

SECRET

COASTAL COMMAND REVIEW

March and April, 1942

No. 2

**HEADQUARTERS,
COASTAL COMMAND
ROYAL AIR FORCE**

Any person other than the authorized holder upon obtaining possession of this document by finding or otherwise should forward it, together with his name and address, in a closed envelope, to THE UNDER-SECRETARY OF STATE, AIR MINISTRY, KINGSWAY, LONDON, W.C.2. Letter postage need not be prepaid ; other postage will be refunded.

All persons are hereby warned that the unauthorized retention or destruction of this document is an offence against the Official Secrets Acts, 1911-1920.

This book is secret. No quotations may be made without the authority of the Chief Intelligence Officer, Headquarters, Coastal Command.

"While this book is, of necessity, issued as secret, and no part of it must be communicated to anyone outside the Services, it is intended for the information of all officers but principally of all members of aircrews, under conditions of security approved by the Commanding Officer. The whole purpose of producing it would be frustrated if it were relegated to the interior of an official safe."

*The Air Officer Commanding-in-Chief,
Coastal Command.*



Plate 1. *Frontispiece.* TIRPITZ IN FOETTEN FIORD: PHOTOGRAPHS BY P.R.U. taken on 28th March and 9th February, 1942.

COASTAL COMMAND REVIEW

March and April, 1942

No. 2

**HEADQUARTERS,
COASTAL COMMAND
ROYAL AIR FORCE**

CORRECTIONS TO PREVIOUS ISSUE

Page 9, lowest table, last two items : *For* " 59 " and " 35 ", *read* " 70 " and " 42 " (to exclude chance sightings).

Page 14, paragraph 4 (ii), first line : *Read* " Compared with daytime figures, it needs *twice* as much ".

Page 35, line 8 : Transpose " heavy " and " ringed ". (Line 17 is correct.)

Page 38, penultimate paragraph, penultimate line : *Read* " consequently *some* failures to meet must be due ".

Page 42, first line of the last section : *For* " fitting " *read* " filling ".

CONTENTS

Section 1.—Review of Operational Activities		<i>Page</i>
(i) Anti-Submarine Activities, March and April, 1942	5
General		
Attacks on U-Boats		
(ii) Anti-Shipping Operations, March and April, 1942	9
(iii) The Story of the Photographic Reconnaissance Section	10
 Section 2.—Some Notable Incidents		
(i) Narratives of Attacks	14
Ship probably Sunk at Night		
Night Attack on a Submarine, using Special Equipment		
Destruction of a Motor Launch		
Moonlight Attack on a U-Boat		
Air Fighting over the North Sea		
Repulse of Air Attack on a Convoy		
Bombing of an Enemy Tanker		
Periscope seen and Attacked		
Surprise Attack on a U-Boat through Cloud		
(ii) Narratives of Other Incidents	18
St. Elmo's Fire		
Photographing the Renault Works		
" Oh, the little more, and how much it is !		
The little less, and what worlds away ! "		
Survivors from a Fall of 2,000 Feet		
A Hudson's Belly Landing		
 Section 3.—Analysis of Past Operations		
(i) Sightings of U-Boats near Convoys	23
(ii) The Air Offensive against U-Boats	24
 Section 4.—Technical and Scientific		
(i) Camouflage of Anti-Submarine Aircraft	27
(ii) Photographing Rockall and its Birds	29
 Section 5.—The Enemy		
(i) Enemy Shipping Routes	32

LIST OF ILLUSTRATIONS

1

Plate		Facing page
1	(Frontispiece) <i>Tirpitz</i> in Foetten Fiord : Photographs by P.R.U.	
2	Photographs by P.R.U. : Warships at Brest	12
3	<i>Prinz Eugen</i> and <i>Scheer</i> in Lo Fiord : Photographs by P.R.U.	13
4	Photographs by P.R.U. : The Growth of the U-Boat Pens at St. Nazaire	16
5	Enemy Shipping	17
6	Pack Ice 70° North	20
7	Brash Ice off Denmark	21
8	Eyja and Sevdís Fiords, Iceland	26
9	Aircraft camouflaged White and Black	27
10	A camouflaged Hudson over Northern Ireland	28
11	Rockall	29
12	Rockall	30
13	A Waterspout	31
13	Fishing Vessels Caught in Ice	31

CHARTS

Chart		
I. Anti-Submarine Activities, March-April, 1942		8
II. Anti-Shipping Activities, March-April, 1942		8

DIAGRAMS

Fig.		
1	Distribution of Torpedoings	25
2	Intensity of Flying in the Western Approaches	25

SECTION 1

REVIEW OF OPERATIONAL ACTIVITIES

(i) Anti-Submarine Activity

March and April, 1942

General

U-Boat activity in the North Atlantic has remained chiefly concentrated on the American side. No ships have been attacked east of 30° W., except for some sunk in convoys in the far north on their way to Russia. Only a few U-Boats—perhaps half a dozen—have been operating in the eastern part of the main ocean, usually around Rockall. Coastal Command aircraft attacked most of them, a fact which may largely account for their lack of success. Night patrols, too, have been started in the Western Approaches and have already led to one attack.

In March the Navy sighted a U-Boat 100 miles off the north of Scotland, and in April a Walrus found another (by chance) west of Cape Wrath. Otherwise anti-submarine flying in that region has proved unproductive. Four U-Boats have been seen north of 65° (in the positions 65° 08' N., 13° 10' W.; 65° 20' N., 07° 49' E.; 66° 47' N., 22° 55' W.; 67° 50' N., 07° 30' E.); the first, off the eastern end of Iceland, was the only one attacked.

In the Bay of Biscay there has been a steady flow of U-Boats making the transatlantic passage. In March, four of them were sighted and two attacked—one at night. In April, eight were sighted and all attacked (one again at night). It looks as though a few U-Boats now try to cross the Bay in daylight, to avoid wasting dozens of hours by proceeding more slowly beneath the surface, as has been their custom in order to escape our day offensive.

No less than six U-Boats have been sighted off the north-west and south-west coasts of Spain by aircraft on transit. Aircraft from Gibraltar sighted four U-Boats (one by night) in the Mediterranean and attacked one of them. A P.R.U. aircraft also saw a submarine of unknown nationality entering the harbour of Oran.

In all, 109 finds of U-Boats were reported in the Atlantic east of 30° W. during March and April. They were made by various methods and authorities, chiefly naval, but in 40 cases by aircraft.

Hunts, lasting on the average five hours and made by several aircraft, were laid on after twenty-one of the finds, and resulted in five sightings.

Last summer and autumn, one U-Boat was sighted in the north-eastern Atlantic every twenty-seven sorties, in November the rate became one in thirty-four, in the months December to March one in forty-three, and in April one in forty-seven. The concentration of U-Boats off America is not entirely responsible for the change, because our chances of sighting dropped when we succeeded in forcing U-Boats to remain submerged by day in the Bay of Biscay; search by night has not given equally good results. The fact that the rate of sightings per sorties should have diminished so little, in spite of these adverse factors, seems to indicate a rise in Coastal Command's efficiency, and promises well for the future, when U-Boats are likely again to operate extensively in the eastern Atlantic.

During March and April, 102 convoys and 39 independently routed ships were given aircraft protection, which entailed 683 sorties. Of the 255 aircraft sent as escort, 85 per cent. succeeded in meeting the convoy and 78 per cent. the independent ship to which they were dispatched—an unusually high proportion in each case.

A total of 4,491 hours was spent on anti-submarine flying, excluding time in transit, in the two months (see Chart I). Escort duties accounted for 19 per cent., protective sweeps for 30 and offensive operations for 51 per cent. of the hours. (These figures exclude flying from Gibraltar, which totalled 663 hours on anti-submarine work; two-thirds of that time was spent over the Mediterranean). The weather was unusually good for the time of year and interfered very little with flying programmes.

Attacks on U-Boats

A large number of excellent attacks were made by aircraft during the two months, especially in April. Short accounts of all the twenty-three attacks follow here, while detailed narratives of a few of the most instructive are printed on later pages. In every case the U-Boat was sighted fully surfaced, unless otherwise stated.

On 1st March, Whitley *X/612* was flying in cloud at 1,200 ft. at 1200 hours when it received a Special Equipment contact at 6 miles range. The aircraft homed, broke cloud at 300 ft., and sighted a U-Boat three miles ahead making 12 knots. The conning tower disappeared between the release of the depth-charges and their explosion. The stick straddled the course, and burst about 60 ft. ahead of the swirl. (Position $49^{\circ} 00' N.$, $13^{\circ} 35' W.$)

At 1500 hours on the 7th, Hudson *Q/224*, flying at 1,000 ft., sighted a U-Boat six or seven miles away. In an attack from the starboard quarter, four depth-charges were released, 30 seconds after it had disappeared. They fell 50 ft. ahead of the swirl and so probably missed 250 ft. astern. (Position $57^{\circ} 28' N.$, $17^{\circ} 00' W.$)

At 0304 hours on the 8th, Whitley *D/502* was flying at 3,000 ft. in cloud, when it received a contact four miles to starboard. The aircraft homed, losing height, and at 2,000 ft. sighted a U-Boat directly underneath, apparently not moving. Six depth-charges were released when it was still on the surface and exploded in salvo. Actually the U-Boat was probably moving, hence they missed astern. See page 14. (Position $47^{\circ} 03' N.$, $06^{\circ} 55' W.$)

At 1055 hours on the 10th, Northrop *D/330* was flying in showery weather at 1,000 ft. off the eastern end of Iceland, when it sighted a U-Boat 4 miles away. It disappeared when the aircraft got within a mile and an attack was made 20 seconds later, at an angle of 30 degrees to the course. One depth-charge was released from 50 ft., the other two failed because the revolving bomb selector had frozen. The explosion took place 100 yards ahead of the swirl and therefore should have been level with the U-Boat. (Position $65^{\circ} 19' N.$, $13^{\circ} 10' W.$)

On the 12th at 1104 hours, Hudson *E/224*, flying at 1,700 ft. at cloud base, sighted a U-Boat 2 miles away, making 12 to 15 knots. The conning tower and stern were still visible when the aircraft released depth-charges from the port beam at a height of 300 to 400 ft. The stern could still be seen when the stick exploded, either just ahead or on the forepart of the U-Boat. Rough sea and heavy rain and very bad visibility prevented any further effects being seen. (Position $58^{\circ} 24' N.$, $13^{\circ} 10' W.$)

On the 13th, Hudson *T/224* was flying at 700 ft. at 1115 hours when it sighted what appeared to be a small vessel half a mile on the starboard bow. On approaching, it was recognised as a U-Boat making 5 knots. The pilot could not open the bomb doors in time to make a depth-charge attack, so he used his front guns as he went over the U-Boat, and obtained hits. He then attacked from the port quarter, releasing depth-charges from 50 ft., 4 or 5 seconds after the U-Boat had disappeared. The stick straddled its line of advance, with one explosion dead ahead of the swirl by about 75 yards. This, and perhaps another, must have burst beside the bow, or underneath it. As an oval oil patch, approximately 30 by 15 ft. in size, appeared a minute later, midway between the swirl and the explosion marks, the U-Boat seems to have been slightly damaged. (Position $59^{\circ} 38' N.$, $13^{\circ} 45' W.$)

At 1920 hours on the same day, Sunderland *N/228*, flying at 300 ft. in haze, sighted a half-submerged U-Boat half a mile away, making 6 knots; the beam aeriels were in use but gave no contact. Seven depth-charges were released at 50 ft. at an angle of 30 degrees to the U-Boat's course, 15 seconds after its

disappearance. They straddled its line of advance, 100 yards ahead of the swirl, therefore presumably 12 yards ahead of the conning tower. Two members of the crew saw the stern above water between two of the explosion marks. The U-Boat must therefore have been forced up by the explosion, and was probably damaged. (Position $60^{\circ} 35' N.$, $14^{\circ} 00' W.$)

At 0558 hours on the 31st, Catalina C/202 from Gibraltar was flying over the Mediterranean at 300 ft., in darkness but good visibility, when a contact was received 10 miles ahead. The U-Boat was sighted at one mile range, making 10 knots. The aircraft attacked up the track and released four depth-charges from 200 ft., 5 seconds after the U-Boat disappeared. They exploded along the line of advance some 60, 100, 140, and 180 ft. ahead of the swirl. All were right for range, for the tail should then have been 56 ft. ahead of the swirl. The aircraft remained in the vicinity until broad daylight, but saw no signs of destruction. Unquestionably the U-Boat must have had a very severe shaking. (Position $37^{\circ} 12' N.$, $03^{\circ} 35' E.$)

The first attack in April was made at 02 hours on the 1st, by a Catalina from Gibraltar, flying at 2,500 ft., which picked up a U-Boat by Special Equipment at 8 miles distance. The weather was good and the visibility 250-300 yards down moon. The aircraft homed on the track and saw a wake, and when almost up to it, sighted a U-Boat making 10 knots. Seven depth-charges were dropped from 75 ft. at right angles to the course, while the hull was still visible. One of the explosions swirls was accompanied by much froth and oil. There was also a large eruption of air two or three hundred yards along the track, and immediately after the explosions a large oil patch appeared; eventually it covered 400 by 60 yards. Obviously damage had been inflicted. (Position $37^{\circ} 37' N.$, $06^{\circ} 22' E.$)

On 1st April, Whitley F/502, flying at 1,500 ft. in calm cloudless weather under a full moon, at 2343 hours, sighted a U-Boat 700 yards distant and making 10 knots. The aircraft turned directly over the U-Boat and then circled, losing height, till it could attack from the starboard quarter. The conning tower remained just visible. One of the depth-charges seems to have exploded in contact with the hull and the U-Boat may have received fatal damage. See page 15. (Position $46^{\circ} 30' N.$, $06^{\circ} 35' W.$)

On the 2nd, Whitley H/502 received a signal from base to locate a submarine which had been sighted by a civil aircraft at 1120 in the position $45^{\circ} 22' N.$, $10^{\circ} 07' W.$ The Whitley arrived at 1523 and flew along the submarine's reported course. Seventeen minutes later, when it was flying at 1,500 ft., a submarine of Italian type was seen 2 miles away, making 10 knots. An attack was made just abaft the port beam, at an angle of approximately 70 degrees to the course the submarine had been taking; it dived 15 to 20 seconds before the release of the depth-charges. The stick exploded 70-100 ft. ahead of the swirl; on the evidence the submarine should have advanced 100 ft. farther, so the result probably was a slight shake-up. (Position $45^{\circ} 20' N.$, $11^{\circ} 00' W.$)

On 13th April, Sunderland R/201 flying at 5,000 ft. at 1142 hours, sighted a wake at 12 miles distance, when in 3/10 cloud, the base of which came at 2,000 ft. The aircraft approached above the clouds, but the U-Boat dived when still a mile and a quarter away. Three depth-charges were dropped, 30 seconds after its disappearance; five more failed to release. The nearest is thought to have fallen 200 ft. astern. (Position $54^{\circ} 18' N.$, $14^{\circ} 53' W.$)

On 14th April at 1031 hours, Whitley M/502 was flying above dense clouds at 2,500 ft. and received a contact 9 miles to port. The aircraft broke cloud at 1,000 ft., 5 miles from a U-Boat making 8 knots. As the aircraft came in to attack, one mile away, the U-Boat began to dive; the stern was still above water when six depth-charges were released from the port quarter at an angle of 30 degrees to its course. Brownish yellow scum was observed after the explosions, but no concrete evidence upon which to base a claim; certainly the U-Boat must have been severely shaken. (Position $49^{\circ} 09' N.$, $12^{\circ} 01' W.$)

At 1400 hours on the 14th, Whitley S/502 was flying at 2,000 ft. in the process of climbing, with no clouds and visibility 15 to 20 miles, when it sighted a U-Boat 5 to 6 miles away, making 8 knots. The U-Boat altered course as the aircraft approached, and began to dive slowly when the distance had been reduced to $1\frac{1}{2}$ miles. The attack was made at 10 degrees to the U-Boat's track, from the

starboard quarter, 30 to 40 seconds after its disappearance. One of the depth-charges seems to have missed just astern of the tail, the others were outside lethal range. The U-Boat was probably shaken. (Position 50° 34' N., 15° 19' W.)

