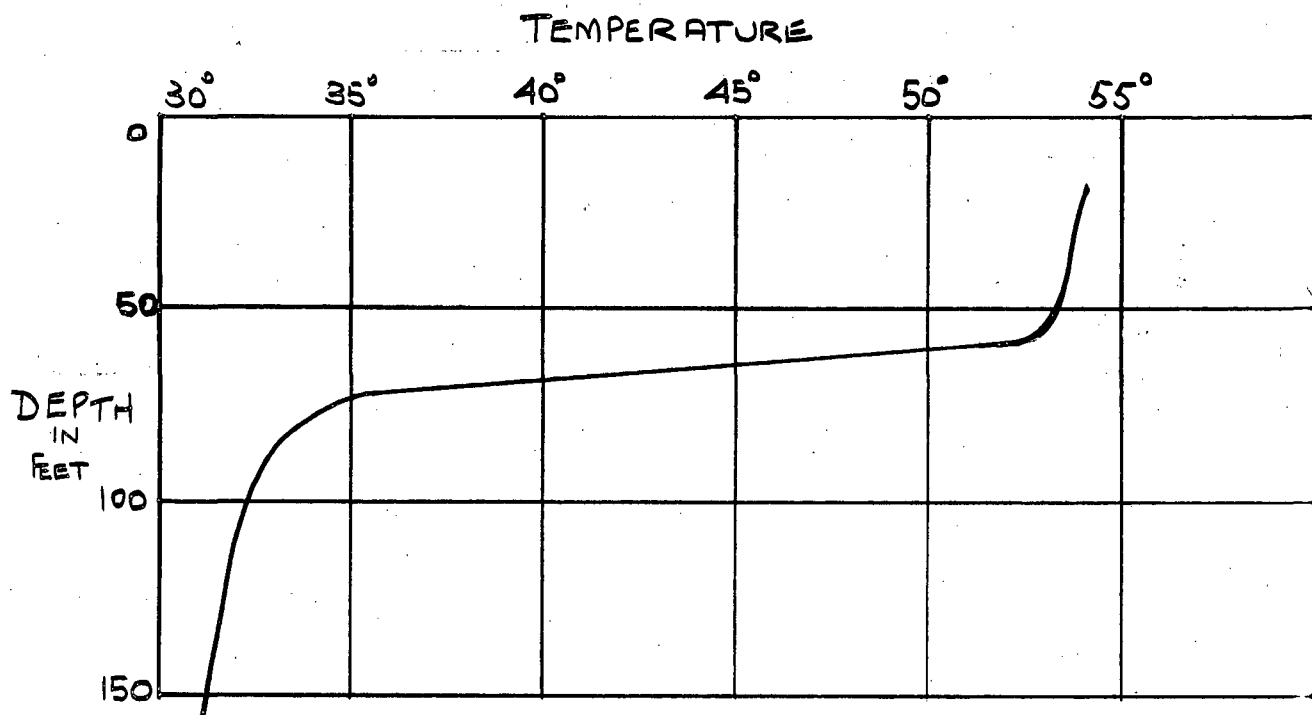


## THE EXERCISE AREA

1. Submarines to keep as close as possible to "normal patrol position" shown in each area.
2. The 100 fathom curve is a boundary of the exercise area.
3. Initial patrol areas are shown, and as far as is known areas 4, 7, 8 and 9 were not used.

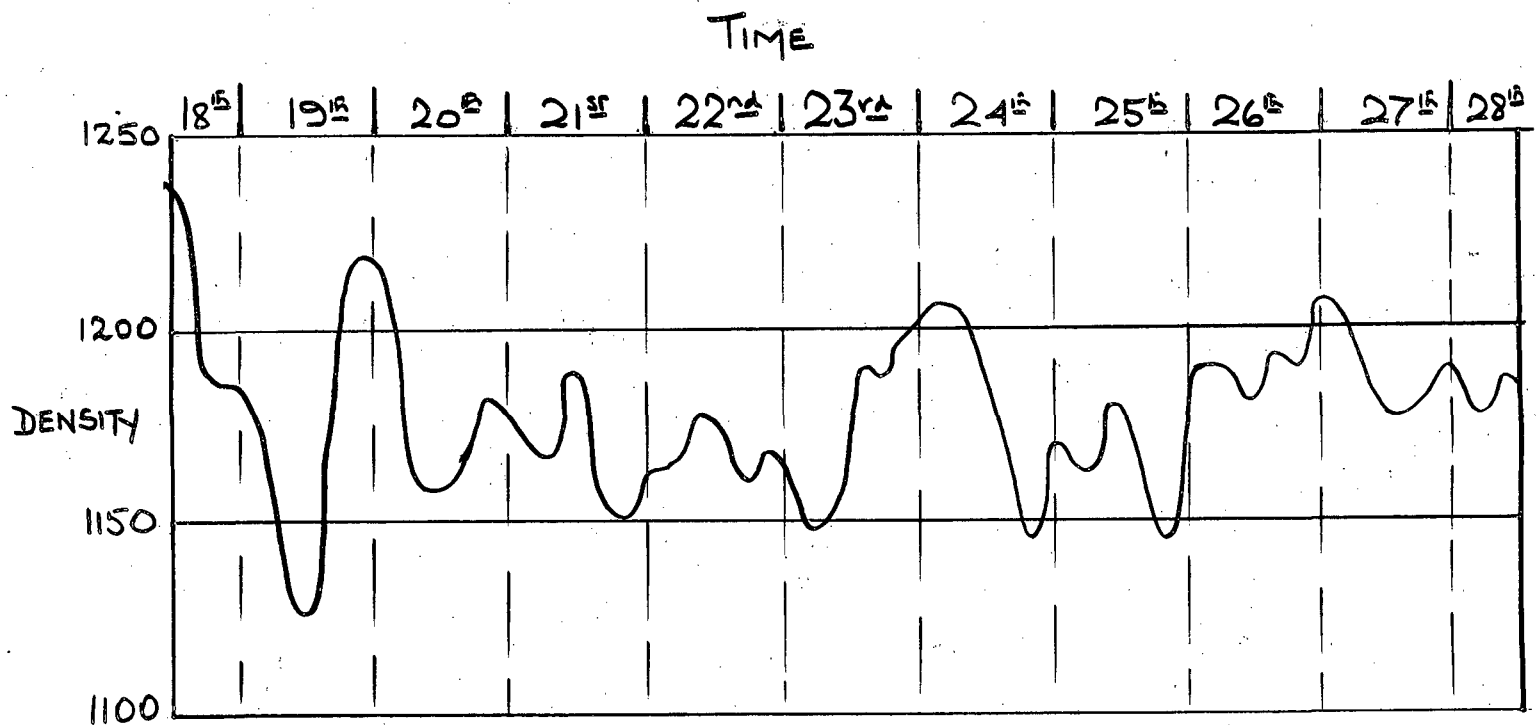
# APPENDIX "C"

## TYPICAL BATHYTHERMOGRAPH TRACE



# APPENDIX "D"

## BATTERY DENSITY CHART



SECRET

GUARD

SECRET - GUARD

Office of Flag Officer Atlantic Coast  
H.M.C. Dockyard, Halifax, Nova Scotia  
14th September, 1954

ACS: 1660-5

EXERCISE LANTSUBEX 1 - 55

Enclosure (1) Report by Lieutenant Commander Bonner,  
R.N. on LANTSUBEX 1-55 dated 7th  
September, 1954.

Enclosure (1) is submitted for the information of Naval  
Headquarters.

Chief of Staff  
14th September 1954

REAR ADMIRAL

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REPORT

ON

EXERCISE LANTSUBEX 1-55

(A submarine versus submarine exercise  
carried out off Newfoundland during August 1954)

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REPORT ON EXERCISE LANTSUBEX 1-55

Exercise LANTSUBEX 1-55 was carried out off the east coast of Newfoundland from 1200Z on 18th August to 1200Z on 28th August 1954, by United States Naval forces under the direction of the Commander Submarines, United States Atlantic Fleet.

2. For the duration of the exercise the Staff Officer Submarines to the Flag Officer Atlantic Coast was embarked in U.S.S. CROAKER as Royal Canadian Naval observer.

U.S.S. CROAKER

3. U.S.S. CROAKER is a fleet submarine of the GATO class, launched in December 1943. In December 1953 she was recommissioned after conversion to SSK, a specialist anti-submarine submarine.

4. The main points of this conversion were:

- (a) Removal of two upper forward torpedo tubes to make room for installation of BQR4A listening array round bow.
- (b) Removal of No. 2 main engine in order to make room aft for auxiliary machinery (ballast pumps, compressors, distillers, refrigeration machinery etc.).
- (c) The space vacated by this auxiliary machinery (the old pump room) has been converted into a sound insulated "sound room" containing all the listening stacks, and an electronics equipment room where all such equipment is gathered together comparatively free from damp.
- (d) The silent mounting of all machinery.
- (e) Removal of motor and pump drive from hydroplanes and steering. These are all direct hydraulic.
- (f) Streamlining of superstructure, with plastic casing in vicinity of BQR4A array.

5. The battery is of the standard fleet boat type, a GOULD 8460 amp. hour in two sections of 126 cells each with individual cell ventilation, operating at 250 volts. This battery has been fitted with agitator equipment, but this does not appear to be very effective, as gravity after a high discharge is still wont to read higher than before. This type of battery is rated for a top dived speed of 10 knots for 1 hour with 7 knots for 6 hours.

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### EQUIPMENT

#### Masts

6. CROAKER has ten telescopic masts carrying equipment which may thus be exposed above the water when the ship is at periscope depth. These are:

- (i) AN/BPS radar antenna.
- (ii) Search periscope with ST. radar antenna.
- (iii) Retractable whip aerial.
- (iv) Directional ECM antenna (a).
- (v) UHF and IFF aeriels.
- (vi) VLF loop. (This only raises clear above top of sail, not above surface).
- (vii) ECM omni-directional antenna (c).
- (viii) Attack periscope.
- (ix) Snort induction, with omni-directional ECM antenna (b).
- (x) Snort exhaust (also below surface. Kept six feet below induction).