At 1540 hours, Sunderland *Z/201* started to search for the same U-Boat, flying at 4,000 ft. The Special Equipment received a contact at 1826 hours, at 8 miles distance to port. The U-Boat was sighted from 6 miles distance, making 7 knots. It submerged when the aircraft approached to a mile and a quarter. Three depth-charges were dropped, four failed to release, thus enlarging the spacing to 90 ft. At 1850 hours, flying at 500 ft., the aircraft sighted a periscope feather, a quarter mile distant, which immediately disappeared. A second attack was made with the remaining depth-charges, 90 seconds later, but one again failed to release. (Position 50° 00' N., 14° 08' W.)

On the 18th, Sunderland *Y/10*, flying in cloud at 3,000 ft. sighted a U-Boat 6 miles ahead, making 5 knots. It submerged as the aircraft came down, at 4 miles range, but left a well-marked oily wake with frothy edges which ended at the diving place; 100 yards on was a very faint line of oil or wake which seemed as though it might have been made by a periscope. A stick of depth-charges straddled the line of advance, with the centre 100 yards farther ahead. The result probably was a miss astern, but another depth-charge was dropped a few seconds later, 100 yards still farther on. (Position 46° 43' N., 10° 43' W.)

On 21st, Beaufighter *B/248*, on patrol off the Norwegian coast, saw an escort vessel and a surfaced U-Boat. A long burst of cannon fire resulted in smoke or dust coming off the conning tower. The U-Boat did not attempt to dive and no one appeared on deck, nor was any return of fire noticed from the escort vessel. (Position 58° 40' N., 05° 30' E.)

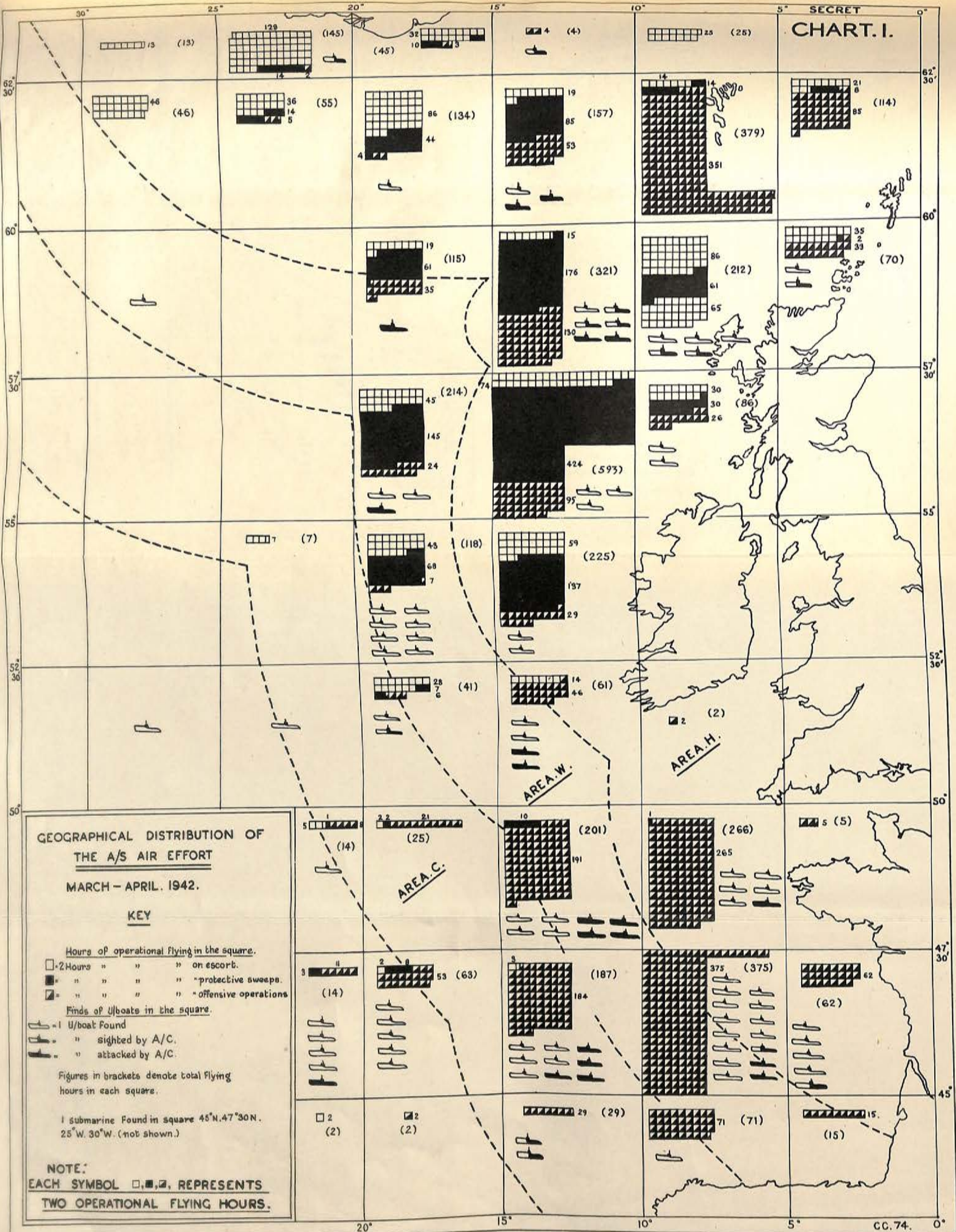
On the same day, the 21st, Whitley *L/502* saw a periscope and attacked with depth-charges, one of which exploded alongside it. See page 17. (Position 47° 53' N., 06° 57' W.)

On the 22nd, Whitley *O/502*, flying at 5,000 ft. in cloud, at 1344 hours, sighted a U-Boat making 10 knots, 5 miles distant. The aircraft circled to lose height, keeping up sun of the U-Boat, which did not begin to submerge until the distance had been reduced to one mile. Fire was opened with the front guns at 300-400 yards range, and then depth-charges were released, at an angle of 60 degrees to the U-Boat's course, a second or two after the stern had disappeared. From the photographs taken, a very near miss ahead is thought to have resulted, so that the U-Boat was probably not damaged, though severely shaken. (Position 46° 54' N., 08° 27' W.)

On the 25th, Liberator *P/120* was flying at cloud base (1,500 ft.) at 1032 hours, in a haze, when the beam aerals received a contact 7 miles to starboard. The aircraft homed, and at about 2 miles broke cloud and sighted a U-Boat right ahead. It was of 715-ton type carrying a 3-in. or 4-in. gun. The conning tower and stern were still visible when six depth-charges were dropped on the starboard quarter; the stick fell in two irregular groups because it had to be released by hand. All the explosions occurred while the stern was still out of water, and the U-Boat was seen going straight into the last. Twenty seconds later, whitish air bubbles, about 20 ft. across, appeared between two of the depth-charge marks, due perhaps to the final venting of the ballast. The U-Boat must have had a very severe shaking. (Position 47° 20' N., 20° 20' W.)

On the 27th, Hudson *Q/500* was flying at 5,000 ft. at 0806 hours in no cloud and sighted the wake of a U-Boat, 8 miles away; it was going at 10 knots, and carried a gun forward of the conning tower. The aircraft dived, and overshot, but got in two bursts of machine gun fire and scored some hits. After a steep turn an attack with depth-charges was made, at 30 degrees to the track, from the port quarter, three seconds after the disappearance of the U-Boat. This was an excellent attack but produced no evidence of concrete damage. (Position 60° 08' N., 10° 20' W.)

On the 28th, Hudson *K/500* was flying above the clouds at 4,400 ft. and sighted a U-Boat 7 or 8 miles off, at 1906 hours. With the aid of the clouds the aircraft made a dive attack and completely surprised the U-Boat, which was still on the surface when depth-charges exploded all round. It disappeared bows down and stern in the air. From subsequent indications a kill is possible. See page 18. (Position 58° 06' N., 15° 30' W.)



50 Ships sighted.
22 Attacked.

NORWAY COAST - MILES FLOWN.

21,450

DANISH COAST - MILES FLOWN.

5,700

19 Ships sighted.
9 Attacked.

38 Ships sighted.
17 Attacked.

GERMAN, DUTCH & BELGIAN COAST - MILES FLOWN.

8,650

3 Ships sighted.
None attacked.

FRANCE, N. COAST - MILES FLOWN.

1,600

9 Ships sighted.
3 Attacked.

BAY OF BISCAY - MILES FLOWN.

4,800

ANTI-SHIPING ACTIVITIES.

MARCH & APRIL

1942.

KEY

- 1 Effective sortie.
- 1 Ship sighted.
- 1 Ship sighted and attacked, (whatever the result of the attack).

NOTE:- Shipping symbols indicate the number of sightings and attacks within the major areas between the heavy lines, and bear no closer relation to actual positions.

On the 29th, T/228 was searching for the same U-Boat at 1,500 ft., at 0448 hours, when it succeeded in homing on a special equipment contact, flying almost down the moon path, and sighted a U-Boat a mile ahead, making 10 knots. The aircraft lost as much height as possible and, on reaching 700 ft., attacked as the U-Boat commenced to dive, from its starboard quarter, at 40 degrees to the track. Only three depth-charges released out of the eight, completely wrecking the spacing. The result was probably a shake-up. (Position 58° 00' N., 15° 00' W.)

(ii) Anti-Shipping Operations

March and April, 1942

Coastal Command's anti-shipping operations extend from Norway to the Bay of Biscay; an article at page 32, describes the more important shipping routes covered and the types of cargo carried along them. Our operations are of two classes: armed reconnaissance patrols, usually by single aircraft; and strikes, on which several aircraft are dispatched together to attack a specified ship or convoy. In addition our aircraft occasionally attack ships and installations in ports.

Chart II summarises the total operations directed against all sorts of shipping, naval as well as merchant. This article is restricted to activity against merchant shipping, which involved the following amount of flying:—

	December, 1941.	January and February, 1942.	March and April, 1942.
	Hours.	Hours.	Hours.
Anti-shipping patrols	1,100	1,100	2,100
Anti-shipping strikes	500	300	600
Attacks on harbours	200	100	50

Information is needlessly imperfect as regards the ships attacked because of the still regrettably small number of photographs taken of shipping sighted and attacked. The importance of this cannot be over-emphasized, and it is again pointed out that every aircraft on anti-shipping duties should carry a camera, and that it should be an essential part of the crew's drill that the camera is switched on immediately the aircraft is committed to the attack.

Patrols

During March and April aircraft of Coastal Command operated chiefly along the enemy shipping routes off Norway, Holland, and the north Spanish—south-west French coasts.

In their 109 daylight patrols along the Norwegian coast, our aircraft reported 31 ships and convoys, an average of one ship or convoy for every 1½ hours of flying off the enemy shore. As the average length of their patrols is half-an-hour the chance that any one of them will report shipping cannot be very high; in fact 25 per cent. of the patrols sighted a ship or convoy.

By night and twilight our aircraft made 173 patrols off Norway and reported 28 ships and convoys, an average of one for every 3½ hours flying on the coast. Special Equipment has played no part in these operations, presumably owing to the nature of the coastline. The average length of the night patrols was 40 minutes. Ten per cent. of the sorties sighted shipping. Because of the shortness of the patrols compared with the time taken in transit across the North Sea, only one-tenth of the total flying time is spent on the shipping lane.

Only 12 per cent. of the 322 sorties had to return before reaching the patrol area, usually owing to unsuitable weather.

By day, along the coast of Holland and north-west Germany, we sighted 26 ships and convoys in the course of 28 patrols. Most of the sightings were made during the last three weeks of April, when, on days of good visibility, a ship or convoy was sighted on the average every ten minutes. The average length of day patrols was half-an-hour, and over the whole period 45 per cent. of them reported shipping. By night, 47 patrols were flown on this coast, reporting 10 ships, all but two being accounted for by Special Equipment. In addition, six contacts were received and the source not identified: on two occasions this may be attributed to very low visibility, but on the others the pilot searched in good visibility without success; extremely small vessels may have been responsible.

Twenty-one twilight patrols were flown, mostly in March, when shipping was scarce; there were no sightings. The patrols along the Dutch and German coasts are about as long as those off Norway, but the transit distances are less, so that a greater proportion of the flying time (20 per cent.) is spent on the shipping route. Only seven per cent. of the sorties had to return before reaching the patrol area.

Along the north coast of Spain and the south-west coast of France, comparatively few patrols (19) were flown but they were most successful, a total of 32 ships being seen. All the day patrols (each on the average 60 minutes long) and 30 per cent. of the night patrols (averaging 30 minutes) reported shipping.

This region is further away than any other from our bases, and only seven per cent. of the total flying time was spent on patrol. Three out of the 22 sorties returned before reaching the patrol area.

Strikes

During March and April, 11 anti-shipping strikes were flown by day, 10 by twilight, and 19 by night. 145 aircraft were involved; 30 per cent. of them succeeded in finding either the target or some other shipping, on 25 of the 40 strikes.

Attacks

About 40 ships were attacked by Coastal Command in March and April. In March, seven were damaged (totalling some 8,000 tons), one of 500 tons was sunk by Whitley T/502, and a motor-boat too was destroyed (see page 14). At least three very good attacks were made on merchant vessels during April, by Hudson P/248 on one of 2,000 tons off Norway; by Hudson X/53 on one of 3,000 tons, south of Sylt; and by Hudson D/53 on another of 3,000 tons off Horn Reefs. The final assessment of that month's attacks is not yet available.

Enemy Air Opposition

On shipping patrols and strikes, Coastal Command aircraft sighted 72 enemy aircraft during March and April. Our aircraft attacked two Ju.88's and one Me.110; and chased one Me.109. The enemy aircraft which interfered with operations were of the types: Me.109 (these made two attacks and three chases); Ju.88 (one attack and two chases); He.111 (one attack, one chase); Me.110 (one chase); night fighters (one attack, 13 chases). In addition there were four chases by aircraft of unknown type.

Attacks on Harbours

The only operation against shipping in harbours during this period was the raid on Norway on 27th-28th April. Ten Hudsons were despatched to attack shipping in the Aalesund area, and of these, three aircraft actually attacked ships and four more attacked oil storage tanks.

(iii) The Story of the Photographic Reconnaissance Unit

The conditions under which the present war is being fought, so far as the Western European area is concerned, have tended to make air photography a highly specialised subject.

The absence of a clearly defined front, the very great efficiency of enemy air defence methods and their fighter cover, have made the system which prevailed in the last war quite impossible of application. Only in quiet parts of the war zone is it possible to use aircraft of relatively low performance for photography, as was done then. This has led to the creation of a highly specialised unit known as the Photographic Reconnaissance Unit.

It was originally formed in October, 1939, from the remnants of a peace-time surveying unit. Many of the personnel were civilians who had specialised in surveys before the war. Some of them had actually carried out very important photographic work over the Continent during the year 1939. The original home of the unit was Heston; in large measure it used the standard civilian equipment, and was organised on the same lines as had been found satisfactory in the original surveying unit. Photography was carried out at varying levels but mainly from very considerable heights. These tactics were due to the desire to keep the activities of the unit secret from the enemy. The aircraft themselves were camouflaged in special colours to make them almost invisible against the sky. Fighters were employed to obtain the performance necessary at great height, and although at first other types were used, ultimately the equipment of the flight, or squadron as it later became, was composed of Spitfires. One or two Hudsons were added for photography in the quiet areas.

On 6th November, 1939, a detached flight went to France. The weather was unsuitable for photography until the 22nd, but many photographs, particularly of German aerodromes, were taken between that date and 11th January, when the flight returned to Heston. During these operations the modified Spitfire proved a success, though an incident showed that further alterations were necessary. This was when a pilot was flying at 32,000 ft. and tried to pick up his map from the floor of the cockpit. He promptly blacked-out, and although he regained consciousness very soon, he could not get control of his spinning aircraft until it reached 5,000 ft. The flight returned to France on 19th January, 1940; during the next two months it continued to increase in size, and finally was established as No. 212 Squadron. As the Germans advanced, so it was pushed back from its aerodromes, and finally returned to Heston on 14th June.

During the period from April-June, 1940, the Photographic Intelligence Section dealt with 127,350 contact prints, 32,340 enlargements, and 780 plots, the result of the work of the photographic aircraft. These were sent to various recipients in Britain and France. When Italy entered the war the scope of the P.R.U. was further extended. Arrangements were made to photograph the northern half of the country from bases in southern France and Corsica. At the French collapse this part of the unit returned safely, either by air or with the help of the navy via Algiers and Gibraltar. From Malta too, many extremely useful and interesting photographs were taken of the surrounding Axis-occupied country.

During this period the P.R.U. was administered direct from the Air Ministry, but on 18th June, 1940, it was transferred to Coastal Command; it was then re-formed into four (later five) operational flights and one flight for training and experimental work and ferrying. The area covered in operations ranged from northern Germany to western France. As the theatre of war extended, one flight was sent to a base in the north of Scotland to cover Norway, and another to south-western England to deal with western France. The latter and the other two operational flights at Heston concentrated on the ports from which invasion seemed imminent, and photographed them more than twice daily, sometimes from low levels. They also kept watch on concentrations of aircraft at aerodromes inland in Occupied France, Holland, Belgium and north-west Germany.

In the whole of 1940, 1,193 sorties were made, two-thirds of which were successful. As Heston suffered severely from air raids, the flights and the Central Interpretation Unit moved to safer quarters. The interpretation unit was placed under the Air Ministry for direction and policy, but under Bomber Command for administration. To save time the first phase of interpretation was done by each aerodrome's detached section.

In the early days of Coastal Command control, its headquarters arranged the daily programme. Afterwards the intelligence section of P.R.U. became responsible for compiling this, on a directive issued from Coastal Command, and also decided

the daily priorities. The primary object has always been to look for enemy shipping, especially by watching the ports. Another constant, if minor, preoccupation has been observation of the weather; this has been of vital assistance to the Meteorological Office.

In the first six months of 1941, sorties by the operational flights at headquarters averaged about five a day. One day 16 were made. The regular reconnaissances covered the German North Sea ports, the Frisian Islands, and Dutch, Belgian and French ports, usually at 20,000 or 30,000 ft., but at low levels on many occasions. Besides the continual watch on shipping activity, regular reconnaissances were also made far inland over hundreds of aerodromes, well into Germany, and at the request of the War Office, a photographic record was kept of military activity at dumps and marshalling yards, and of troop concentrations. Detachments were also sent to Gibraltar, to observe French ships at Dakar and Casablanca, and on the north and south coasts of the Mediterranean.

The detached flight in the south-west specialised in work over ports, particularly U-Boat bases, and aerodromes between Cherbourg and Bordeaux. Brest became increasingly important after the arrival of the *Admiral Hipper* early in 1941, and the subsequent arrival of the *Scharnhorst* and *Gneisenau*. On four occasions the whole of Brest was photographed as a panorama from 500 ft. After the enemy became aware of our daily reconnaissances, he constantly increased his standing patrols and his flak, and eventually put up a balloon barrage. This naturally impeded low-level flying, and after the loss of two aircraft on two consecutive sorties, it was decided to discontinue it except on the most urgent occasions.

The flight in the north of Scotland also recorded enemy naval activity. It was the first to sight the *Bismarck* and *Prinz Eugen* in a fiord near Bergen, on 21st May, 1941. Later it found the cruiser *Leipzig* at Oslo, and again at Horten. It saw the pocket battleship *Lützow*, accompanied by destroyers, passing through the Skagerrak on 13th June, and on the 22nd the cruiser *Nürnberg* at Copenhagen. Continued daily reconnaissance of the coast of Norway revealed a great deal of other shipping activity which provided targets for both Bomber and Coastal Commands. Watch was kept on aerodromes, especially those likely to form new bases for Focke-Wolf Condors.

On one occasion the only long-range Spitfire in P.R.U. service was making a sortie to Namsos, because of a report that naval units had been seen there. As it came near the target, it experienced heavy and accurate flak, which stopped the engine and put most of the instruments out of action. The engine picked up but kept missing, so that the pilot continually lost height, but he nursed his engine till he got back to base, and thus saved an aircraft of enormous value to the unit. Shortly after he landed he developed delayed concussion.

By the summer of 1941 an average of 8.5 sorties were being made daily by P.R.U.; photographs were taken of about 20 German aerodromes each day, and the location of major German warships was constantly made known—information invaluable to the Admiralty. Increasing numbers and improved types of long-range aircraft made it possible to extend reconnaissances far into the Baltic, and even to Genoa and Spezia, though with only a bare margin of fuel. Once a pilot flew blind through cloud to Genoa and Spezia, photographed them, and returned, again blind through cloud. The wind changed to head, and his petrol ran low. By nursing his engine he contrived to stay in the air for seven hours and ten minutes and then prepared to bale out, but caught a first glimpse of land and recognised it for the cliffs of Dover. He made a perfect landing in a field full of obstacles, with two gallons left in the tank. On a certain day in September the flights covered Turin, Berlin, Leipzig, Stettin and Copenhagen. Another record day in October resulted in 9,780 photographs of value. One pilot contributed an unparalleled collection from a single sortie. He was a man with an extremely keen interest in long-range flying, and did the tests himself of a new type of Spitfire designed to have an exceptional range. Afterwards he received instructions to use it to photograph Berlin but on arriving found the town hopelessly wrapped in cloud. He turned north on his own initiative, into better weather, and photographed an aerodrome. Calculating the amount of petrol available, he went on to Stettin and visited all the ports from it to Den Helder. By rationing negatives and making only the essential exposures at each, they just lasted out; there was a little petrol to spare.

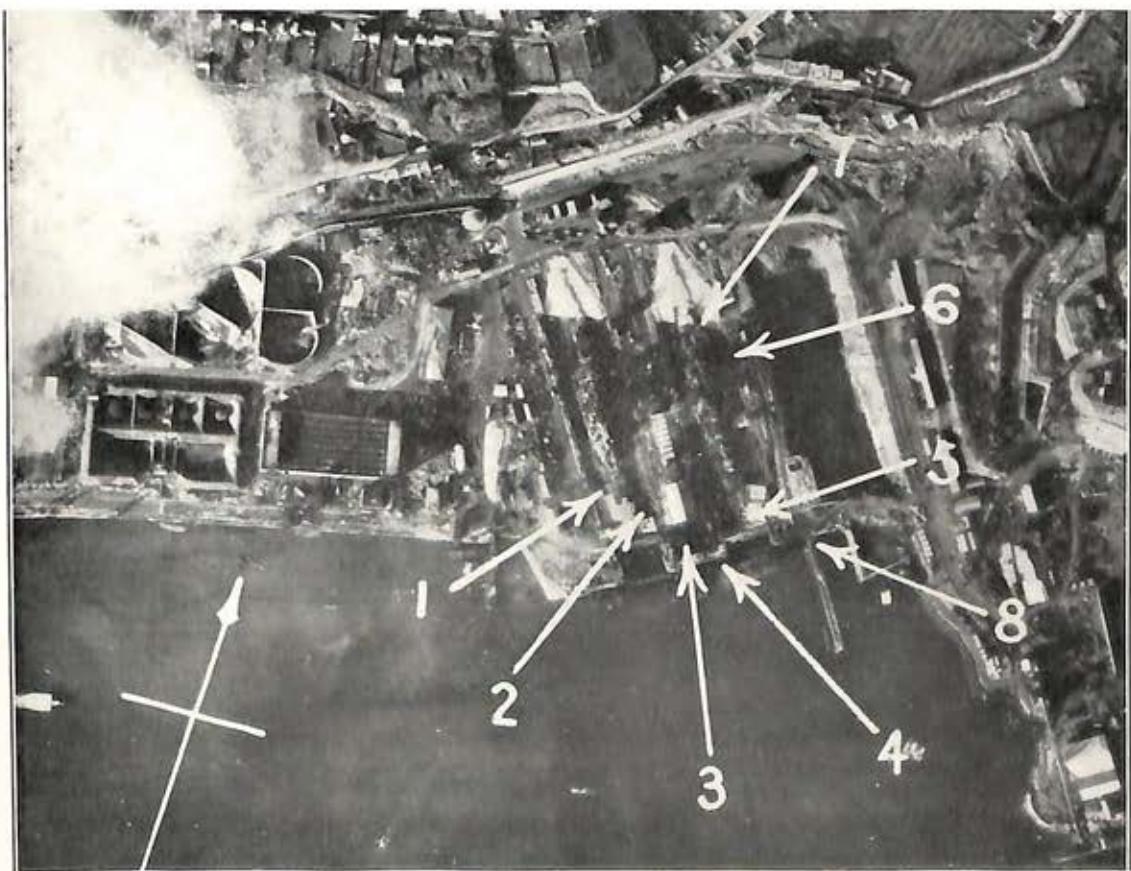


Plate 2. PHOTOGRAPHS BY P.R.U.: WARSHIPS AT BREST. Above, *Hipper*, from 500 ft.; 26th January, 1941. Below, *Scharnhorst* and *Gneisenau* lying camouflaged in dock, with pointers to bomb bursts of 75 minutes earlier. 18th December, 1941.



Plate 3. *PRINZ EUGEN* AND *SCHEER* IN LO FIORD: Photographs by P.R.U. taken on 9th March, 1942. Double booms surround the warships. *Scheer* is only seen above, to left. A submarine supply ship lies alongside *Eugen*, and a floating crane at the stern is repairing damage; on its removal the stern was seen to have been cut square.

A great deal of local photography was also carried out by "F" flight (that originally formed for training and experimental work, which now also maintains some Blenheims for operational use); it fulfils orders from any command and from various branches of other services. All demands for photography, which can be executed from western Europe, are now received through Coastal Command. It has taken over a flight originally formed by Bomber Command, the aim of which is to assess bomb damage, and P.R.U. is now unified in Britain. Detachments have gone to form similar units overseas.

P.R.U. continues to perform its normal round of visits at regular intervals as well as to make numerous special sorties—an account of one is to be found on page 19. While the details of present workings cannot be disclosed, it may be said that activity has constantly increased, and the degree of success attained shows no falling off. It is almost unknown for a P.R.U. pilot to fail to reach his objective, although most flights are made solo; there have been some extraordinary feats of navigation, especially considering that no wireless, R.D. or beam apparatus was carried.

In February it lost its greatest single objective, with the escape of the enemy warships from Brest; their preparations for leaving port had been noted steadily and successfully, day by day, to the very end, in spite of the increasingly bad weather which was eventually such a handicap to attack. The dispersal of the German fleet required even greater efforts from P.R.U., which in two days photographed almost every one of its known major vessels.