#### Radar

7. AN/BPS is a combined air/surface warning set. It has been fitted as an improvement on SV but is not so popular, mainly because its minimum range is about 800 yards

8. ST is the periscope radar, the antenna for which is carried on top of the search periscope. The beam width is about sixty degrees and this is a very convenient short range set for quick sweeps round in bad visibility to ensure own safety, in addition to its primary function of attack.

#### ECM

9. The BLR 1 search receiver is fitted with the three antennae marked (a), (b), and (c) in paragraph 6 above. Antennae cover following bands:-

- (a) has 2 horns, 2,500 m/cs to 5000 m/cs and 5,000 m/cs to 10,750 m/cs
- (b) 1,000 m/cs to 4,500 m/cs.
- (c) 4,500 m/cs to 10,750 m/cs.

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### Sonar

10. The main sonar set is the BQR4A listening array described in ACS: 1225-1 of 16 June, 1954. The stack for this set appears to be an exact copy of that for the German GHG, or "Balkon", hydrophone.

11. The fire control sonar is the JT, a passive listener with a split magneto striction hydrophone. When in firm contact this can be switched to automatic target follow, giving a smooth rate of bearing change to the fire control computer.

12. The only other sonar set is the WCA equipment, a listening and transmitting set mounted on a bottomside lowering dome. It carries a JT on the port head and a QB on the starboard. This obsolete set is generally regarded as "worthless" but is presumably retained as the only means of echo ranging or of transmitting on S.S.T.

### Underwater Communications

13. The standard UQC underwater telephone is used.

14. Various equipments to increase the security of underwater speech are now under trial, and one, the XLF, is partially installed in CROAKER. This is an underwater telephone operating at 2.5 k/cs with a legend range of 70 miles. Transmission is all round and CW transmissions go out "in clear". Speech, however, is carried onto a tape which transmits it at  $\frac{1}{4}$  the speed it was received, the receiving tape bringing it back to normal speed in the loudspeaker. In transit, however, the quarter speed speech is alleged to sound more like fish noise than most fish noise.

### Passive Ranging Device

15. CROAKER is due to be fitted in September with a "passive ranging device". It was not possible to glean much information about this. It is said to work on the triangulation principle; that time of wave reception at three different points in the ship can, by time delay mechanisms, be represented as simultaneous arrival at the ship and two other points. The radius of the circle through these three points is the range.

## THE EXERCISE ORDERS

### The Aim

16. The primary aim of LANTSUBEX 1-55 was to:

"Test and develop submarine anti-submarine warfare doctrine while training forces in its use, and test the feasibility of employing SS/SSK type submarines in patrol areas close in off a U-boat base, in the face of moderate to extensive ASW Air and Surface opposition".

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The Setting (See Appendix "B").

17. The concept of the exercise was that BLUE and totalitarian BLACK had been at war for one month. Trinity Bay, Newfoundland, was a BLACK base from which submarines operated in the mid-Atlantic and on the east coast of the U.S.A. BLACK had air and surface control of the exercise area, but waters inside the 100 fathom line had been made unpassable by BLUE minelaying. BLUE submarines were patrolling as close as feasible to BLACK's base in order to destroy his submarines in transit to and from their patrols.

Forces Taking Part

18. BLACK

Submarines	U.S.S. TROUT (SS) U.S.S. HARDHEAD (SS) U.S.S. SABLEFISH (SS)
Aircraft	V.P. 18 (NEPTUNES) from ARGENTIA
Surface Ships	14th Escort Squadron (4 DE's) U.S.S. GILMORE (Depot Ship).

19. BLUE

Submarines	U.S.S. ANGLER (SSK) U.S.S. KI (SSK) U.S.S. TRIGGER (SS/SSK) U.S.S. CROAKER (SSK) U.S.S. CAVALLA (SSK).
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20. BLUE submarines were disposed in areas as shown in Appendix "B". Each submarine was given a normal patrol position in the centre of her area, which she was to endeavour to maintain, keeping at all times within 15 miles of this point.

Exercise Artificialities

21. (a) Speed of advance of BLACK submarines was 5 knots minimum.
- (b) At least forty per cent of time of every transit was either surfaced or snorting.
- (c) When sea state was 5 or greater and during all scheduled charging periods BLACK submarines ran either surfaced or below 300 feet.
- (d) The period of the exercise was divided into two parts. Until 231200Z BLACK submarines transitted partly surfaced and partly submerged on main motors. During this period BLUE submarines charged as required. After 231200Z BLACK transits were conducted combining snorting and submerged main motor operation with limited surface running. During this period BLUE submarines had to charge during designated

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21.

(d) Cont'd

charging periods as follows:

<u>PRIMARY</u>	<u>SECONDARY</u>
0400 - 0500	0000 - 0100
1200 - 1300	0800 - 0900
2000 - 2100	1600 - 1700

Any emergency charging required had to be carried out on the surface.

BLUE Aims

22.

- (1) Simulate destruction of BLACK submarines.
- (2) Test and develop submarine anti-submarine warfare doctrine and tactics.
- (3) Test feasibility of conducting SSK patrols off enemy bases in face of moderate to extensive ASW air and surface opposition.
- (4) Test communications, particularly the transmission of contact and amplifying reports among submarines in the operating area during scheduled charging periods.
- (5) Assign and test the accuracy and reliability of navigating by RAFOS units.
- (6) Test the reliability and security of single ping echo ranging.
- (7) Evaluate the ability of a small submarine to remain submerged for a prolonged period under simulated war conditions.
- (8) Exercise the relief of submarines on station and the avoidance of mutual interference between friendly forces.

23.

The action taken to achieve these aims is described as follows:

Aims 1, 2, 3, and 6 under "Conduct of CROAKER's Patrol", paragraphs 25 - 54 and Narrative, Appendix "A".

Aim 4 under "Communications" paragraph 56.

Aim 5 under "Rafos" paragraph 57.

Aims 7 and 8 under "Operations of U.S.S. KI", paragraph 65.

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### Comment on the Exercise Orders

24. This is the first occasion on which a U.S.N. SSK exercise has had a strategic setting and an actual land base to be blockaded, but it is felt that the exercise largely failed through lack of imagination. The orders to the BLUE submarines to remain within 15 miles of a fixed point unless otherwise ordered by submarine control was unrealistic. There were no safety lanes or alternate areas to which a submarine could retire were her original patrol position compromised. CROAKER was discovered early on the second day of the exercise. After a four day's lull she was then systematically hunted by surface and air forces who knew both her position and the scheduled snorting periods laid down in the exercise orders.

### CONDUCT OF CROAKER'S PATROL

#### General Policy

25. Little thought appeared to have been given to the problem beforehand, and it was difficult at any time to elicit a firm policy from the Commanding Officer. In general the policy was to patrol continuously at slow speed, circling or weaving at 110 or 115 feet, listening on the BQR4A array, snorting for a charge for 1 hour in eight. W/T routines could be read at 80 feet, but the ship generally came to periscope depth for 15 minutes during each routine.

26. The ten days of the exercise were spent as follows:-

	<u>Hours</u>	<u>Minutes</u>	<u>Percentage</u>
Surfaced	4	54	2
Snorting	33	27	14
At periscope depth	19	33	8
Deep	182	06	76

#### Quiet Routines

27. Two stages of Quiet Routine, Patrol Quiet and Ultra Quiet were used. Ships' orders were detailed on what machinery was to be run in each state. No real attempt to achieve quiet was ever made however. Two or three cinema shows a day continued through the ultra quiet state and the one hundred record juke box (six selections for a nickel) was in constant use. The ultra quiet state which had been used for 15 minutes in each hour was abandoned on the third day of the exercise as it was considered that the boat became too cold and damp with heaters, blowers and air conditioning switched off.

#### Listening Conditions

28. Water conditions varied little throughout the exercise, a surface layer of about 55 degrees decreasing very rapidly to about 32 degrees at 100 feet. (See Appendix "C"). A normal array depth of 95 or 100 feet was used for listening.

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29. Maximum detection ranges of about 25 miles were achieved on a snorting submarine and on DES but it is stressed that this could only be ascertained by later analysis, as such contacts appeared and faded in the skip distances of the set and could not then be differentiated from the many other unclassified contacts gained.

30. This multiplicity of contacts appears to present the major problem in the use of the low frequency long range listening array. When four or five equally unattractive contacts are held simultaneously, the problem is whether to start tracking one immediately or to wait until a definite indication of propeller noise is heard when it may be too late to close to an attacking position. CROAKER gained 115 contacts on her BQR 4A. Of these, 16 were definitely identified either by sighting, by the fact that they were transmitting or on UQC after attack. Of these 16 contacts, 4 were developed into attacks. Two unidentified contacts were also attacked.

31. Of the tremendous number (99) of unidentified contacts gained it can only be assumed that the majority were schools of fish. Fish noise was a problem throughout the exercise, and could often be clearly heard through the hull. Although a number of contacts were classified as fishing vessels, no fishing vessel was ever sighted in the area.

32. Two sonarmen stood a 4 hour watch in tricks of about  $\frac{1}{2}$  an hour each.

#### Charging

33. A state of charge graph is attached as Appendix "D".

34. Although normal speed when deep was the minimum possible, there was no attempt to reduce the auxiliary load. Fresh water consumption was approximately 800 gallons a day, necessitating considerable use of the distillers. No control was placed on the use of heaters, lights, hot plates or the galley. Thus CROAKER was twice caught at what was considered to be a dangerously low state of charge. At 1252 on the 19th a surfaced submarine was allowed to pass as CROAKER had insufficient power available to close, and at 2010 on the 25th she was forced to surface in the presence of a DE, to put in a four and a half hour surface charge.

35. The policy was not to keep the battery as full as possible consistent with good listening, but to try to get by on three hours charging time a day. This routine of one hour's charging in eight had been so instilled into the Commanding Officer that when the R.C.N. observer suggested, towards the end of Part I of the exercise, that additional snorting periods should be taken to get the battery to a high state of charge before the "scheduled snorting periods" started, it was stated that snorting for more than one hour in eight was, unless absolutely necessary, "not playing the game".