During the two and a half years of its existence the members of this comparatively small unit have received one award of the Polish decoration *Virtute Militare*, two of the D.S.O., 29 of the D.F.C., with three bars (two to the same officer), and two of the D.F.M. One is an officer and four are members of the Order of the British Empire (Military Division). Thirty have been mentioned in despatches.

SECTION 2

SOME NOTABLE INCIDENTS

(i) Narratives of Attacks

Ship probably Sunk at Night

On 1st March at 2115 hours, Whitley T/502 on an anti-submarine patrol sighted lights in the position 45° 48' N., and 09° 17' W. These lights (which were doused as the aircraft approached) appeared to be spaced equally over an object approximately 200 ft. long. At first it was thought to be a U-Boat, but almost immediately three or four Very lights were fired from the same locality, and a few seconds later a merchant vessel, of approximately 1,000 tons, and a trawler were observed, travelling at a speed of six knots.

The larger vessel was attacked with three 250-lb. depth-charges from 50 ft., while it was illuminated by the Whitley's landing light; the aircraft passed between the masts during the attack. The stick was seen to straddle the ship amidships, two of the depth-charges falling on the starboard side, and the third on the port. It is considered that the first two may have struck the side of the ship and exploded underneath. The aircraft made a second attack, dropping two 250-lb. depth charges from 50 ft., and a column of spray was seen alongside; 900 rounds were fired from a machine-gun during this attack. It is considered that the depth charges must have fallen directly beneath the vessel. Oil and wreckage were observed later by several members of the crew, and the captain of the aircraft is confident that the ship was sunk.

Night Attack on a Submarine, using Special Equipment

Whitley D/502 was flying at 3,000 ft. over the Bay of Biscay, at 0305 hours on 8th March, using its beam aerials, when a contact was made four miles to starboard. The beam aerials were retained in use, to approach the object up moon. The aircraft turned 90 degrees to starboard, only just before contact disappeared, so as not to cross directly over the object. A contact was again obtained to starboard at two miles distance; after a further turn to starboard, contact was made at one mile. The aircraft again turned 90 degrees to starboard, with the homing aerials switched on, but stayed at 2,000 ft. so as to drop flares if necessary.

The object was now sighted and identified as a submarine, and the aircraft turned directly to port and circled, losing height as rapidly as possible. It then approached, using homing aerials, directly up moon, and carried out an attack from 150-100 ft., at an angle of about 45 degrees.

The submarine appeared to have a conning tower of the Italian type, and was believed to be stationary since no wake was seen. Six 250-lb. depth-charges were dropped at 50 ft. (Mark VIII pistol, set for 25 ft., spacing 45 ft.). They appeared to explode about 10 yards off the port quarter, and the rear gunner caught sight of a green flash behind the water thrown up.

The depth-charges seem to have missed astern. Probably the U-Boat was not stationary, but charging hard with one tail clutch out and making five knots or so on the other engine, which would produce no wake.

Destruction of a Motor Launch

On 20th March, a Sunderland R/10, on an anti-shipping patrol in the position 43° 43' N., 01° 43' W., sighted a motor launch, approximately 50-60 ft. long, with deckhouse amidships, and flying the German flag; it was then 0745 hours. The aircraft attacked four times, but the first was unsuccessful as the depth-charges hung up. The second was made with machine-gun fire, many hits being

scored, and pieces were seen flying off the vessel. On the third attack, four 250-lb. depth-charges, set at 25 ft., were dropped from 500 ft. The motor launch was seen to be in their centre, and was blown up on the crest of the explosion. Wreckage was seen when that had subsided. Three 250-lb. depth-charges were dropped in the next attack from 500 ft., with a setting of 25 ft. (the fourth depth-charge hung up). Once again the vessel was well within the explosion area and was blown up on the crest. After this attack the launch appeared to be a mere shell floating well down by the stern, and was surrounded by wreckage. Survivors were seen to jump overboard with rafts and dinghies. As a single-engined aircraft was then seen to be approaching, the Sunderland went away. (Plate 5).

Moonlight Attack on a U-Boat

Whitley F/502 was flying on an A/S sweep over the Bay of Biscay, at 2343 hours on 1st April, in position $46^{\circ} 30' \text{ N.}, 06^{\circ} 35' \text{ W.}$, when the rear gunner sighted a large ocean-going U-Boat with a conning tower of German type, fully surfaced and going at 10 knots. F/502 was flying at 1,500 ft., in calm weather; there was good visibility up the moon path, and no cloud. The beam aerials failed to pick up the U-Boat because it was in a blind area.

The aircraft turned to starboard directly over the U-Boat, losing height, until it reached a position 10 degrees on the starboard quarter of the U-Boat and attacked from this bearing, dropping five 250-lb. depth-charges (25 ft. setting, 50 ft. spacing) from a height of 50 ft. A sixth depth-charge failed to release. The first two were seen to fall short of the conning tower, then awash and disappearing, but the third exploded on or just abaft it. In addition to the usual blue flash, a shower of whitish yellow sparks were seen, and a fountain of water rose to some 150 ft.—it was at least four times as high and broad as after the two first depth-charges. The explosions of the remaining depth-charges were not seen by the crew, probably because of it.

After the attack, a large foaming patch was observed on the surface, in diameter approximately equal to the length of the U-Boat; this patch lasted about ten minutes. Three minutes after the explosions there was a convulsion of water 20 ft. across, such as might be caused by an explosion or the uprush of a great quantity of air; it appeared towards the forward edge of the patch. Nothing further was seen, though the aircraft returned one and a half hours later, and stayed 40 minutes.

Although no wreckage or bodies were seen, the U-Boat was probably destroyed; such comparatively small objects would be difficult to distinguish even in bright moonlight. The effects of the third depth-charge suggest that it lodged on the hull and exploded on reaching the correct depth, while the eruption of foam three minutes later from the same spot as the explosion, and the persistence of the large foaming patch for ten minutes, point strongly to a kill.

Air Fighting over the North Sea

On 1st and 2nd April, aircraft were detailed to find and escort Norwegian ships which were leaving Sweden in an attempt to reach Britain. The vessels expected were six tankers and four cargo steamers, and their speeds varied between 8 and 14 knots. To assist identification, each ship was to wear a Norwegian flag at the ensign staff and a white flag with "G.B." at the foremast, and also display "I.N." in white letters on the bridge top. They had been told to expect Blenheim and Beaufighter escort, but aircraft on the search were warned not to fly too close, because they might be fired upon, unless recognised as friendly.

During the two days our aircraft met and escorted some of the ships, and on these sorties they sighted and had combats with many enemy aircraft. All our crews returned safely, and their aircraft received no serious damage.

At 1827 hours on 1st April, Beaufighter X/248 sighted a Ju. 88 in the position $57^{\circ} 34' \text{ N. and } 08^{\circ} 03' \text{ E.}$ The enemy aircraft took to cloud cover, but reappeared two minutes later, about 400 yards astern of X/248, and attacked with a short burst of machine-gun fire. Our aircraft climbed into clouds, and when it emerged in a squall of sleet and snow, the enemy was not in sight.

On 2nd April there were many more combats with enemy aircraft which resulted in three being definitely destroyed.

At 1715 hours, Beaufighter *C/248* sighted an He.111k in the position $57^{\circ} 27' N.$, $03^{\circ} 25' E.$; the enemy was circling a merchant vessel, which was sinking. Our aircraft attacked the Heinkel from astern, with cannon and machine gun fire. The starboard engine was seen to fall out, and pieces came off the fuselage; the enemy flew on about 300 yards, and fell burning into the sea. It had not returned fire, but another enemy aircraft shot away the Beaufighter's rear vision mirror while the observer was re-loading.

Later, at 1815 hours, *X/248* sighted a He.115, flying at sea level, in the position $57^{\circ} 14' N.$, $03^{\circ} 55' E.$ Our aircraft made three attacks with cannon and machine gun fire. In the first, pieces were seen to fly off the enemy's fuselage; then he went into low cloud. The Beaufighter approached again, through haze and a snowstorm, and more hits were observed. After this attack no return of fire was experienced, and the rear gunner of the enemy aircraft appeared to have been hit, for his gun was pointing skywards. In the last attack the enemy aircraft went up vertically from sea level, and then dived into the sea. The Beaufighter circled but saw no wreckage. (The pilot of *X/248* was the same on both days, a man with one leg. He has now been awarded the D.F.C.)

At 1735 hours, a Blenheim, *X/404*, sighted an He.111 flying at 200 ft. in the position $57^{\circ} 29' N.$, $04^{\circ} 00' E.$ Our aircraft made an attack with machine-gun fire and hits were seen, although no effect was observed. The enemy aircraft replied with tracer and what appeared to be mortar fire, and escaped.

An He.111 was also sighted in the position $57^{\circ} 30' N.$, $03^{\circ} 59' E.$, by Beaufighter *C/235*, which attacked from the starboard side. Hits were seen along the fuselage and starboard wing. With the second burst the starboard engine began to smoke and pieces fell off. Our aircraft broke away, and saw two sheets of flame coming from the Heinkel, which was going down to the sea. The enemy aircraft had returned fire, but without any effect. Two Heinkel float planes were sighted as the combat finished but *C/235*'s ammunition was exhausted, so the pilot sought cloud cover.

A merchant vessel, in the position $57^{\circ} 29' N.$, $06^{\circ} 26' E.$, was being attacked by a He.111 at 1200 hours, when Beaufighter *N/248* arrived. Our aircraft fired one burst of cannon fire, but no hits were observed, and the enemy made off into cloud cover. At 1245, in position $57^{\circ} 28' N.$, $04^{\circ} 15' E.$, *N/248* sighted another He.111 to starboard, one mile ahead, and very low on the water. The Beaufighter attacked from the starboard quarter with cannon, and possibly scored hits on the tail. Fire from the enemy aircraft hit the starboard engine of the Beaufighter, and damaged the hydraulics. The enemy aircraft made off, and *N/248* set course for base.

Beaufighters *R* and *P/248* sighted an He.111 at sea level in the position $57^{\circ} 23' N.$, $02^{\circ} 05' E.$, at 1235 hours. A running fight ensued, lasting for 15 minutes; our aircraft used all their cannon ammunition. The enemy climbed to 7,000 ft., followed by *R* and *P* which made several attacks. The Heinkel was hit several times and its rear gunner apparently silenced. The enemy aircraft returned fire, but at extreme ranges, and did no damage to either of our aircraft. The He.111 was last seen with white smoke coming from astern. *P/248* gave chase, but lost it in cloud.

At 1737 hours *J* and *L/404* sighted and attacked an He.111 from astern, with the front machine guns, in the position $57^{\circ} 18' N.$, $03^{\circ} 12' E.$ The enemy aircraft returned fire and hit *J* several times, but only caused some slight damage. The Heinkel jettisoned seven bombs. Our aircraft continued to chase it for about 13 minutes but it escaped owing to superior speed. The crew of *L/404* thought that the enemy's rear gunner was put out of action and that the Heinkel was damaged.

Beaufighter *T/248* also sighted an He.111, at 1544 hours, in the position $57^{\circ} 32' N.$, $03^{\circ} 05' E.$ *T* attacked with machine gun and cannon fire on the enemy's port quarter. Hits were seen and the enemy took avoiding action. At 1549 *T* sighted four enemy aircraft in line astern, a mile ahead, and attacked the last in the line, but observed no hits; the enemy aeroplane sheered off and *T* chased it for a short distance and then broke away. These aircraft did not return fire. At 1551 hours two He.115's were sighted, and *T* attacked one on its port



Plate 4. PHOTOGRAPHS BY P.R.U.: THE GROWTH OF THE U-BOAT PENS AT ST. NAZAIRE. Above, the site cleared, 4th April, 1941. Middle, three pens constructed, 26th May, 1941. Below, the completed pens, after the Commando raid, 7th April, 1942: the outer lock gate is clearly destroyed, and the inner is being strengthened by sand pumped from the harbour.



Plate 5. ENEMY SHIPPING. Above, a wreck off Nord Fiord, Norway, on 6th April. Middle, the destruction of a motor-launch (page 14). Below, bombing an enemy tanker (page 17).

quarter: hits were observed on the tail plane, and the enemy took evasive action: little return of fire was experienced. *T* returned undamaged.

Repulse of Air Attack on a Convoy

Liberator *L/120* was engaged on anti-aircraft escort to a convoy at 1446 hours on 5th April, in the position $44^{\circ} 22' N.$, $05^{\circ} 02' W.$, when a Ju.88 was seen circling at a distance of 4-5 miles. The Liberator climbed and placed itself between the enemy aircraft and the convoy, and the Ju.88 dived to sea level on a reciprocal track to the convoy. Our aircraft opened fire with cannon at 600 yards and closed to 300 yards, when the enemy aircraft jettisoned its bomb load in a stick of three; they exploded and the Liberator was hit by the spray. No hits were definitely observed on the Ju.88, but puffs came from the starboard engine, and a white streak was seen in the water, presumably where the enemy aircraft's propeller struck it, as the Liberator closed.

Since the cannon button had jammed, *L/120* turned to starboard. Two more Ju.88's were seen circling, 2 miles on the port beam, and they were joined by the first. Our aircraft fired a burst from long range, and continued to circle between the convoy and the enemy aircraft. The three Ju.88's then approached the Liberator from its starboard beam, closing to 500 yards, but did not open fire. Our aircraft opened up with fire from the starboard side guns, and tracer was seen to straddle the nearest aircraft. The enemy aeroplanes sheered off, and one broke away, climbing rapidly to the north of the convoy. The others circled for two minutes and then set off on an easterly course; they were not seen again. The first Ju.88 climbed parallel to the convoy, and attempted to bomb it, but appeared not to cause any damage, for the ships did not alter course. Our aircraft feared that the other two would make a low level attack, and therefore stayed between the sun and the convoy.

Bombing of an Enemy Tanker

Hudson *Q/608* was airborne at Wick at 0704 hours on 6th April, on a Vaaro patrol. At 1010 hours it commenced its patrol and twenty-five minutes later, in the position $62^{\circ} 10' N.$, $05^{\circ} 05' E.$, sighted a tanker of approximately 6,000 tons, flying the Nazi emblem and accompanied by three escort vessels. The aircraft attacked, from land, using all available natural cover; it flew through a narrow gully to sea level, and approached the tanker on the port quarter. Four 250-lb. G.P. bombs (3 seconds delay) were released in a stick, approximately seven yards from the target, at a height of 20 ft. and a speed of 175 knots (Plate 5). The crew heard a series of thuds immediately after, and the rear gunner on looking back from 250 yards away saw two columns of smoke amidships, rising to mast height. During the approach the tanker had fired tracer, which passed overhead because the aircraft was flying below the level of the deck. After the bombing the flak ships opened up with tracer and intense cannon fire, which increased when the guns of the tanker also were trained seawards. The aircraft sustained one hit from a cannon shell on the door, and one bullet penetrated the tail plane. It returned to base at 1324 hours.

Periscope seen and Attacked

Whitley *L/502* was flying at 4,000 ft. on an anti-submarine sweep on 21st April, in the position $47^{\circ} 53' N.$, $06^{\circ} 56' W.$, when a track was seen on the water almost beneath the aircraft on the starboard bow, at 1532 hours. Believing it to have been caused by a U-Boat, the aircraft began circling left-handed, losing height as quickly as possible while keeping up sun; cloud was 7/10 with base at 7,000 ft. Special Equipment was not being used. The pilot flew up the track and found it ended abruptly at a periscope which stood out 18 ins. or a couple of feet, throwing off a plume and leaving a distinct V-shaped wake; its speed is estimated at 4 knots.

The aircraft attacked at an angle of 10 degrees to the U-Boat's course, from its starboard quarter, releasing six 250-lb. depth-charges (Mark XIII pistol, set to 25 ft. depth) from 100 ft.; the spacing was set to 45 ft., but the aircraft speed was 160 knots, making the actual spacing 55-60 ft. The rear gunner saw at least four explosions, the first alongside the periscope, which was concealed by the fountain.

The aircraft circled for 18 minutes round a sea marker but observed nothing further. It was then obliged to return to base because of fuel shortage. Another aircraft hunted around the position from 1750 to 1920 hours, but it did not see the U-Boat, and had to return early owing to engine trouble.

At least two of the depth-charges should have been right for range and depth, and apparently for line, so that this excellent piece of manœuvring ought to have had good results.

Surprise Attack on a U-Boat through Cloud

Hudson K/500, on an anti-submarine sweep on 28th April, was flying at 4,400 ft. above the clouds when it sighted a surfaced U-Boat seven to eight miles off, making about 10 knots. The time was 1901 hours, the position 58° 06' N., 15° 30' W. The aircraft approached above the clouds, which extended from 2,000 to 1,500 ft., and then made a dive attack, completely surprising the U-Boat. The aircraft pulled out at 60 or 70 ft., attacking the U-Boat from its port beam, and released four 250-lb. depth-charges (Mark XIII A pistol, set to 25 ft. depth, spacing 60 ft.): the U-Boat was still surfaced, in fact three of the crew were seen on the bridge just after the release.

The first depth-charge exploded about 30 ft. from the port beam of the U-Boat, and the second 10 ft. from the starboard beam, the line between the two being just forward of the bridge structure. The Hudson turned steeply to port, when the bows were seen clear of the water and the stern down at an angle of 20 degrees. The aircraft then passed over, firing the front guns, while the U-Boat was disappearing stern down, with the bows still in the air, and listing to starboard; there was a large patch of frothy brown water all round. The U-Boat disappeared as the aircraft commenced another tight turn to port. When this was completed, the U-Boat broke surface for five seconds, but vanished by the time K/500 came over the position. The patch of frothy brown disturbance had by now spread into an oval shape, some 200 ft. long. Owing to shortage of fuel K/500 had to leave soon after. K/500 hunted the area for two hours around midnight, but saw nothing.

Damage must have been inflicted, judging by the frothy brown disturbance, but the fact that the explosions occurred while the U-Boat was almost fully surfaced, presumably means that the second depth-charge did not destroy it. The reappearance of the U-Boat for a few seconds may be explained as the result of a completely upset trim, or a desperate effort to regain the surface.

(ii) Narratives of Other Incidents

St. Elmo's Fire

At 0200 hours on 2nd February, Sunderland X/10 (R.A.A.F.) ran into a front near the Scillies on its way to the Bay of Biscay. As it proceeded along the front, which was almost parallel to the track, weather conditions grew steadily worse, and after two hours the aircraft became almost uncontrollable. The up and down draughts were so severe that it rose and fell as much as 800 ft. at a time. As the area of the storm was approached, static in the intercommunication became more and more noticeable until finally the set was almost useless. Fortunately the W/T operator had the presence of mind to earth his set, so the equipment sustained no damage.

At approximately 0500 hours the first pilot noticed that the tips of the propeller blades were illuminated with a purple glow in the small portion which is painted yellow. A short time afterwards the glow began to spread over the whole of the airscrews, taking about five minutes to do so. During this time the Special Equipment transmitter aerials above the cockpit also became illuminated, beginning at the extreme end of the transverse aerials. About ten minutes later, all the leading edges of mainplanes and control surfaces, and the nose turret, were glowing purple. The nose gun looked as though it were being fired, with sheets of flame, approximately one foot long, leaving the muzzle of the gun. The tail turret was the last part of the aircraft to be affected. When the tail gunner reported that his guns and all the metal of the turret was illuminated, the Captain called him out

of the turret in case of a discharge taking place at the tail of the aircraft and burning him; he noticed a discharge of sparks from the trailing edge of the elevators just before leaving his turret. The upper surface of the mainplane, from the mainspar aft, was not affected at any time.

There was no noticeable effect on the crew at any time. The magnetic compass swung approximately 45 degrees to either side of its normal position, but only during the period when the entire aircraft was enveloped. Fabric was scorched along the trailing edges of the control surfaces, and paint scorched in small patches, approximately one inch in diameter, over the entire aircraft.

St. Elmo's fire is a very weak electrical discharge of a "brush" nature. The phenomenon generally occurs on the mastheads of ships. For at least 3,000 years it has been taken as a sign of divine protection; it was associated by the Greeks and Romans with the Heavenly Twins, Castor and Pollux, and by the Christians with St. Helena; later it was called after St. Elmo, a Spaniard born in 1190 who spent his life preaching to seamen along the Biscay coast, refusing a bishopric sooner than abandon his mission. An alternative theory regarded the flames as the souls of the dead, hence their name *corposants*, literally "holy bodies."

Photographing the Renault Works

Bomber Command's raid on the Renault factory in a suburb of Paris was carried out on the night of 3rd/4th March. It was a matter of urgency to photograph the results in order to supplement the public announcement of the raid and forestall enemy attempts to camouflage the damage. The Photographic Reconnaissance Unit watched the weather closely from early next morning, and kept an aircraft in readiness. It left after two hours waiting, and this is the pilot's report:—

"Airborne at 11.20 hours in heavy rain and poor visibility. Lost sight of ground immediately after take-off and climbed to 2,000 ft., setting course for Rouen. Flying by instruments in 10/10 cloud but without icing.

Tried to find pinpoint on English coast and descended at 11.35 to 1,000 ft. Caught glimpse of field but not enough visibility to establish position so climbed up again to 4,000 ft. Crossed Channel at this height still in 10/10 cloud, crossed French coast at 6,000 ft. just above cloud top with further layers of cloud above. On estimated time of arrival for Rouen, ground not visible, changed course for Paris, steering 136 degrees. Five minutes before E.T.A. for Paris broke cloud at 700 ft. over open country. Altered course to 170 degrees and flying just inside cloud base spotted the Seine three minutes later.

Returned to original course of 136 and three minutes later without warning flew into a clear patch at 1,000 ft. over what we believed to be N.W. Paris. Climbed hard to 2,000 ft. on same course and entered cloud again. Came down and broke cloud at 500 ft. again, three minutes later, on N.E. outskirts of Paris. Turned on to reciprocal, keeping just above cloud base until we hit river Seine again.

Started following the river. The observer lay in bombing position to give guidance as it is very difficult from the pilot's seat to see enough to follow the winding Seine in a very limited visibility. It was difficult to obtain approximate courses while following the river as at each sharp bend the gyro compass would spin. Finally gave up any idea of a course and decided to stick to the river until it took us to the target.

Between 12.35 and 12.40—accurate timekeeping wasn't practicable—we came on the target at 500 ft. It had been passed before we had time to start cameras and we flew on for a minute, then turned steeply left round the approximate target area, which was very difficult to see through low mist, and turned on the oblique camera. Levelled out as observer shouted that the target was visible again, and turned on all vertical cameras.

Flew across middle of target area at 400–600 ft. on altimeter, turned steeply right and ran across the target again from another direction. At the end of this particular run, when turning right again, caught sight of the foot of the Eiffel Tower. Made a third run, this time forced to descend to 400 ft. owing to lowering cloud. Attempted a fourth run but, owing to very poor and decreasing visibility and the speed, lost sight of the target.

As we had then been over the target area for 34 minutes and were confident that we had obtained pictures as good as could be obtained under the prevailing conditions, set course for England, 332 degrees. Climbed to 5,000 ft. and were then just above the top of the low cloud belt which was still 10/10. As this course would have led us out very close to Dieppe, at 13.18 hours altered course to 270 degrees to take us west of the town and at 13.22 returned to original course. Estimated time of arrival for crossing the French coast was 13.25 and at 13.28 we began to descend through cloud with the idea of finding the height of cloud base in good time before striking the English coast. Broke cloud at 1,500 ft. about 10 miles off the French coast.

Cloud base lowered steadily and visibility decreased, coming over the Channel. Altered course to 327 to make sure of crossing the low beaches between Beachy Head and Selsey Bill, at the same time making W/T contact with base. Lowered undercarriage to reduce speed to 160 m.p.h. (air speed indicator) and were forced to reduce height to 0 indicated. At this height could just see the water. Maintained this height and speed with the idea of possibly landing at Ford or Tangmere. At approximately 13.55, at estimated position Selsey, crossed the coast and immediately climbed as it was obvious no landing could be made in this district.

- At 2,000 ft., still in 10/10, followed bearings from base. Base gave weather of 800 ft. cloud base and visibility 1,200 yards. At estimated position 10 miles south of Reading, lowered undercarriage again and started losing height with the idea of finding the Thames and following it. Kept up to 850 ft. so as not to collide with hills. At this height caught glimpse of hangars and aircraft in a temporary break in clouds. Descended to 500 ft. and identified it. After about half a dozen circuits managed to land. Had a nice cup of tea."

The aircraft landed at 1415 hours. A brief visual report was immediately made by telephone to base, and was amplified when the pilot and observer reached their intelligence section. The magazines of negatives were developed by hand, and each print required hand printing. At 2010 hours the photographs and interpretations left by despatch rider for Bomber Command headquarters.

*" Oh, the little more, and how much it is !
The little less, and what worlds away ! "*

A Hudson, O/59, was airborne at 1810 hours on 10th March, for a patrol to find E-Boats. Twenty-five minutes after setting course from base, it was found that the compasses differed by 27 degrees and the pilot decided, almost certainly rightly, that the observer's O2 type was more accurate; unfortunately it had no card to show its magnetic deviations. In such conditions most people would have gone home, but this crew went on to the estimated position for beginning the patrol, and thought they had reached it half an hour later.

At 2103 hours the wireless operator reported contacts at 8, 12, and 28 miles to port. The position then estimated was not far off the coast of Suffolk. The pilot homed on the blips and met an intense barrage of multi-coloured tracer and heavy flak. It became obvious that he was over land, so the correct British pyrotechnic was fired; it had the effect of stopping all the flak and searchlights for a few seconds. Then the barrage opened again, heavy flak bursting so close that it shook the aircraft and could be smelt, while light flak burst behind and to port. The Vary pistol had jammed after the first cartridge, but that did not matter as the true position of the aircraft must have been near Ostend. The flak continued for 10-15 minutes, during which the aircraft was three times held in searchlights. Eventually it escaped into quietness by reducing height from 1,500 to 800 ft., climbing to 3,500 ft. and turning violently. At 2125 hours, course was set " between west and north " and the coast was sighted after half-an-hour, at Harwich. The wireless was out of action, and Darkie was used without success.

After following the coast for a while, the crew realised that they were in the middle of a balloon barrage, because they saw two balloons illuminated by searchlights. A minute later the starboard wing hit a cable. The controls were whipped out of the pilot's hands and the Hudson made steep turns to right and left through about 180 degrees. The crew were all badly jarred. The pilot regained control and homed by searchlights, landing at the nearest aerodrome, Martlesham Heath, at 2215 hours, just as the starboard engine failed.



Plate 6. PACK ICE, 70° NORTH. The first stage in the disintegration of floes.