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36. While snorting CROAKER was attacked by aircraft at 0354/19, 1223/23, 1627/24, and 0809/27. She was detected and reported by aircraft at 0537/23.

#### Use of ECM

37. CROAKER is fitted with a BLR 1 search receiver as described in paragraph 9.

38. This was not used during the first charge by day, but was closed up on every occasion of snorting after the submarine was attacked, during the first night charge.

39. At the beginning of the exercise there was no means of direct communication between the BLR 1 receiver in the forward starboard corner of the control room, and the conning tower. Thus at 1223/23 CROAKER was attacked by aircraft although the BLR 1 operator had been receiving "airborne racket", information of which did not reach the conning position. After this a temporary microphone was hooked up and CROAKER several times succeeded in getting deep safely on BLR 1 warning. CROAKER was, however, attacked three times by aircraft when BLR 1 was operating but had no contact.

40. After some experience the following routine was used when snorting. Antenna (b) on the snort induction was used, with continuous wave band sweep. When a contact was gained the receiver was locked on the received wave length and switched to the directional antenna (a), in order to get a bearing. This was only rarely achieved as policy was to secure snorting and go deep immediately on receipt of a "racket".

#### Use of Radar

41. CROAKER used her radar almost exclusively for self protection when snorting in bad visibility, when it was felt that there was a possibility of encountering a fishing boat lying to nets or some other type of silent obstruction.

42. Under these circumstances an all round ST sweep every five minutes, with a BPS4 sweep every 15 minutes was generally used. During one of these BPS sweeps the target subsequently attacked at 2332/21 was detected at 11350 yards before BQR4 gained contact.

43. No aircraft contacts were made on radar and there was no evidence to suggest that CROAKER's radar was ever detected by BLACK forces.

#### Maintenance of Equipment

44. The general technical knowledge of the enlisted men and of the junior officers was of an enviably high standard, but this failed to replace the ability of a qualified engineer officer. On several occasions no attempt was made to investigate a defect or to attempt running repairs.

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45. Throughout the patrol the following were defective: steering, both L.P. blowers, A.C. lighting circuits, snort head valve.

46. The following failed intermittently: one main engine, one main motor, battery agitator, retractable whip mast, fan to main transmitter.

47. The electronics technicians maintained a somewhat higher standard. Radar and W/T sets were all got back into commission fairly quickly after breakdowns, and the two main A/S sets, the BQR4A and JT were kept in continuous operation.

#### Attacking

48. The attack team layout was as follows:-

<u>Conning Tower:</u>	Captain 3rd Officer on T.D.C. 6th Officer, assistant T.D.C. 5th Officer, local hand plot.
<u>Control Room:</u>	4th (engineer) officer.
<u>Wardroom:</u>	Executive Officer in charge. 7th Officer, time bearing plot. 8th Officer, navigational plot. Chief Q.M., relative plot.

49. The plotting organization in the Wardroom was good, an automatic plot and permanent perspex relative and rate of change of bearing plots being built into the table. Direct communication by intercom was maintained with the conning tower and the sound room.

50. There was, however, no officer in the sound room, and lack of co-ordination between sound room and conning tower was marked. On two occasions bearings of the wrong target were being passed to the plotting team, and it was felt that too much was being left to the sonar-men on the set. There was no means whereby the conning tower could listen direct to the reception at the set, and the command had to rely upon reports from the operators. These were inclined to be altogether too clever with such statements as "Confirmed submarine, snorting at 7 knots, range 25,000 yards. We're thirty degrees on the starboard bow", added to the bearing.

51. Early in the exercise the ship went to Battle Stations Torpedo on each occasion of a promising contact, but after a few unproductive approaches this practice was dropped and approaches and attacks were carried out "on the watch". Thus of the six attacks completed the plotting organization was closed up for only one, in which it was not used.

52. Six attacks were carried out, as follows:  
(See Appendix "A", Narrative)

- (1) At 0048/21 from deep on unidentified target. Probably successful.

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52. (Cont'd)

- (ii) At 2332/21 from deep on unidentified surface target detected by radar.
- (iii) At 0400/23 from deep on submarine HARDHEAD on the surface. Possibly successful.
- (iv) At 0236/25 from deep on unidentified BLACK snorting submarine. Successful.
- (v) At 1110/27 from deep on unidentified D.E. Probably successful.
- (vi) At 1132/28 from periscope depth on unidentified surfaced submarine. Probably missed.

53. There was always reluctance to coming to periscope depth for a look to clarify the situation, and this cost CROAKER the chance of a submarine sinking during attack (v). But where the attack policy from deep is to get directly under the target the wish to keep the layer between the submarine and a possible A/S vessel is understandable.

54. Single ping echo ranging was used on only one occasion. No range was obtained.

#### Communications

55. Apart from one failure of the main transmitter no communication difficulties were experienced. CROAKER read the FOX V.L.F. schedule from Radio Washington without difficulty at 80 feet, and transmitted exercise traffic to shore on the retractable whip.

56. Inter-submarine communication (aim 4 of the exercise) was not attempted on the orders of the Squadron Commander.

#### RAFOS

57. RAFOS (so called as being the opposite of SOFAR) is a system of navigation whereby 55 lb. charges are exploded in known positions at known times. The time of arrival of the explosion noise is taken in the submarine, the travel time of the noise giving a range from the firing station which may be plotted as a position line. The Hydrographic office have produced RAFOS charts on the same lines as those for LORAN.

58. During this exercise three stations were in operation:

<u>STATION ABLE</u>	<u>STATION BAKER</u>	<u>STATION CHARLIE</u>
USS PENGUIN	USS PRESERVER	USCGC McCULLOGH
51 30'N	59 30'.2N	52 45'N
53 42'W	44 47'.5W	35 30'W

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59. Firing times were arranged so that signals were received in the order ABLE, BAKER, CHARLIE at approximately 5 minute intervals once every four hours. Ranges of stations from the patrol area were approximately 200, 650 and 800 miles. The nearest station was always heard through the hull, occasionally all three. A signal was only very occasionally missed on the hydrophones, and it seems probable that these shots were not fired due to firing ship being out of position, or a misfire. At least three misfired shots were heard to explode some 30 minutes late.

60. A scientific officer from Wood's Hole Oceanographic Institute was embarked in CROAKER to investigate the problem of taking accurate bearings of a RAFOS shot in order to obtain a fix from a single explosion.

61. The system used was as follows:-

One of the rod hydrophones of the BQR4A array was cut out of the array circuit and connected to a pen and ink recorder in the sound room. A moving coil hydrophone was fitted on the after casing and connected to another pen on the same recorder. A third pen on this recorder was driven by an accurate timing device measuring in milliseconds. The recorder was started just before a RAFOS shot was expected (the paper ran at 230 feet per minute) and the time difference of reception at the two hydrophones noted. The distance between the two hydrophones was known, and a cosine triangle would therefore theoretically give the relative bearing of approach of the sound front.

62. In fact, due to the varying response, of the two types of hydrophone in use and the rumbling nature of the explosion it was found extremely difficult or sometimes impossible to match the recorded sound waves. Thus no acceptable accuracy could be obtained by this method.

63. In general RAFOS fixes appeared to give an accuracy of about 6 miles.

64. Thus with fixed shore stations giving additional accuracy this appears to be a feasible method of submarine navigation in peacetime. To escape enemy interference in time of war short transmissions at high power on varying frequencies may possibly take the place of the explosive charges.

#### OPERATIONS OF U.S.S. KI

(U.S.S. KI is described in the report forwarded under cover of ACS:1225-1 of 16 June, 1954).

65. In order to prove the ability of the K class of small specialist anti-submarine submarine to carry out a patrol under simulated war conditions KI sailed from New London at 0800Q on 10th August, diving later that day off the Nantucket Shoal Lightship. She then proceeded dived to the exercise area, took part in the exercise, and is, at the time of writing of this report, returning dived to New London, E.T.A. 8th September. She will thus have remained submerged for approximately one month.

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66. In order to test the relief of submarines on station and the avoidance of mutual interference between friendly submarines, she passed westward to her patrol position through friendly submarine areas on 19th August. A moving haven was established around her, this message being received in CROAKER at 0225Z/19th. She passed through CROAKER's area as expected being spoken on XLF at 0724Z on 19th.

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APPENDIX "A"

NARRATIVE OF U.S.S. CROAKER'S PATROL

ALL TIMES ZEBRA

Unless otherwise stated all contacts made by Sonar BQR 4A

Sunrise 0820 Sunset 2230 throughout

Wednesday 18th August

- 0700 - In patrol position 48° 35' North 51° 04' West.  
1028 - Dived. Battery reading 1246.  
1200 - Exercise LANTSUBEX 1-55 commenced. Wind SSW Force 5.  
Sea and Swell 53. Sea conditions: 200° negative layer  
between 45 and 80 feet.

POLICY: Stated policy is to patrol beneath layer at  
array depth 110 feet. BQR 4A manned continuously,  
JT and WCA at standby. 15 minutes of each hour in  
ultra-quiet state. Remainder at patrol quiet. Speed  
normally 40 turns for 1-2 knots on broad weave or  
circling. No fixed policy for charging. This will  
be carried out as required mainly by night.

- 1545 - BQR contact No. 1. This contact was tracked and  
eventually sighted at  
1714 - Identified as DE. Range about 9,000 yards. CROAKER  
2,000 yards off track.  
1720 - Another DE sighted about 2,000 yards beyond first.  
Ship then returned to 115 feet. Intention to pass  
deep between the two DES in the hope that if they  
were escorting a submarine this would be picked up  
when the DES had passed.  
1721-  
1804 - After going deep only one contact, the first DE,  
was regained. This passed close ahead.  
1804 - Periscope depth. Nothing in sight.

COMMENT

This was probably a surface attack unit of two  
ships sweeping west through the area. CROAKER at  
no time held the initiative as she was deep, receiving  
too little information to form any idea of what was  
going on. She was saved from detection by the layer.  
Initial detection range of DES was about 24 miles.

- 1913 - Commenced snorting for charge. Battery reading 1189.  
Visibility good. Wind South Force 4. Sea and Swell  
43. 3/10 cloud. BLR 1 was not operated as "visibility  
was good enough".  
2014 - Secured snorting. Battery reading 1199. Depth 115  
feet to listen.

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- 2027 - BQR contact No. 4.
- 2033 - Lost contact.
- 2218 - BQR contact No. 5, bearing 330°.
- 2227 - BQR contact No. 6, bearing 057.
- 2232 - Contact No. 5 lost.
- 2302 - BQR contact No. 7 bearing 005.
- 2320 - BQR contact No. 8 bearing 043.
- 2331 - BQR contact No. 9 bearing 160.
- 2338 - Contact No. 6 strength increasing, No. 7 faded,  
No. 9 fading, No. 8 held. No appreciable bearing  
movements. After fluctuations of signal strength  
all contacts had faded by 0018.

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Thursday 19th August

- 0037 - Contacts 6, 8 and 9 having been regained spasmodically were classified as fish.
- 0054 - BQR contact No. 10 bearing 269, classified as fish.
- 0149 - BQR contact No. 11 bearing 340.
- 0156 - BQR contact No. 11 growing right, classified as screw noise. Started approach.
- 0211 - Broke off approach as CROAKER had reached limit of her area.
- 0258 - BQR contact No. 12 bearing 011.
- 0303 - Contact No. 11 faded, possibly masked by No. 12.
- 0311 - No. 12 classified as fish. No. 11 not regained.
- 0316 - Periscope depth. Wind force 4 from SSW. Sea State 4. Clear sky. Moonlight.
- 0343 - Started snorting to charge. Battery reading 1186. BLR 1 manned, operating on directional antenna.
- 0354 - Two grenades. On looking through periscope found flare overhead and aircraft's navigation lights visible.
- 0355 - Secured snorting. Went deep.
- 0417 - Returned to periscope depth. White flare sighted about 3 miles away.
- 0418 - BQR contact No. 13 bearing 065.
- 0430 - Aircraft sighted approaching but stayed up as W/T routine was being read. Aircraft is circling vicinity dropping flares and possibly sonobuoys but no contact can be made on BLR 1. Periscope and whip antenna are up but aircraft appears to have no contact. Whip antenna mast jammed slightly below right up position.
- 0457 - Went deep on completion of W/T routine.
- 0459 - BQR contacts No. 13 bearing 065, No. 14 bearing 160, No. 15 bearing 015.
- 0514 - No. 15 faded.
- 0517 - No. 16 bearing 080, reported as range closing, classified possible submarine.
- 0556 - No. 14 faded.

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- 0724 - Established XLF communication with K 1 transitting northern portion of our area. She was contact No. 16.
- 0726 - No. 13 faded.
- 0738 - No. 16 faded.
- 1025 - Contact No. 17 bearing 360.
- 1053 - No. 17 faded.
- 1128 - Contact No. 18 bearing 243.
- 1143 - Regained No. 13 bearing 080. This and another contact bearing about 160 appear to be ghosts appearing intermittently.
- 1200 - Previous 24 hours have been spent:  
Periscope depth 2 hours 45 minutes.  
Snorting 1 hour 12 minutes.  
Deep 20 hours 3 minutes.
- Clear sky, good visibility, wind south force 4, sea state 3. Water conditions same.
- 1219 - Sighted DE bearing 205 about 5 miles. This is contact No. 18. Transmissions heard.
- 1230 - Sighted surfaced submarine astern of DE. Identified as USS SABLEFISH by reading hull number. (Contact No. 19).
- 1232 - Went deep, dead slow, to commence tracking.
- 1252 - Broke off attack as battery now low (gravity 1140) and distance off track estimated as 7,000 yards.

COMMENT

Whip antenna being jammed in up position forced decision to make submerged approach but this was not started until 1240 although bearing movement had been evident since 1150.

- 1355 - Commenced snorting for charge. Battery reading 1127. Clear sky, sea state 4, wind west by south force 4.
- 1410-
- 1450 - BLR 1 held intermittent contact on 2.35 KMC. No known U.S. radar.
- 1802 - Stopped snorting. Battery reading 1212. Went deep, 115 feet.
- 1805 - BQR contact No. 20 bearing 020.
- 1835 - No. 20 faded.
- 2031 - Contact No. 21 bearing 292.

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- 2035 - No. 21 faded.
- 2050 - Contact No. 22 bearing 152.
- 2058 - Contact No. 23 bearing 324.
- 2146 - All contacts faded. Battery reading 1213.
- 2205 - Commenced snorting for charge. Visibility good with 9/10 cloud cover. Sea state 3. Wind SSW force 4.
- 2306 - Secured snorting. Battery reading 1220.
- 2324 - Contact No. 24 bearing 097.
- 2345 - Contact No. 25 bearing 072.
- 2348 - Echo ranging heard on bearing of No. 24. Appreciation was that No. 25 was a surfaced submarine escorted by No. 24.
- 2349 - Commenced sound approach.

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Friday 20th August

- 0011 - Lost contact No. 25.
- 0013 - Contact No. 26 bearing 163. Commenced tracking. No appreciable change of bearing for 20 minutes, although BQR reported closing.
- 0045 - Bearing still steady, but contact fading. Broke off approach as it was appreciated that target had reversed course.

COMMENT

Probably one DE passed through area, but it is possible that it was surfaced submarine pinging. Contact No. 26 was probably distant fishing boat.

- 0115 - Contact No. 26 faded still bearing 165.
- 0233 - Contact No. 27 bearing 258.
- 0244 - Contact No. 28 bearing 210.
- 0317 - No. 28 faded.
- 0403 - No. 27 faded.
- 0422 - Contact No. 29 bearing 065.
- 0437 - Contact No. 30 bearing 170.
- 0521 - Contact No. 31 bearing 000.
- 0815 - All contacts faded.
- 0900 - Started snorting for charge. Battery reading 1179. Weather: good visibility, Wind S by W force 4. Sea 4 Swell 3. Sky 4/10 covered by cloud.
- 1029 - Secured snorting. Battery reading 1158. (Pilot cells had been watered during charge. No true reading was taken) Went deep.
- 1100 - Contact No. 32 bearing 070.
- 1140 - Contact No. 33 bearing 140.
- 1143 - Lost No. 33.
- 1147 - Regained No. 33.
- 1152 - Lost No. 32.
- 1157 - Lost No. 33.
- 1200 - Previous 24 hours have been spent:

Deep	15 hours 27 minutes
Snorting	6 hours 38 minutes
Periscope depth	1 hour 55 minutes.

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- 1203 - Regained No. 33.
- 1206 - Lost No. 33.
- 1215 - Regained No.'s 32 and 33.
- 1220 - Lost No. 33.
- 1240 - Lost No. 32. No contacts.
- 1539 - Contact No. 34 bearing 015.
- 1601 - Contact No. 35 bearing 112.
- 1613 - No. 34 faded. New contact No. 36 bearing 085.
- 1628 - No. 35 faded.
- 1703 - Contact No. 37 bearing 295.
- 1802 - Contacts 36 and 37 still hold. Nothing in sight from periscope depth. Started snorting. Battery reading 1163. Visibility 2 miles in rain. Sea and swell 33 from South.
- 1905 - Lost depth control deep. Enforced secure snorting. Battery reading 1172. Steadied at 115 feet.
- 1916 - Contact No. 38 bearing 228.
- 1930 - Decision taken to no longer use ultra quiet state. Too cold and damp.
- 1941 - Contact No. 39 bearing 250.
- 1950 - Contact No. 40.
- 2016 - Contact No. 41 bearing 292.
- 2055 - No. 41 faded.
- 2108 - No. 40 faded.
- 2122 - No. 39 faded. No contacts.
- 2158 - Started snorting for charge. Battery reading 1174.
- 2308 - Secured snorting. Battery reading 1184.
- 2336 - Contact No. 42 bearing 065.
- 2351 - Contact No. 43. Firm contact with screw beat bearing 190.
- 2355 - Commenced tracking No. 43.

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Saturday, 21st August

0007 - Lost contact No. 43.

0015 - Contact No. 44 bearing 150.

0028 - No. 44 firm contact giving screw beat bearing left.

0032 - Manned Battle Stations Torpedo. CROAKER on course 060 at 2 knots holding bearing steady at 135. No other contacts. High pitched screw noise about 200 revs. Bearing held steady until target was very close (TDC gave 250 yards from track at 600 yards range) when at

0046 - CROAKER swung with full right rudder under target on approximately opposite course. TDC solution of enemy course 335 at 11 knots held as bearing changed rapidly left and at

0048 - CROAKER fired two simulated mark 28 Mod. 2 torpedoes from stern tubes at 520 yards range.

COMMENT: Target unidentified. Sounded too light for submarine. Attack unconventional by our doctrine but seemed very effective if intelligent torpedoes co-operate. No reply was received to calls on UQC and QB.

0116 - Contact No. 45 bearing 045.

0123 - Contact No. 46 bearing 170.

0126 - Contact No. 44 (target of the attack) appeared to be closing again, then steady, finally fading by 0155.

0206 - Lost contacts 45 and 46. No contacts.

0240 - No. 45 regained.

0308 - No. 45 faded.

0350 - Contact No. 47 bearing 304.

0402 - BQR4A reports engine noises on bearing.

0412 - No. 45 regained bearing 065.

0422 - No. 45 growing right, appears to be closing, bearing 071.

0438 - No. 46 regained bearing 189.

0449 - CROAKER turned to course 304 to investigate No. 47.

0454 - BQR4A reports No. 45 closing from 075.

0501 - Regained No. 43 bearing 190.

0507 - Contact No. 47 suddenly ceased.

COMMENT: No. 47 was probably USS CAMALLA, patrolling in area to North West of us, on a snorting charge.