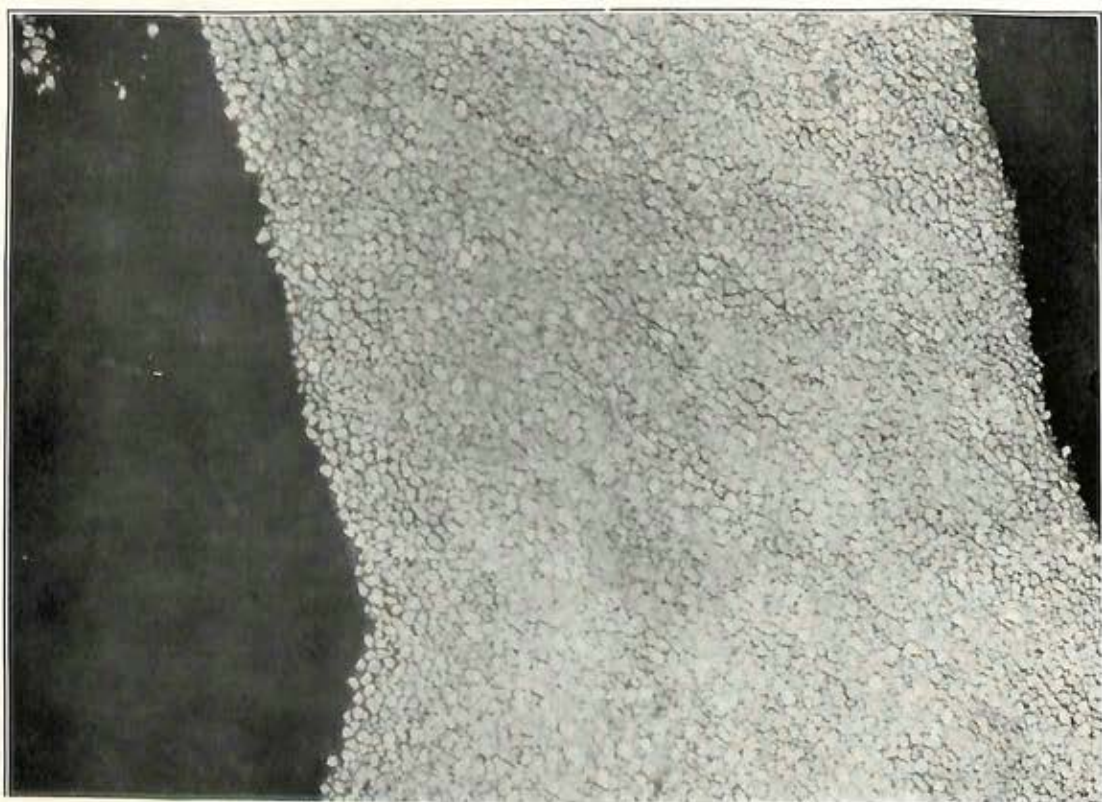
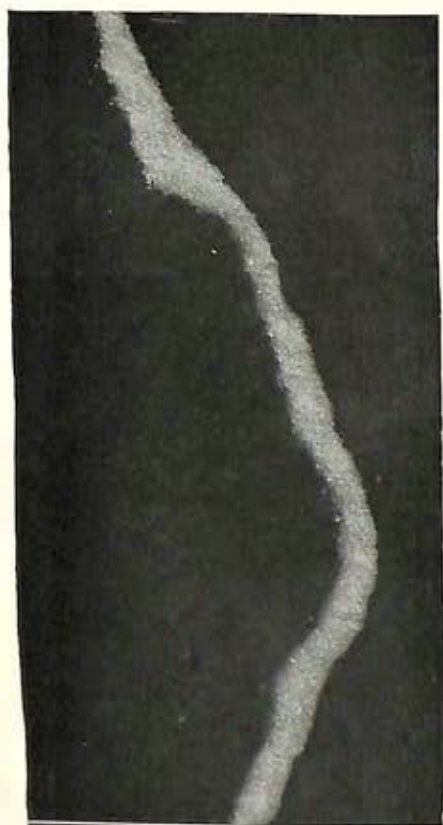


Plate 7. BRASH ICE OFF DENMARK, 14th March. The final stage in the disintegration of floes. The pieces have become less than 10 ft. in diameter, through melting and knocking together; they are blown into bands, varying from 30 to 350 yards wide, which are fairly compact on the windward edge and streak out to leeward.

The cable had made a cut of four feet through the leading edge of the starboard wing, right to the main spar, 2 ft. 6 ins. outboard of the motor. There was also an abrasion on the blade of the starboard propeller, and the navigation lights had failed.

Survivors from a Fall of 2,000 Feet

A Beaufort of 86 Squadron left Skitten on the evening of 12th March, when the meteorological forecast was extremely good, in order to carry out a patrol along the Norwegian coast. The weather, however, deteriorated rapidly while the aircraft was on its homeward journey, the wind increasing to gale force and bringing with it low cloud and extremely heavy rain and sleet.

The wireless operator was unable to obtain any bearings, and for the remainder of the flight was completely out of W/T touch with the ground stations. Owing to the strength of the wind and the darkness, which made it impossible to obtain any drifts, the aircraft returned well to north of the intended track and the observer could not be certain of the exact position in which they found themselves. An endeavour was made to home on the S.E. beacon, but failed owing to some obscure fault.

The aircraft flew around in the Caithness area for a considerable time. All aerodrome lights were showing at Wick, Skitten and Castletown, rockets were fired from these stations, and all searchlights in the area were exposed, but the aircraft was unable to locate the aerodrome. At about 2315 hours, the weather had become so bad that it was doubtful whether the pilot would be able to land, even if he located the aerodrome, so the captain of the aircraft decided that they would have to climb to a reasonable height and abandon it.

The pilot flew out to sea and jettisoned the torpedo, and then flew inland and climbed to approximately 2,500 ft. Petrol was very low by this time and owing to severe icing, it was not found possible to go higher. The observer and one of the gunners then baled out, the gunner going through the rear hatch, and the observer climbing through the roof and plunging down over the wing. The second gunner and pilot then prepared to leave the aircraft. The pilot, in the excitement, not only undid the Sutton harness but also his parachute harness, stepped from his seat without a parachute and prepared to climb out of the roof. At this moment, fortunately, the starboard engine cut out through lack of petrol, and the rear gunner and the pilot were thrown back into the aircraft. It went down in a spiral and crashed on a hill 2,000 ft. below, 15 miles south-west of Wick.

Both the pilot and gunner were thrown clear, and considering the complete disintegration of the aeroplane, suffered reasonably minor injuries. An inspection of the wreckage made it quite clear that the aircraft must have been travelling at a good 200 knots at the moment of impact.

The gunner who had baled out, severely injured his feet on landing, because of the strength of the wind. He was, however, able to walk a certain distance until he found shelter beneath a wall, where he remained until the following morning; then he was able to struggle to a crofter's cottage. The pilot and second gunner, after they had recovered from the concussion which they had suffered in the crash, similarly made efforts to locate some form of habitation. They did not meet after the crash, and each eventually had to rest and shelter under what cover they could find, till morning, when both managed to reach a cottage and met there. All these three members of the crew were soon in hospital, and although suffering from shock, frostbite, cuts and bruises, and one from a broken arm, were soon well on the way to recovery.

Since nothing was heard of the observer, search parties were sent out, as well as an aerial reconnaissance, which found the body about two miles from the wreckage, and directed a search party to the spot. His death was due to severe injuries to the skull, perhaps sustained by hitting some part of the aircraft as he was baling out, or the result of being dragged along the ground by his parachute, for a full gale was blowing at the time.

A Hudson's Belly Landing

On 14th March at 0310 hours, Hudson G/59 was taking off from North Coates in extreme darkness and haze, when it hit a dyke. Damage was caused to the Pitot head and starboard oleo leg; the wheel was torn off, complete with axle and

vertical stub, and was found later in an adjacent field. The accident is believed to be due to the fact that the aerodrome was in a soggy condition, and the aircraft took a considerable time to take off; it also sagged on becoming airborne, for no apparent reason.

The pilot realised that the air speed indicator was unserviceable, and on informing base, was diverted to Leuchars. But visibility there was poor, so the aircraft jettisoned its bombs into the sea, flew north, and sighted Crail aerodrome. The crew then noticed that the port wheel was stuck down, and the other was missing. The Hudson fired a distress signal, and received a reply instructing it to land. Owing to a failure in the hydraulic system the flaps would not lower, and a belly landing was made without their aid. It was so skilfully done that it entailed only slight damage to the aircraft (in the bomb-doors, bolt-heads and propellers), and none of the crew was injured.

SECTION 3

ANALYSIS OF PAST OPERATIONS

(i) Sightings of U-Boats near Convoys

The object of this article is to estimate the results of air protection to attacked and unattacked convoys from the standpoint of sighting U-Boats, and to indicate the range from convoys to which the U-Boats extend. The figures given show that, per flying hour, patrolling aircraft sight 15 times as many U-Boats near convoys which are being attacked as near those unattacked. The distances from attacked convoys at which U-Boats are sighted form a rough guide as to how far our aircraft should extend their patrols, though they do not represent the true density of U-Boats because the amount of flying was unevenly distributed. Of the U-Boats sighted during the attacks, 30 per cent. were found within some 10 miles of the convoy, 45 per cent. between 10 and 35 miles, and 25 per cent. between 40 and 70 miles. These inconclusive results suggest that escort to 10 miles range is necessary for attacked convoys but that aircraft should also circle about 15 and 30 miles away, if not further. For unattacked convoys we have no evidence that sightings were concentrated near them; even so, a fairly close escort probably gives them better protection than a distant one.

Attacked Convoys

This analysis takes account of all Atlantic convoys from August to October, 1941, that being the end of the long period in which U-Boat activity was practically confined to the eastern part of the ocean. During these months, some 150 convoys passed through the area, and only eight of them were attacked. These eight convoys were given 182 aircraft sorties for escort or protective sweeps, and the aircraft sighted 25 U-Boats—one in every seven sorties or every 22 operational flying hours. With the unattacked convoys 1,018 sorties on escort or protective sweeps resulted in only 12 sightings—one in every 83 sorties or 323 hours. (On offensive operations in the Bay of Biscay, in the same period, 1,179 of such sorties resulted in 61 sightings—one in every 19 sorties or 63 hours.) It follows that escort and protective sweeps for convoys produce 15 times as many sightings when they are being shadowed as when they are not, for the same amount of operational flying, and three times as many as are found on offensive operations.

Sightings also give some indication, though vague, as to the relative value of escort and protective sweeps for attacked convoys. The U-Boats were found at the following distances, in nautical miles, from the convoys in question: 7, 8, 8, 8, 15, 15, 15, 15, 20, 30, 30, 40, 60, 60, 70 (in addition, three were sighted by aircraft on passage). In other words, five were within 10 miles of the ships, seven between 10 and 35 miles, four between 35 and 70. In the absence of definite information to show how much flying was done at different distances from the convoy, it is impossible to use the sighting figures alone to deduce what are the most profitable ranges at which to fly in order to find U-Boats. It can, however, be said that the U-Boats seen a long way off, 60 to 70 miles, though few, were yet more numerous than is generally the case in the neighbourhood of an unattacked convoy. Whether or not it is profitable to fly at such great distances, it is, however, certain that a close escort is essential.

Though the neighbourhood of attacked convoys has proved very fertile for sighting U-Boats, the actual number of sightings there is less than would be expected, if we suppose that a whole pack of about five U-Boats stays within 60 miles of an attacked convoy and on the surface. This may mean that the U-Boats spend a large proportion of their time submerged.

Unattacked Convoys

Aircraft engaged on escort or protective sweeps over unattacked convoys sighted twelve U-Boats in 3,880 operational flying hours. Only one of these U-Boats is known to have been close to a convoy (12 miles off); otherwise the nearest positions reported were 40 and 50 miles distant, and two others at 90 miles. The distance of the remainder from the convoys is unknown, although two of these

U-Boats were apparently moving to attack ships, the position of which had been signalled by enemy aircraft. It looks as though most of the U-Boats had arrived by pure chance in the positions in which they were sighted, and had not in fact realised the presence of a convoy.

That conclusion is confirmed by a very rough calculation which shows that the number of U-Boats sighted near unattacked convoys is more or less what might be anticipated as the result of patrolling at random over the Atlantic. We can assume one U-Boat to every 90,000 square miles as a fair average. As an aircraft can effectively sweep about 400 square miles an hour (see previous issue, page 36) it would then sight a U-Boat every 220 hours. The actual figure for the escort and protective sweeps over unattacked convoys is one in every 323 hours.

The enormous amount of flying done for the sake of unattacked convoys, though comparatively unproductive in sighting U-Boats, may have the result of preventing a number of attacks. In the course of this flying, 12 U-Boats were sighted by aircraft, which were able to warn the convoys concerned so that course could be altered to avoid the danger spots. Some of these U-Boats would probably have detected the convoys but for the aircraft's signals.

It is difficult to ascertain the most effective type of flying around a convoy which has not been attacked. A close escort, say to 20 miles, may produce fewer sightings than more distant escort. That is because the former tends to cover the same area more than once, and the figures of sightings show no counter-balance in the way of a higher density of U-Boats near the convoy. On the other hand, the U-Boats sighted close to the convoy are potentially much more dangerous than those farther away. On the whole, a fairly close escort, extending to about 30 miles, probably gives the most effective protection to unattacked convoys.

(ii) The Air Offensive against U-Boats

This is a brief review of the results achieved by Coastal Command in the battle against U-Boats, with particular reference to the summer and autumn of 1941, which was a period of fairly high activity. In 1942 the U-Boats have so far been less active on this side of the Atlantic.

From the beginning of the war up to May of 1941 (21 months) Coastal Command aircraft made about 200 attacks on U-Boats. This number certainly considerably exceeds the total number of U-Boats that took part in active operations during this period. We can therefore conclude that most of the operating U-Boats each received several attacks from the air. About a third of the attacks were delivered before the U-Boat had time to submerge. This earlier air offensive was, however, not as intense as that which followed in the summer and autumn of 1941. A fuller analysis of the latter has been made and the results can be expressed with more completeness.

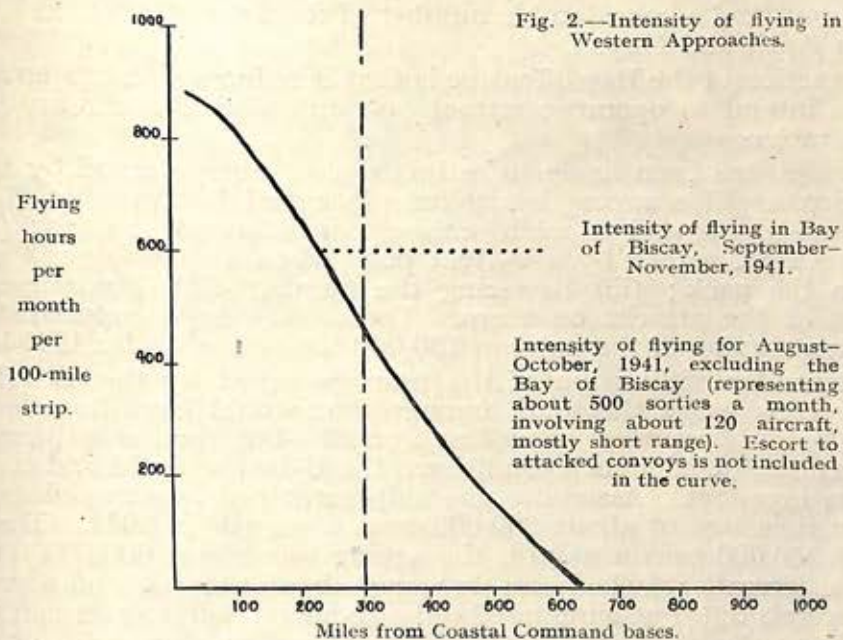
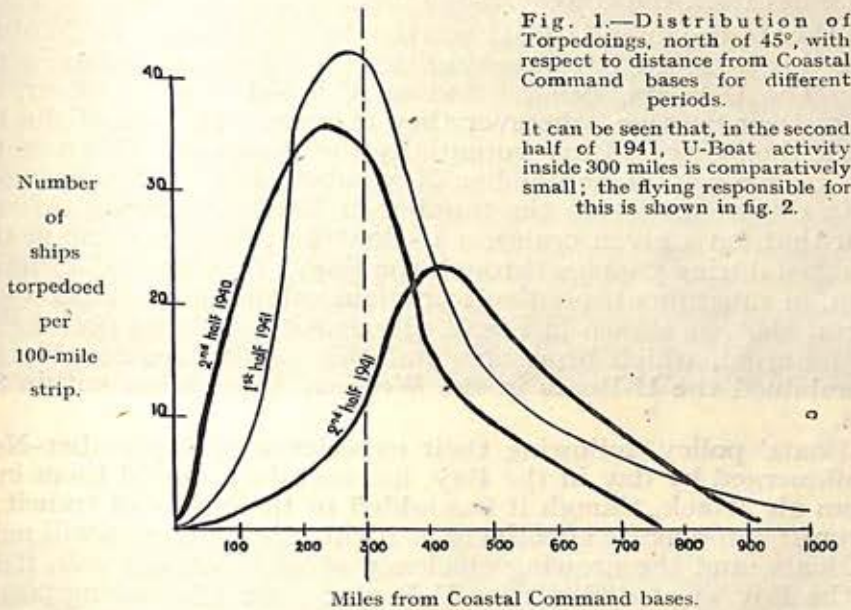
Nearly 130 air attacks on U-Boats were made in that period (June–November, 1941). It is estimated from the relation of flying hours to sightings, and from other data, that the total number of U-Boats that were operating during this time was about 60 to 70. The number of attacks was thus about double the number of U-Boats. In other words, in the space of these six months, every operating U-Boat was on the average attacked twice by aircraft. The summer of 1941 marked not only an increase in the frequency of air attacks but also in their effectiveness (partly due to shallow depth charge settings). Actually, about 35, that is half the U-Boats operating, received damage, while two or three were sunk or otherwise eliminated. There can be no doubt that the U-Boats must have felt very keenly the impact of this air offensive.