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- 0512 - Contact No. 48 bearing 252, is now only contact held by BQR 4A.
- 0548 - Contact No. 49 bearing 114.
- 0557 - Contact No. 50 bearing 009.
- 0614 - Contact No. 51 bearing 082.
- 0731 - No. 49 faded.
- 0740 - No. 50 faded.
- 0757 - No. 51 faded. No contacts.
- 0835 - Started snorting charge. Battery reading 1170.  
Weather: Wind SSW - 2. Sea 1 Swell 3. Haze.  
Visibility about 3 miles.
- 1000 - Visibility 1000 yards.
- 1025 - Operating ST radar. Visibility 2 cables. No contact.
- 1035 - Secured snorting. Battery reading 1191.
- COMMENT: After our unfortunate experience of being sunk ten minutes after the start of our first night charge, stated charging policy is now to charge mostly by day for three hours out of the 24. This is influenced by the fact that no aircraft have been sighted by day and possibly only night patrols are being flown.
- 1044 - Regained No. 45, bearing 070.
- 1200 - Last 24 hours spent as follows:
- |                 |                     |
|-----------------|---------------------|
| Deep            | 18 hours 30 minutes |
| Snorting        | 4 hours 12 minutes  |
| Periscope Depth | 1 hour 18 minutes.  |
- 1256 - Contact No. 52 bearing 080.
- 1312 - No. 45 faded.
- 1342 - No. 52 faded. No contacts.
- 1634 - Contact No. 52 bearing 021.
- 1712 - Regained No. 51 bearing 085.
- 1721 - Regained No. 45 bearing 062.
- 1735 - Contact No. 53 bearing 042.
- 1831 - No. 53 reported growing left and closing.
- 1921 - No. 53 after remaining steady at 025 for 50 minutes reported closing and growing left.
- 1930 - Commenced tracking.

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1948 - To periscope depth. Visibility 500 yards. Nothing in sight. Returned deep.

2028 - Contact No. 54 bearing 110.

2031 - Contact No. 55 bearing 065, turn count 180. Started tracking.

2040 - Echo ranging heard from Nos. 54 and 55, bearings growing left. Both contacts passed to northward, nearer between 800X and 1000X. No other contact.

COMMENT: Probably two ship S.A.U. Layer saved us from detection again.

2120 - Contact No. 56 bearing 157.

2130 - Periscope depth. Visibility 1000 yards. ST radar sweep. No contact.

2149 - All contacts faded.

2150 - Started snorting for charge. Battery reading 1157. ST radar sweep every 5 minutes, and BPS4 radar sweep every 15 minutes. Weather: Wind NNW force 3. Sea 2 Swell 3. Visibility 500 yards.

2245 - BPS-4 radar contact No. 57 bearing 030, 11350 yards.

2254 - Secured snorting. Battery reading 1161. Went deep. Started tracking. Target appeared to be heavy single screw about 95 revs., reciprocating.

2332 - Simulated firing. Made B's on SST and UQC.

2336 - Received UQC transmissions from USS TROUT (a target submarine) requesting range check. Range proved to be 20,000 yards. TROUT made "Attack was not made on me".

2344 - Contact No. 58 bearing 060.

2351 - No. 58 faded.

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Sunday, 22nd August

- 0408 - Contact No. 59 bearing 330.
- 0417 - Started snorting for charge. Battery reading 1163.  
Wind S force 3. Sea and Swell 22. Visibility 1000  
yards in fog. BPS radar sweeping every 10 minutes.
- 0517 - Contact No. 60 bearing 058.
- 0530 - Secured snorting. Battery reading 1172.
- 0544 - No. 59 faded.
- 0618 - Contact No. 61 bearing 180.
- 0657 - Contact No. 62 bearing 091.
- 0835 - All contacts faded.
- 1010 - Contact No. 63 bearing 287. Regained No. 60 bearing  
032.
- 1200 - Last 24 hours spent as follows:
  - Deep 18 hours 20 minutes
  - Snorting 2 hours 20 minutes
  - Periscope depth 3 hours 20 minutes.
- 1214 - Started snorting. Battery reading 1174. Wind north  
west force 1. Sea and Swell 21. Visibility 2½ miles.
- 1314 - Secured snorting. Went deep. Battery reading 1177.
- 2000 - Started snorting for charge. Battery reading 1161.  
Wind ESE force 2. Sea and Swell 22. Visibility  
8,000 yards.
- 2100 - Secured snorting. Went deep. Battery reading 1167.
- 2130 - Retractable whip found to be free to lower.

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Monday, 23rd August

0101 - Contact No. 64 bearing 115. Reported drawing right and closing. Started tracking.

0142 - Target had grown right to 140 and now fading.

COMMENT: Sounded like fishing vessel. Probably distant on broad track.

0223 - Lost No. 64.

0306 - Contact No. 65 bearing 287. High noise level. Turned towards. Started approach.

0322 - Bearing of 65 drawing slowly right. Adjusted course and speed to steady bearing.

0346 - Evaluated contact as submarine.

0400 - Target passing through stern from right to left. Simulated firing of one Mark 28 Mod 2 from stern tubes.

0414 - Target identified herself as U.S.S. HARDHEAD (Submarine) doing 16 knots on surface.

COMMENT: CROAKER did not go to battle stations. No tracking plot was made. Firing data was taken from speed by turn count (5 knots slow) and "tracking solution" from T.D.C. Error in gyro angle of one torpedo fired was 25°. Range about 1000 yards. Possible hit towards limit of actuation range of torpedo homing.

0454 Started snorting for charge. Battery reading 1148. Very dark. Sea calm. Operating BLR 1.

0536 - BLR 1 contact closing bearing 200. Aircraft. Secured snorting. Battery reading 1149.

0537 - Observed flare close. No charges dropped. Went deep. (Rebroadcast of aircraft contact report subsequently intercepted).

0545 - Contact No. 66 bearing 030. Reported closing.

0600 - No. 66 faded.

0626 - Contact No. 67 bearing 172.

0857 - Started snorting for charge. Battery reading 1154. Operating BLR 1.

0953 - Emergency secure snorting when aircraft sighted closing. No attack. Went deep. No ECM contact.

1110 - Contact No. 68 bearing 208, and No. 69 bearing 355.

1130 - Started snorting for charge. Battery reading 1172. Wind NE 2. Sea and swell 22. Heavy overcast. Raining.

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- 1153 - ECM contact bearing 345 drawing left.
- 1158 - Lost ECM contact. Nothing in sight. No contact on ST radar.
- 1200 - PART 2 OF EXERCISE STARTS
- Spent last 24 hours as follows:-
- |                 |                     |
|-----------------|---------------------|
| Deep            | 18 hours 10 minutes |
| Periscope depth | 2 hours 44 minutes  |
| Snorting        | 3 hours 6 minutes.  |
- 1215 - Regained contact on BLR 1.
- 1221 - Contact closing.
- 1223 - Two charges. Emergency secure snorting. Aircraft sighted banking out of cloud for another run. Went deep. Battery reading 1181.
- 1550 - Started snorting for charge. Battery reading 1186. Wind ENE 3 Sea 4. Overcast with rain. Visibility 4 miles.
- 1657 - BLR 1 contact. Secured snorting. Went deep. Battery reading 1192.
- 1702 - Contact No. 70 bearing 020.
- 1812 - No. 70 faded.
- 1957 - Started snorting for charge. Weather as at 1550. Battery reading 1189.
- 2100 - Secured snorting. Battery reading 1199.

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Tuesday 24th August

- 0001 - Started snorting for charge. Battery reading 1198.  
Wind NNE 3. Sea 3. Visibility 4 miles. Overcast.
- 0100 - Secured snorting. Battery reading 1200.
- 0400 - Started snorting for charge. Sky now clear. Wind  
NE 4. Sea and Swell 33. Visibility estimated 7  
miles. Battery reading 1200.
- 0500 - Secured snorting. Battery reading 1208.
- 0539 - Contact No. 71 bearing 190.
- 0544 - No. 71 faded. Probably fish.
- 0559 - Contact No. 72 bearing 100.
- 0737 - No. 72 faded.
- 1038 - Contact No. 73 bearing 270.
- 1120 - Contact No. 74 bearing 240. 73 and 74 possible  
warships.
- 1127 - 73 and 74 assessed as same echo (74 sidelobe of 73).
- 1135 - No. 73 bearing 265 assessed as snorting submarine.
- 1153 - Started tracking No. 73 - definite submarine.
- 1200 - No. 73 faded. Probably snorting submarine gone  
deep for scheduled BLUE charging period. CROAKER  
intends to forego this charging period in order to  
continue approach on snorter at end of period.  
Therefore turned to parallel course at 3 knots.  
Last 24 hours spent as follows:-
- |                 |                     |
|-----------------|---------------------|
| Deep            | 18 hours 12 minutes |
| Snorting        | 4 hours 30 minutes  |
| Periscope depth | 1 hour 18 minutes.  |
- 1203 - Temporarily regained No. 73 bearing 272, but this  
was lost in dead arc astern as CROAKER turned to  
parallel course.
- 1240 - Swing to port to open dead arc astern. Nothing  
heard.
- 1253 - No. 73 bearing 320.
- 1258 - Heard DEEP, DEEP, DEEP, distant on UQC. This is  
the warning for a BLACK submarine coming to sur-  
face or snort depth from 300 feet.
- 1307 - Lost No. 73.
- 1315 - Regained No. 73 still bearing 320.
- 1327 - No. 73 bears 327. Does not sound very convincing.

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1353 - Periscope depth. Nothing in sight.

COMMENT: This was certainly a submarine before 1200.

She probably turned off track on going deep, and although we heard her DEEP, DEEP, DEEP, at 1258, the noise picked up at 1253 (when BLACK submarines should still have been deep) and subsequently tracked without success was probably a ghost.

1434 - No. 73 faded.

1452 - Contact No. 75 bearing 173.

1458 - No. 75 classified fish.

1534 - Contact No. 76 bearing 154.

1548 - Contact No. 77 bearing 274.