Evidence for this is provided in the first place by the very large decrease in the second half of 1941 in U-Boats operating inside the area heavily covered by aircraft, that is within about 300 miles of Coastal Command bases. The curves in Figure I show the number of ships torpedoed north of 45° by U-Boats at different distances, in the following three periods: second half of 1940, first half of 1941, and second half of 1941. It will be seen that in the first period many sinkings took place even inside 100 to 200 miles. There is a distinct shift outwards in the next half year, and for the second half of 1941 there were comparatively few ships sunk within 300 miles of Coastal Command bases.

It is estimated that inside 300 miles, the density of flying in the summer of 1941 was such that a U-Boat patrolling on the surface in this area would have

been attacked about once a week. About one attack in every three caused appreciable damage, so that a U-Boat could not efficiently patrol the area inside 300 miles without becoming a casualty sooner or later during its cruise of a month or so. The limited U-Boat activity in the region is therefore understandable.

The offensive inside 300 miles has played a large part in saving shipping, for although the U-Boats have, of course, sufficient range to operate well outside this range, their chances of finding a convoy are much less at large distances. Furthermore, the assistance the U-Boats can receive from their co-operating aircraft is less, the further out they are. A saving of shipping has also resulted through the deterrent effect on the U-Boats which have remained inside the 300 mile range, and through the material damage done to them.



Owing to the small number of long-range aircraft available, the density of flying falls very rapidly with increasing distance from base. This is shown by the curve in Fig. 2, which represents the flying at different distances for the period August–October, 1941. At 500 miles, the density of flying is only about one-fifth of that inside 300 miles. Thus at these longer distances the reconnaissance work of the U-Boats was not seriously harassed from the air. However, on the special occasions of a mass attack on a convoy, long-range aircraft provided a certain amount of escort as far out as about 700 to 800 miles. Such escort, even though

limited, had a decided effect in reducing the force of U-Boat attacks and in ultimately breaking them up. An analysis of the mass attacks during August to October shows, for instance, that in each case about half the U-Boats in the pack were attacked by aircraft in the first two days or so. Furthermore, there is evidence that air escort compelled the U-Boats to remain submerged for long periods during the day, thus preventing them from taking up suitable positions for attack at night, and also possibly from keeping contact with the convoy.

It is to be noted that aircraft have a particular advantage over surface escort in coping with a mass U-Boat attack because of their greater mobility. This permits a striking force to reach the convoy under attack in time, and also enables a large area around the convoy to be covered—the threatening U-Boats extending to about 70 miles from the convoy (page 23).

The transfer of the main U-Boat activity to the American side of the Atlantic in December, has reduced the opportunities for offensive action in the Western Approaches. The U-Boats, being based on this side, are, however, still exposed during part of their passage, wherever they operate. The use of the Biscay ports has thus made the Bay of Biscay potentially the most profitable area for offensive operations. In the period September–November, 1941, 36 attacks on U-Boats were made in this area. From the number of U-Boats passing through the Bay we may infer that, on a given cruise, a U-Boat had to risk a one in three chance of being attacked during passage through the Bay. This was sufficient of a menace to force them, in subsequent months, to remain submerged in the Bay in daytime. It is of interest that, as shown in Fig. 2, the density of flying (*i.e.* the flying hours divided by the area), which brought about this result, was roughly the same as that which subdued the U-Boats in the Western Approaches within 300 miles of the air bases.

The U-Boats' policy, following their experience of September–November, of remaining submerged by day in the Bay, has certainly repaid them in the matter of safety from air attack, though it has added to their time of transit. However, provided aircraft can operate effectively at night, diving tactics will not materially help the U-Boats, and the growing efficiency of night attack will, it is expected, soon make the Bay most difficult for U-Boats. Already, owing possibly to the growing fear of night attack, they are again crossing it at least partly on the surface by day, and a considerable number of daylight attacks have been carried out there in April and May.

The attraction of the Bay offensive is that it reduces sinkings, no matter where the U-Boats intend to operate; attacks on outgoing U-Boats are in particular very remunerative.

An attempt has been made to estimate the tonnage saved by the air effort against U-Boats. This saving has taken place mainly through: (i) Preventing U-Boats from sighting and attacking convoys or independent ships; (ii) Reducing the force of a mass attack by a U-Boat pack when a convoy has been found, by breaking up the pack; (iii) Reducing the number of U-Boats operating, as a direct result of the attacks on them. These have been considered separately, and a resultant saving of the order of 130,000 tons a month for 1941 is arrived at.

An independent indication of the tonnage saved by the air effort may be obtained by considering the total tonnage that would have been lost had there been no protection by surface as well as aircraft—but assuming the same number of U-Boat cruises. Under such conditions, the U-Boats would find enough targets for all their torpedoes. Assuming one ship sunk per two torpedoes, this would mean an average loss of about 800,000 tons a month in 1941. The actual loss being about 150,000 tons a month, the saving was about 600,000 tons a month. At that time aircraft attacked and damaged about the same number of U-Boats as surface vessels did, but eliminated only about one-quarter as many. It is not unreasonable on the basis of these results to apportion the credit for saving ships in the ratio of about one to three between air and surface forces—this gives roughly the same figure as above for the saving by air effort—about 150,000 tons a month.

The effect of the air offensive on the morale of a U-Boat's crew is additional to the factors considered above. The surprise value which aircraft have by virtue of their high speed, and the large areas they can cover for the same reason, compel the U-Boat to keep a constant watch while on the surface. The advent of Special Equipment has prevented any relaxation even at night. Thus, while within aircraft range, and on the surface, there is a constant strain on the crew.



Plate 8. EVJA AND SEVDIS FIORDS, ICELAND. Like the Norwegian fiords and the lochs of Scotland, these are "drowned valleys" cut by glaciers when the land stood at a higher level in relation to the sea. With their steep sides and great width they are good examples of the U-shaped troughs eroded by ice, or rather by the stones carried beneath and beside it, in contrast to the V-shaped gorges of rivers. The country is covered with sheet upon sheet of lava; the snow outlines their horizontal edges. Cold air tends to descend and fill the valleys with mist during the night.

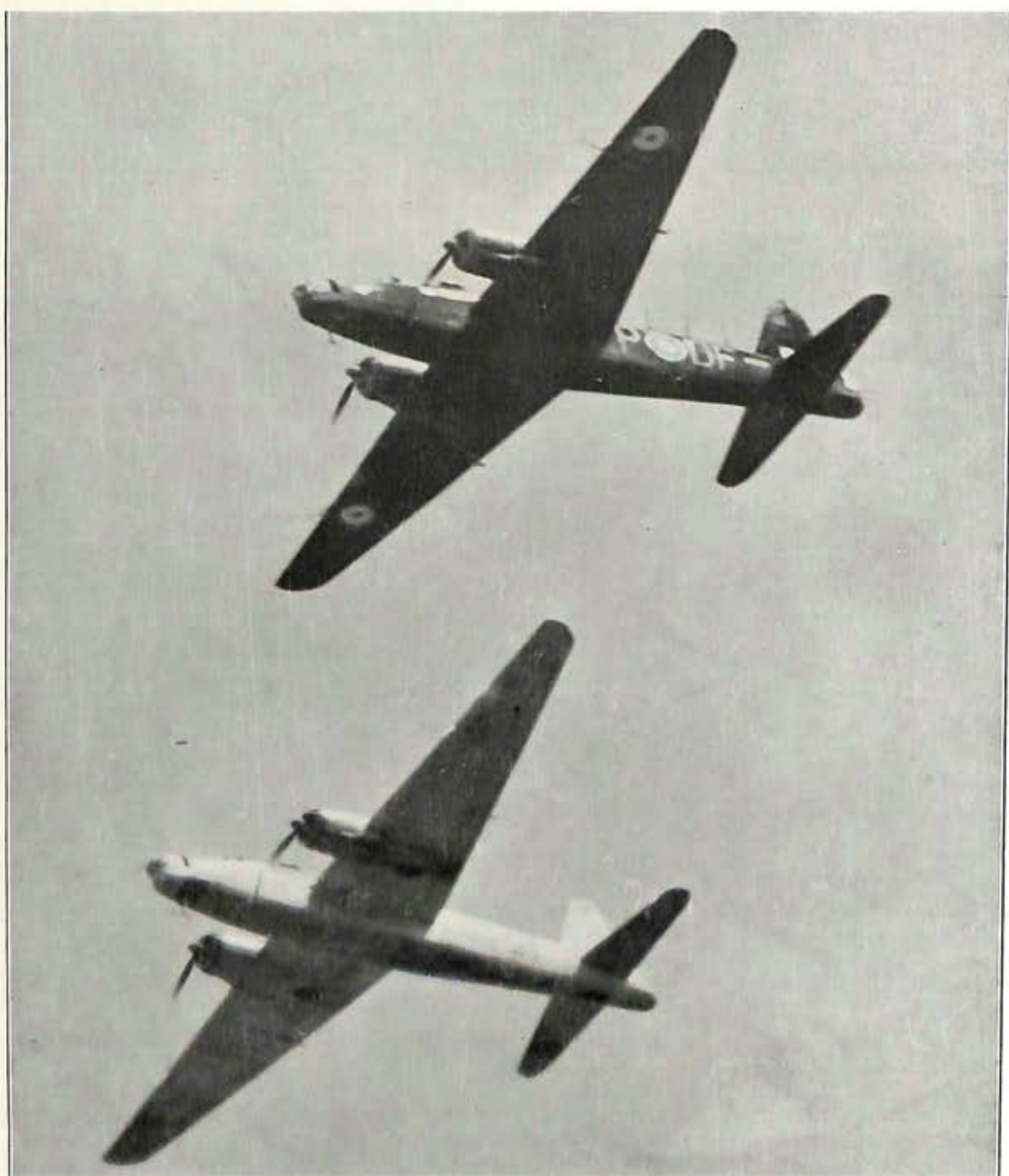
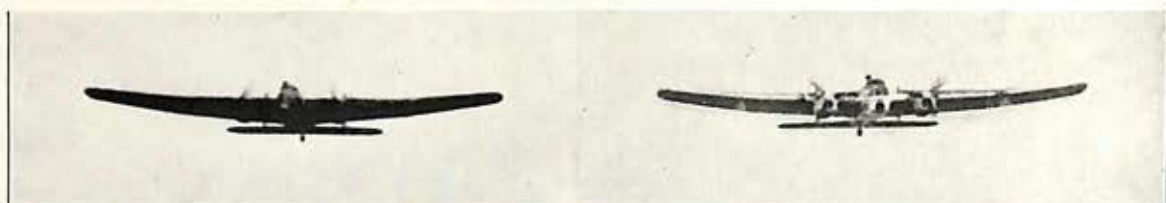


Plate 9. AIRCRAFT CAMOUFLAGED WHITE AND BLACK. Above and middle, Whitleys one mile distant. Below, Wellingtons at 400 yards (page 29).

SECTION 4

TECHNICAL AND SCIENTIFIC

(i) Camouflage of Anti-Submarine Aircraft

Introductory

In the previous issue of this review (page 36), it was shown that painting aircraft white rather than black should have the effect of 30 per cent. more U-Boats becoming liable to surprise attack. This argument was based on the assumption that white aircraft are able to approach 20 per cent. nearer to a U-Boat without being seen. That is only a generalization, because, as might be expected, the improvement, due to painting white, varies considerably with the light. It has, however, been found that only when an aircraft is flying in a very clear atmosphere, and with the sun or full moon shining directly upon it, is black camouflage on the sides preferable to white. Undersurfaces should always be white.

Shortly after the outset of the War all heavy bombers of the R.A.F. were painted on their sides and undersurfaces with a special black paint, mainly in order to prevent them showing up when caught in a searchlight beam, but also from a mistaken idea that this was the best night camouflage. Anti-submarine aircraft of Coastal Command were included in this scheme, in spite of the fact that it renders them most conspicuous to a U-Boat by day, and that it is no part of their usual job to fly over searchlights.

In the summer of 1941 the problem of a suitable camouflage for Coastal Command aircraft was recognised to be of the greatest importance, in order that U-Boats should be given the minimum warning of an attack and therefore be caught more often on the surface. As a result two aircraft of 502 Squadron were painted an off-white colour similar to that which P.R.U. had already developed and used successfully for their Spitfires.