1556 - Started snorting for charge. Battery reading 1161. Wind N force 3. Sky clear. Visibility good. Sea and Swell 22.

1627 - Aircraft sighted overhead. No BLR 1 contact. Secured snorting. 2 charges dropped close before ship could go deep. Went deep.

1730 - Contact No. 78 bearing 166. Possible submarine. Began tracking.

1740 - Lost No. 78.

1747 - Contact No. 79 bearing 306. Regained No. 78 classified as fishing vessel.

1751 - Contact No. 80 bearing 110.

1802 - Lost No. 80.

1844 - Contact No. 81 bearing 205.

1852 - Lost No. 81.

1855 - Regained No. 81 bearing 204.

1906 - Lost No. 81.

1922 - Contact No. 82 bearing 175.

1937 - No. 82 faded.

1957 - Started snorting for charge. Battery reading 1145. We badly needed charge at this stage. Early morning secondary had been missed as not required. Midday primary was missed as were tracking snorter. Afternoon secondary was mostly missed when we were put down by aircraft. Weather: 1/10 scattered cloud. Good visibility. Wind force 3 from SW. Sea and Swell 22. Sky clouded to 7/10 by end of charge.

2020 - Number 3 engine out of action.

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- 2100 - Secured snorting. Went deep. Battery reading 1195.
- 2105 - Regained No. 78 (fishing vessel) bearing 155.
- 2200 - Contact No. 83 bearing 310.
- 2240 - Lost Nos. 78 and 83. No contacts except one of our regular ghosts at 055.
- 2332 - Contact No. 84 bearing 270.
- 2352 - No. 84 possible submarine. Began tracking.
- 2354 - No. 84 faded suddenly. Possible snorter gone deep for charging period. Decided to miss charging period to await developments.

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Wednesday 25th August

- 0019 - Regained No. 84 bearing 258.
- 0023 - Contact No. 85 bearing 345.
- 0030 - Contacts No. 86 and 87 bearing 210 and 050.
- 0102 - All contacts faded.
- 0153 - Regained No. 84 bearing 250. Sounds good. Began tracking.
- 0217 - JT holding No. 84 in ATF. No plotting team closed up. Target data from TDC.
- 0236 $\frac{1}{2}$  - Simulated firing one Mk 28 Mod 2 and one Mark 27 Mod 4. Target data course 080, 10 knots, range 1200 yards.
- 0237 - Spoke BLACK submarine on UQC. Her data course 090, speed 10.5, range 1300, snorting.

COMMENT: Good and successful attack. Initial range about 25 miles.

- 0255 - Contact No. 88 bearing 276.
- 0302 - No. 88 faded.
- 0306 - Regained No. 88.
- 0353 - Started snorting for charge. Sea calm. Visibility good. Battery reading 1164.
- 0440 - BLR 1 contact bearing 160 strong. Emergency secure snorting. Battery reading 1165.
- 0444 - Contact No. 88 bearing 298. Started tracking.
- 0449 - No. 88 bearing 291. Classified submarine.
- 0458 - No. 88 bearing 278. Growing left.
- 0501 - No. 88 reported opening, then closing at 0507, then opening at 0514.
- 0515 - Classified non submarine. Secured tracking. Contact No. 89 bearing 185.
- 0525 - No. 88 faded.
- 0528 - Contact No. 89 bearing 150.
- 0531 - Contact No. 90 bearing 065.
- 0554 - Contact No. 91 bearing 077.
- 0559 - Lost No. 91.
- 0601 - Nos. 89 and 90 faded.
- 0630 - No. 91 bearing 064 classified submarine.
- 0635 - Regained No. 89.

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- 0645 - Contact No. 92 bearing 165.
- 0710 - No. 91 faded.
- 0730 - Regained No. 91 bearing 040.
- 0802 - Started snorting for charge. Battery reading 1169.  
All contacts lost. Wind SSW force 3. Sea and Swell  
22. Overcast. Good visibility.
- 0900 - Secured snorting. Battery reading 1180.
- 0938 - Contact No. 93 bearing 020.
- 0957 - No. 93 classified submarine. Started tracking.
- 1051 - Contact No. 94 bearing 260.
- 1115 - No. 93 faded.
- 1200 - Spent previous 24 hours as follows:-
- |                 |                     |
|-----------------|---------------------|
| Deep            | 19 hours 12 minutes |
| Snorting        | 3 hours 18 minutes  |
| Periscope depth | 1 hour 30 minutes.  |
- 1202 - Started snorting for charge. Battery reading 1180.  
No contacts.
- 1213 - Sighted DE bearing 276 (this was contact No. 93).  
Range 4 miles. Emergency secure snorting. DE  
approaching but not in contact. Went deep and  
manoeuvred to open range.
- 1243 - DE passed about 3000 yards astern. No contact on us.
- 1254 - Contact No. 94, another DE, not sighted, sweeping in  
company with No. 93 passed about 750 yards astern.  
Did not gain contact.
- 1320 - Lost all contacts.
- 1544 - To periscope depth to prepare to snort. DE in sight  
about 4 miles away, searching the area. BLACK forces  
know our charging periods. We have been sunk by air-  
craft during this period on the last two days, so  
they know both where and when. So here is a DE.  
Another lost charging period. (DE allotted contact  
No. 95).
- 1606 - Went deep. Retired to southward.
- 1705 - No. 95 faded.
- 1920 - Contacts No. 96 bearing 325, No. 97 bearing 183.
- 1938 - Lost contact No. 97.

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1950 - Periscope depth. Sighted DE (No. 96) range 8,000 yards, searching at slow speed. Appeared to be hove to. Battery reading now 1146 so endeavoured to raise DE by SST to inform him that we were about to surface for emergency charge. Weather: wind S force 5. Sea 5 Swell 4. Visibility 5 miles, sky overcast.

2010 - Surfaced after dive of 177 hours 42 minutes.

COMMENT: Although C.O. in his narrative remarked that DE was sitting target and would have been attacked in war, I would like to have seen this simulated.

2020 - Started charge, informing DE by light of situation. DE retired.

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Thursday 26th August

- 0001 - Weather as before except visibility down to 2 miles in mist.
- 0103 - Dived. Battery reading 1189.
- 0349 - Contact No. 98 bearing 055.
- 0355 - Contact No. 99 bearing 020.
- 0411 - No. 99 classified possible submarine.
- 0415 - Transmissions heard from No. 99 bearing 040. Classified DE.
- 0430 - Lost contact No. 98.
- 0442 - Contact No. 100 bearing 095.  
The DE (contact No. 99) continued to sweep out the area, twice passing close to CROAKER, and retired at the end of the snorting period, 0500.
- 0549 - Lost No. 99.
- 0550 - Lost No. 100.
- 0610 - Regained No. 100 bearing 024.
- 0755 - Started snorting for charge. Battery reading 1189.
- 0813 - Contact 100, a DE closing. Secured snorting. Battery reading 1191. Went deep.
- 0823 - Contact No. 101. Bearing 290.
- 0904 - Lost No. 100.
- 0910 - No. 101 passed close ahead. Classified DE.
- 0915 - Retired to southern part of area.
- 0928 - No. 101 faded.
- 1200 - Last 24 hours spent as follows:-
- |                 |                     |
|-----------------|---------------------|
| Deep            | 17 hours 13 minutes |
| Snorting        | 0 hours 29 minutes  |
| Periscope Depth | 1 hour 24 minutes   |
| Surfaced        | 4 hours 54 minutes. |
- 1202 - Started snorting for charge. Battery reading 1182. Wind S force 4. Sea and Swell 54. Fog.
- 1300 - Secured snorting. Battery reading 1190.
- 1555 - Started snorting for charge. Battery reading 1195. Sea state 3 from south. Visibility 1 cable in fog.

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- 1700 - Secured snorting. Battery reading 1199.
- 1702 - Contact No. 102 bearing 045. Fishing vessel.
- 1836 - Contact No. 103 bearing 090.
- 1902 - No. 103 faded.
- 1915 - Lost No. 102.
- 1938 - Contact No. 104 bearing 125.
- 1955 - Started snorting for charge. Battery reading 1191.  
Weather: wind force 5 from SW. Sea and Swell 54.  
Overcast. Visibility 4 cables.
- 2100 - Secured snorting. Battery reading 1207.
- 2113 - Contact No. 105 bearing 096.
- 2210 - No. 105 faded.
- 2239 - Contact No. 106 bearing 345.
- 2248 - No. 106 faded.
- 2350 - Periscope depth. Very dark. Intermittent ECM  
contact about 9150 kcs.
- 2359 - Started snorting for charge. Battery reading 1207.  
Too dark for weather observation.

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Friday 27th August

- 0030 - ECM contact faded.
- 0033 - New ECM contact (9475 kcs) distant.
- 0100 - Secured snorting. Battery reading 1209.
- 0345 - Contact No. 107 bearing 350. A DE sweeping the area echo ranging as our snorting period approaches.
- 0426 - DE passed about 1800 yards to westward. Continued to sweep back and forth and was not lost until 0639.
- 0731 - Regained No. 107 bearing 336, distant.
- 0805 - Started snorting for charge. Battery reading 1197. Wind WSW 3. Sea and Swell 22. Visibility good. Sky clear.
- 0809 - Sighted aircraft closing. Emergency secure snorting.
- 0811 - Went deep. 1 charge. Probable successful attack.
- 0836 - Contact No. 108 bearing 310.
- 0845 - No. 107 faded.
- 0850 - No. 108 faded.
- 1001 - Regained No. 107 bearing 230. Closing.
- 1007 - Started tracking No. 107, the DE.
- 1110 - Simulated firing one Mark 28 Mod 2 from aft. Transmitted firing data on UQC. Answered by submarine SABLEFISH 1200 yards on beam.

COMMENT: This was hard luck. A DE has been prowling round our area just before every snorting period, we've always let him go. This time the decision was taken to teach him a lesson and we attacked. The attack was carried out on the same principle of keeping the bearing steady, then turning underneath him on opposite course and firing from the stern tubes. This seems very dangerous to me against a DE. On this occasion the DE was escorting a surfaced submarine whose HE was masked by the DE. But as the DE did not gain contact the result of this action was probably 1 DE sunk. 2 submarines escaped.

1200 - Spend last 24 hours as follows:

Snorting	4 hours 12 minutes
Deep	18 hours 35 minutes
Periscope Depth	1 hour 13 minutes

- 1205 - Started snorting for charge. Battery reading 1177. Wind WSW 3. Sea and Swell 43. Sky clear. Visibility good.

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- 1300 - Secured snorting. Battery reading 1178.
- 1422 - Contact No. 109 bearing 150. High noise level.  
Closing.
- 1440 - No. 109 faded.
- 1507 - Contact No. 110 bearing 338. Reported closing, angle  
on the bow starboard 30, range about 15,000 yards,  
classified submarine. Started tracking.
- 1527 - Periscope depth. Sighted DE. Let him go.
- 1611 - Started snorting for charge. Battery reading 1181.  
Lost No. 110. Wind SW force 4. Sea and Swell 33.  
Sky clear with 1/10 scattered cloud. Visibility  
8 miles.
- 1700 - Secured snorting. Battery reading 1186.
- 1705 - Contact No. 111 bearing 053, fishing vessel.
- 2000 - No. 111 faded. Started snorting for charge. Battery  
reading 1186. Wind SSW 3. Sea and Swell 23. Sky  
clear.
- 2100 - Secured snorting. Battery reading 1193.
- 2201 - Contact No. 112 bearing 328. Regained No. 111  
bearing 048.
- 2220 - No. 112 faded.
- 2342 - Lost No. 111.

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Saturday 28th August

- 0403 - Started snorting for charge. Battery reading 1181.  
Wind SW 3. Sea and Swell 33. Sky 5/10 clouded.  
Visibility 7 miles.
- 0500 - Secured snorting. Battery reading 1189.
- 0524 - Contact No. 113 bearing 172.
- 0645 - Lost No. 113.
- 0702 - Contact No. 114 bearing 180.
- 0713 - Lost No. 114.
- 0811 - Contact No. 115 bearing 148.
- 0902 - No. 115 faded.
- 1054 - Contact No. 116 bearing 275. Classified submarine.  
Started tracking.
- 1127 - Periscope depth. Sighted contact No. 116, surfaced submarine.
- 1132 - Simulated firing 2 Mark 16 torpedoes, range estimated 2800 yards on 114 track. Failed to make contact with target on UQC.
- COMMENT: Only two straight running torpedoes at 3,000 yards range in a heavy sea seems a very false economy.
- 1200 - EXERCISE LANTSUBEX - 1 COMPLETED. Battery reading 1181.

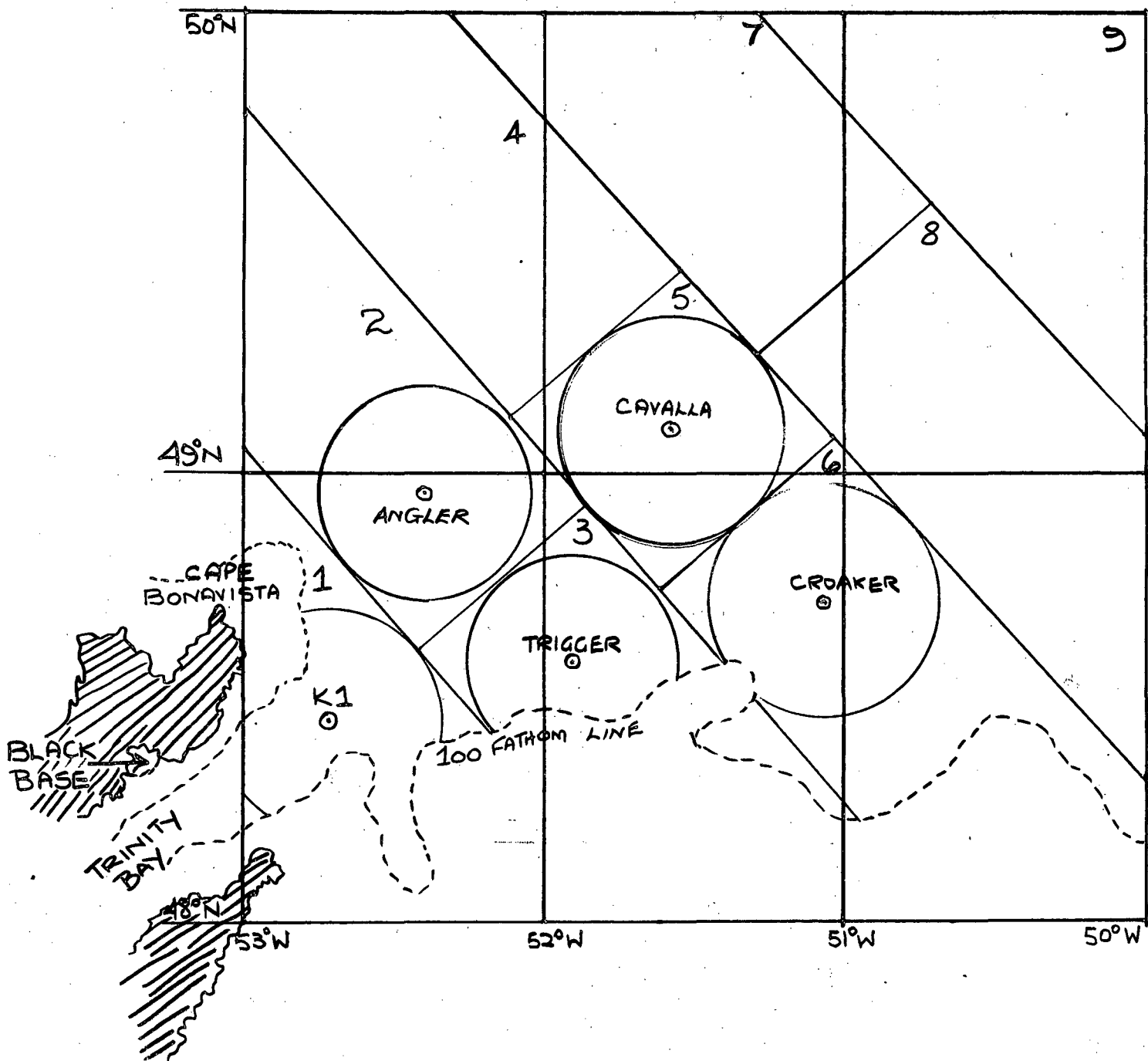
Last 24 hours spent as follows:-

Periscope depth	2 hours 6 minutes
Snorting	3 hours 30 minutes
Deep	18 hours 24 minutes.

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APPENDIX "B"



THE EXERCISE AREA

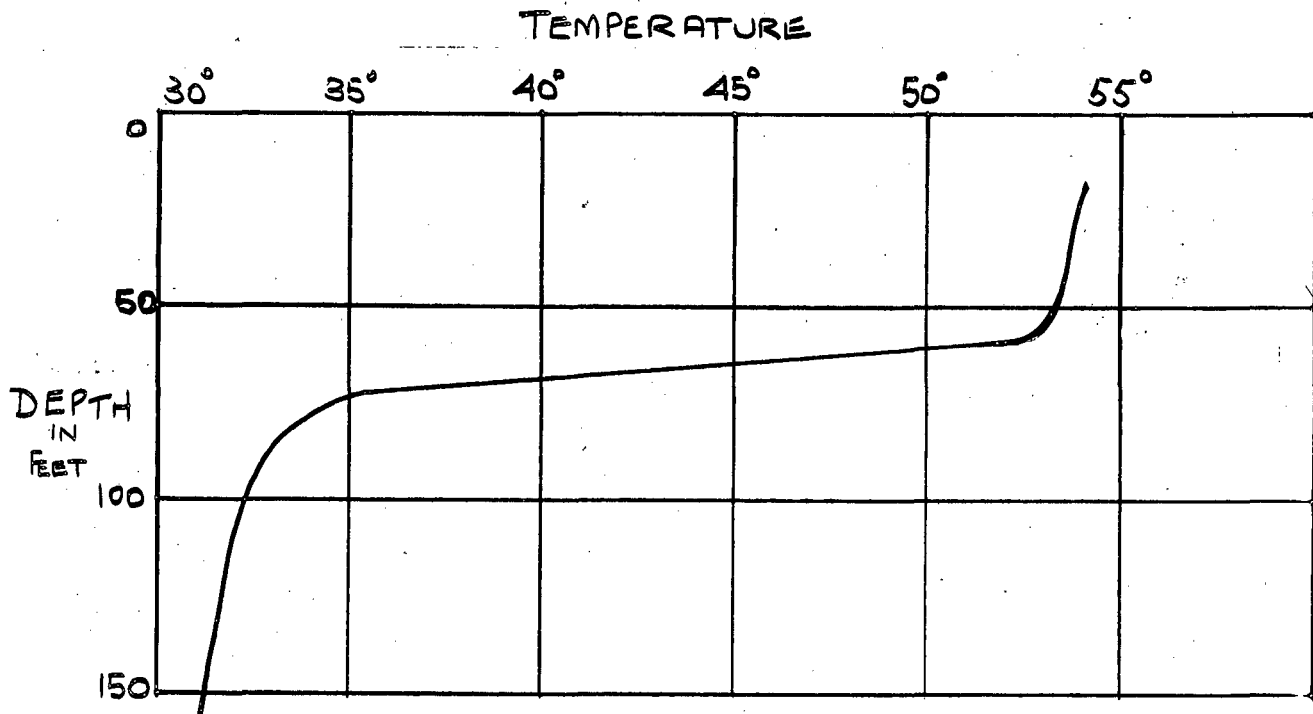
1. Submarines to keep as close as possible to "normal patrol position" shown in each area.
2. The 100 fathom curve is a boundary of the exercise area.
3. Initial patrol areas are shown, and as far as is known areas 4, 7, 8 and 9 were not used.

**SECRET** **GUARD**

SECRET GUARD

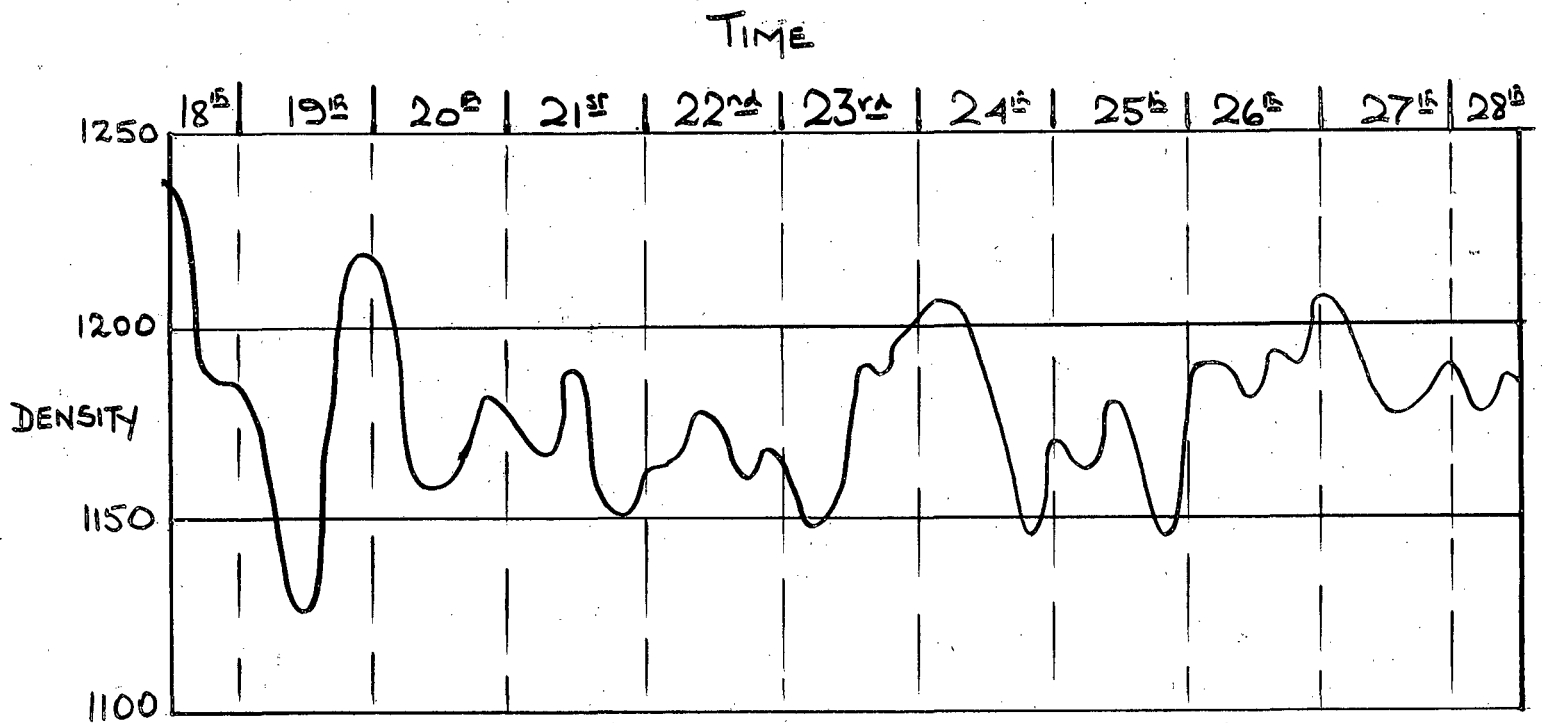
APPENDIX "C"

TYPICAL BATHY THERMOGRAPH TRACE



APPENDIX "D"

BATTERY DENSITY CHART



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Joint Maritime Warfare School,  
H.M.C.S. "STADACONA",  
Halifax, N.S.

7 September, 1954.

Sir,

I have the honour to submit the attached report on exercise LANTSUBEX 1-55 in which I took part as Royal Canadian Naval Observer, embarked in U.S.S. CROAKER.

The overall aim of the exercise was to test the feasibility of employing specialist A/S submarines in patrol areas close in off a U-boat base in the face of varying strengths of ASW air and surface opposition.

The report makes no attempt to draw any conclusions from observation of a single patrol, but the following points are considered to be of interest:

- (a) The great detection range of the BQR4 Sonar did not prove of great assistance. There were always so many contacts appearing and fading that a distant submarine could not be identified. For instance the snorting submarine attacked at 0236/25 was detected at about 25 miles range. However, it was classified, held and tracked from only 6 miles range. When snorting, detection ranges were understandably poor the target attacked at 2332/21 being detected by radar at  $5\frac{1}{2}$  miles before BQR gained contact.
- (b) CROAKER's experiences with A/S patrol aircraft show tremendous improvement, from the air point of view, over the results of MARINER and recent exercises. The initial attack upon CROAKER in a state 4 sea at 0354 on the 19th demonstrated that a combination of sea state, darkness and ECM cannot guarantee immunity to a snorting submarine.
- (c) When a submarine is carrying out an A/S patrol in a chequer-board pattern close to an enemy base there must be some means whereby she can retire through friendly submarine areas immediately her patrol position becomes compromised. Otherwise the weight of air and surface opposition available at that base may be sufficient to ensure her destruction.

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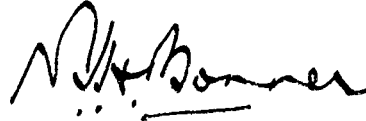
- 2 -

Since parts of the report may appear to be harshly critical of U.S.S. CROAKER's conduct of her patrol it is desired to make it clear that the R.C.N. observer was given every facility. His advice was asked and given, taken or refused in the spirit of one submarine C.O. to another, and it is desired to record this officer's appreciation of the co-operation which he received while embarked in U.S.S. CROAKER.

I have the honour to be,

Sir,

Your obedient servant,



(M. J. H. BONNER)  
LIEUTENANT COMMANDER  
ROYAL NAVY

Flag Officer Atlantic Coast,  
H.M.C. Dockyard,  
Halifax, N.S.

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SECRET - GUARD

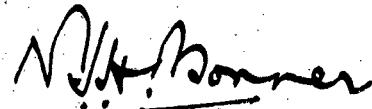
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(M.J.H. BONNER)  
LIEUTENANT COMMANDER  
ROYAL NAVY

Flag Officer Atlantic Coast,  
H.M.C. Dockyard,  
Halifax, N.S.

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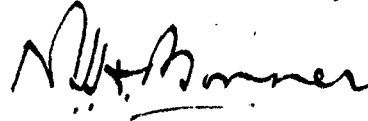
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ROYAL NAVY

Flag Officer Atlantic Coast,  
H.M.C. Dockyard,  
Halifax, N.S.

SECRET - GUARD

# NAVAL MESSAGE

CANFLAGLANT

CANAVUS  
From:

To:

CONFIDENTIAL DEFERRED

PARAPHRASING NOT REQUIRED NO  
~~UNCLASSIFIED REPLIES OR REFERENCES~~  
IF DTG QUOTED

CANAVHED 221735Z JULY, CNO 092030Z AND COMSUBLANT 101753Z  
HAVE BEEN PASSED TO CANAVHED FOR INFORMATION

121550Z

CYS  
FLAGS  
SEC  
809  
801  
A/COS(AIR)  
A/COS(T&A)  
A/COS(P&O)  
CTO  
COS SEC  
SOSM

( 221735 REGRET NO RCN OBSERVER AVAILABLE)  
( 092030 RE LCDR M.J. H. BONNER RN TO ATTEND  
LANTSUBEX)  
( 101753 RE LCDR BONNER RN BOARD  
CROAKER AS RCN OBSERVER)

TYPEX GR 51 HJC 058 TOR 130205Z AUG/54 SC PK

Acc 1660-5

000332

S. 1320 H

4,000M 9-50 (3578)

N.S. 7570 - S 1320H

# NAVAL MESSAGE

To: CANFLAGLANT  
INFO CANAVUS

From:  
CANAVHED

CONFIDENTIAL ROUTINE

PARAPHRASING NOT REQUIRED  
NO UNCLASSIFIED REPLIES OR  
REFERENCES IF DTG QUOTED

CANAVUS 142116Z CONSIDER DESIRABLE X CAN YOUR SOS/M BE SPARED X

CYS  
FLAGS

162214Z

SEC

(142116Z-RE ONE RCN OBSERVER COULD BE ACCOMMODATED  
FOR LANTSUBEX)

S00

S01

A/COS (P&O)

A/COS (T&A)

A/COS (AIR)

CTO

COS SEC

SOSM

Acc-1660-5

TYPEX GR 48 HJC 055 TOR 170325Z JULY 54 MB-FMH

000333

S. 1320 H

4,000M 9-50 (3578)

N.S. 7570 - S 1320H

NAVHED  
To: INFO CANFLAGLANT

# NAVAL MESSAGE

CANAVUS  
From:

CONFIDENTIAL ROUTINE

PARAPHRASING NOT REQUIRED  
NO UNCLASSIFIED REPLIES OR  
REFERENCES IF DTG QUOTED

INFORMATION HAS BEEN RECEIVED THAT COMSUBLANT WILL CONDUCT -  
A SUBMARINE EXERCISE LANTSUBEX 1-55 TO EVALUATE THE SUBMARINE  
IN THE ANTI-SUBMARINE ROLE IN ENEMY CONTROLLED WATERS FRO 18-28  
AUGUST 1954 X ANTICIPATE THAT ONE RCN OBSERVER COULD BE ACCOMMODATED  
IF DESIRED X

142116Z

CYS  
FLAGS  
SEC  
S00  
S01

A/COS (P&O)  
A/COS (T&A)  
A/COS (AIR)  
CTO

COS SEC  
SOSM

TYPEX GR 102 HJC 024 TOR 180511Z JULY 54 MB-FMH

000334