Observations and photographs of these aircraft led to the opinion, amply supported on theoretical grounds, that even a pure white aircraft does not usually appear brighter than the sky except in full sunlight. Under the cloudy conditions of the North Atlantic, pure white was found to offer the nearest approach to invisibility (disregarding schemes of artificial floodlighting or transparent fabric), and it was therefore decided to re-paint all those aircraft used exclusively on anti-submarine operations. It was realised that such camouflage would make the aircraft very easy to see when on the ground or when observed from above over the sea, but these disadvantages were considered to be of secondary importance under existing conditions.

Success of the Scheme

Some measure of the success of this white camouflage can be seen from the enlargements, reproduced here, of comparative photographs taken at Wick and Limavady (Plate 9). They show that, although the sides of the white aircraft make a fairly good match with the sky, the undersurfaces still look quite dark owing to the very small amount of light reflected up from the sea. If the aircraft were to fly higher or above the cloud base, this upward light would be much increased and a better match with the sky would result, until with dense cloud beneath the aircraft the undersurfaces would appear brighter than the sky (but in this case the aircraft would anyhow be hidden from the sea). In order to try and improve the undersurfaces when flying low, some have been painted with a very glossy dope to reflect to the observer the more distant and brighter parts of the sea. However, the improvement is not great.

Reports from our own submarines have confirmed that white aircraft are often extremely difficult to see, and are less likely to be noticed by a look-out than black ones. Furthermore, members of flying crews have themselves been made aware of their comparative "invisibility" when co-operating with naval forces.

Some actual measurements of the difference in sighting distances of black and white aircraft were attempted at Limavady at the end of last year. A number of observers were stationed on the sea-shore and the two aircraft flew in towards them. The times at which each observer first spotted each aircraft were recorded, to give a measure of the sighting distances. Unfortunately only a few results could be obtained, but these showed that the white reduces the sighting distance by about 20 per cent. in the head-on attitude—which agreed well with the theoretical predictions. For a side view the difference should be considerably greater. The actual sighting distances will of course vary from day to day according to the visibility, and will change as aircraft pass in front of a dark or light patch of cloud, so that the figure above is only a rough average. In order to obtain measurements under controllable conditions, experiments have been made with model aircraft under artificial illumination designed to simulate natural conditions (by the General Electric Co.). So far these have been confined to moonlight and starlight brightness levels in conditions of meteorological visibility common in the British Isles. The results are given in the following section.

White Aircraft at Night

The sun is about half a million times as bright as the moon, but if the visibility and the cloud conditions are the same there is no difference between daylight and moonlight, except in brightness. In the same way starlight is just like a dimmer version of daylight when the sky is evenly overcast. Therefore a camouflage scheme which is the best by daylight will also be the best at night.

The change in brightness has two effects. One is to reduce all sighting distances to about one-thirteenth in moonlight and one-fiftieth in starlight. The other is to exaggerate the visibility of a white aircraft when it is brighter than the sky background, in the same way that white traffic marks on a road stand out more at night than by day. However, this condition only arises when there is very little cloud and the aircraft is directly lit by the moon.

Recent experiments have been carried out at the General Electric Co. with three model Wellingtons, one black, one white, and the third with "temperate sea" sides and "duck-egg" blue underneath. They have confirmed that the white aircraft is the least visible of the three when the aircraft is not lit directly by the moon but by starlight or has a cloud between it and the moon. For a broadside view, the difference in the sighting distances for the black and the white was found to range from 35 per cent. for a bright moonlight night with overcast sky, to 14 per cent. for a starlight night. In the last case the sighting distances are anyhow so small, that camouflage becomes of no importance. On a fairly clear night with a full moon not obscured by cloud, the "temperate sea" camouflage was found to be the best, because the direct moonlight makes white aircraft appear too bright. However, the white is still less visible than the black by about 10 per cent., though this difference becomes negligible with a half-moon under the same conditions.

The net result of all this is that white is the best all-round camouflage for night. In the special case of a moonlight night with only a small amount of cloud, an aircraft with "temperate sea" sides and white undersurfaces is the least visible.

Bright Sunlight and Bright Moonlight with very clear Atmosphere

Except for the brightness difference, a sunny day is exactly like a clear moonlight night, and the "temperate sea" scheme therefore provides the best camouflage for the sides in either condition. This scheme is preferable to the white one in the Mediterranean, or any other regions of exceptionally good visibility.

General Remarks on Disruptive Camouflage

When an aircraft is seen from above against a background of earth or sea, it is an advantage to break up its shape into different colours and patterns, to match the broken surface of the ground or sea beneath (Plate 10). The aim of this is not to make the aircraft invisible, but merely to make it unrecognizable as an aircraft and prevent it from attracting attention on account of its unnatural contour.



Plate 10. A CAMOUFLAGED HUDSON OVER NORTHERN IRELAND (page 30).

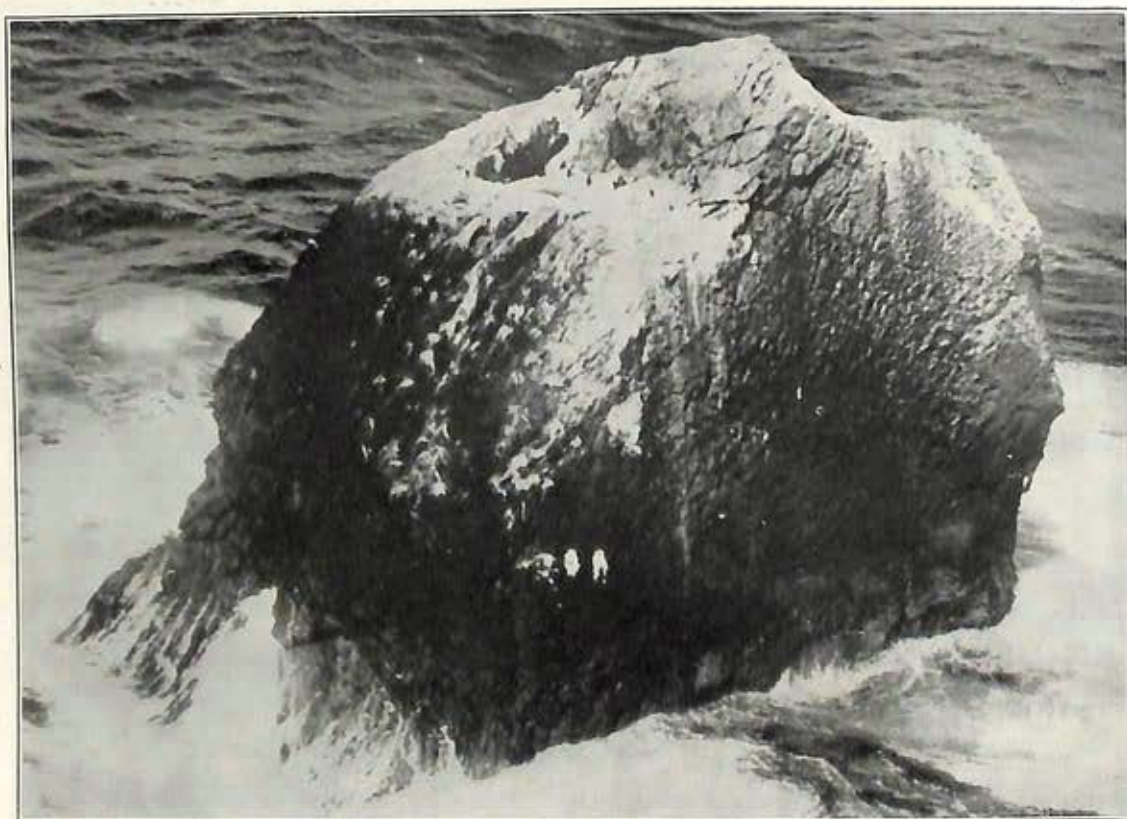


Plate 11. ROCKALL (page 32). Above, Rockall and Leonidas. Below, the white specks are guillemots.

There are two objections to extending this principle of "breaking up the outline" to an aircraft seen against the sky. The first is that the sky itself has no varying areas of brightness and colour like the earth or sea, except on such a large scale that a distant aircraft appears as a mere dot in one single area. It is not possible to disguise an aircraft as a cloud, nor is it expedient to try and disguise it as anything else.

The second objection lies in the fact that even a white aircraft usually looks dark against the sky. Since any attempt to break up the outline involves painting darker areas on the aircraft, this can only have the effect of destroying a reasonably good match with the sky and therefore makes the aircraft more visible instead of less.

Colour

Apart from certain colours, such as yellow, which attract attention because they are so rarely found in the sky, colour in camouflage is of relatively little importance compared to obtaining a good match in brightness. Once a good match in brightness has been obtained, however, then a bad colour match may be the only reason why an aircraft is seen at all.

The correct colour for an aircraft depends on the colour of the background against which it is seen and the colour of the light which is illuminating it. On a cloudy day the sky is white and the light is also white, hence the correct colour is white. On a sunny day with a blue sky, one side of the aircraft will be lit by the white light from the sun and should therefore be blue, while the other side and the undersurfaces will be lit by the blue light from the sky or sea and should therefore be white. Hence although white meets with most of the conditions, blue is equally good for the sides when there is no cloud. The "duck-egg" blue, with which the undersurfaces of Hudsons and flying boats are painted, is therefore not the best colour nor is it bright enough, but it is very much better than black and the advantage to be gained by re-painting with white is probably not worth the trouble involved.

(ii) Photographing Rockall and its Birds

Wars in the past have often provided opportunities for exploration and scientific record in areas of the globe otherwise rarely accessible, and this one will doubtless prove no exception. In one instance at least, crews of Coastal Command aircraft have been able, after a gap of twenty years, to add to and bring up to date scientific knowledge of the avifauna of a little known area: Rockall, most westerly of the British Isles. It is a stack of rock which projects, bleak and isolated, above the waters of the North Atlantic, 150 miles west of St. Kilda—its position according to the latest information is $57^{\circ} 36' 41''$ N., $13^{\circ} 41' 25''$ W.

Rockall is formed throughout of igneous rock, the greater part of the islet consisting of a rather unusual variety of coarse-grained granite. In addition there are present veins and other modifications of a unique rock-type named rockallite, containing some of the rarer earth minerals, such as zirconium. Both types must have been formed under terrific pressure, when a mass of molten rock was being lifted by gases but failed to make its way to the surface and solidified slowly at a great depth.

Rockall bank, rising from the depths of the Atlantic, extends for about 60 miles in a N.N.E.-S.S.W. direction, and has depths of 65 to 100 fathoms over it. The islet of Rockall lies about 18 miles southward of its northern end. Other elevations from the floor of the bank include Helen's reef, two miles E.N.E. of Rockall, with a depth of about six feet, and Heslewood or Leonidas Rock, a small detached rock some 900 ft. N.E. of Rockall, which dries three feet. Specimens of rocks similar to the granite of Rockall, and also of basalt, have been dredged at various localities on the bank, over part of which there are magnetic disturbances possibly due to basaltic rocks outcropping on the sea floor. The basalts represent lava flows which cooled quickly as they poured over the surface of land which is now submerged.

The rocks of Rockall were probably formed about fifty million years ago, when a great plateau of basaltic lava, many thousands of feet in thickness, extended from Antrim and the western seaboard of Scotland northward to the Faroes, Iceland, Jan Mayen and East Greenland. The greater part of this immense volcanic pile has foundered beneath the ocean, but the roots of some of the ancient volcanoes may be seen in the Hebridean islands of Mull, Rum, Arran, Skye and St. Kilda, in the Mourne Mountains of Northern Ireland, and at various localities in the Arctic. It appears probable that the granite stack of Rockall represents all that the ceaseless erosion of the sea has left of another great central volcano, while the basalts of Rockall bank form the most westerly known fragments of an ancient continent, conventionally termed Atlantis.

In the spring of 1941 an enquiry was made of the Commander-in-Chief, by certain ornithologists, whether aircraft were likely to be in the neighbourhood of Rockall and if so whether it would be possible to make observations and take photographs. Five such opportunities did, in fact, occur between 19th June and 7th August, 1941, and the records and photographs proved of great interest.

Rockall rises only 70 ft. above sea level. As will be seen from the photographs (Plates 11, 12), it is very small and insignificant, of 83 ft. maximum width at base, yet being in such an isolated position it is naturally the resting place of relatively many birds, and may be the breeding place of at least one species, in small numbers.

The recorded story of the birds of Rockall begins in 1810, in which year it was visited by H.M.S. *Endymion*, on 8th July. One individual, who landed on the rock, described the top as white with droppings and mentions gannets as being among the throng of birds present. Little further information of any kind is available, and that of a very indefinite character, until 1887-1888, in which years the crews of various fishing vessels landed on several occasions. Their records are contradictory in many respects, but it seems reasonably probable that at least several hundred guillemots were breeding.

The publicity given to these exploits led an anonymous writer to emulate them on paper, for he published in 1892 an account of his landing on Rockall, together with a description of many birds seen there, but on this being questioned by the editor of a scientific journal, he eventually had to admit that the whole story was a fabrication.

In 1896 the only visit made by scientific ornithologists took place; their ship was in sight of the rock on three occasions between 6th and 15th June, but a landing could not be made. However, it was recorded that 200-250 guillemots were on the only ledge on which they could breed, as well as 30 puffins, 50 kittiwakes and 10 gannets, all non-breeding. Fulmars and great shearwaters were seen at sea near Rockall, and possibly one or two razorbills on or near the rock.

Twenty years elapsed before the next visit in 1921, when an ex-circus clown and several sailors managed to land, but their account does no more than possibly confirm previous records.

Next, twenty years later, came the occasions during 1941 on which Coastal Command aircraft were in the vicinity of Rockall; observations were made, and photographs taken, from aircraft of 254 and 210 Squadrons. Others were taken in 1942 by various units of 15 Group.

As a result of these observations and of examination of the photographs, it can be stated, that the following species were present:—

Guillemot—varying numbers, up to 50, in June and July on the broad south-west ledge. It was here that they have been reported as breeding in the past and it seems possible that they may do so now. None was seen in August, which agrees with their habit of going to sea again after the breeding time.

Gannet—one (probably) on the top, and others just off the rock in June and early July, but not later.

Kittiwake—varying numbers (90-140) on or near the rock, late June to August.

It now seems quite certain that neither gannets nor kittiwakes breed there. All three of the above species were recorded definitely in 1896 and 1921, as were also puffins and possibly razorbills, whilst great shearwaters and fulmars were then at sea close by.

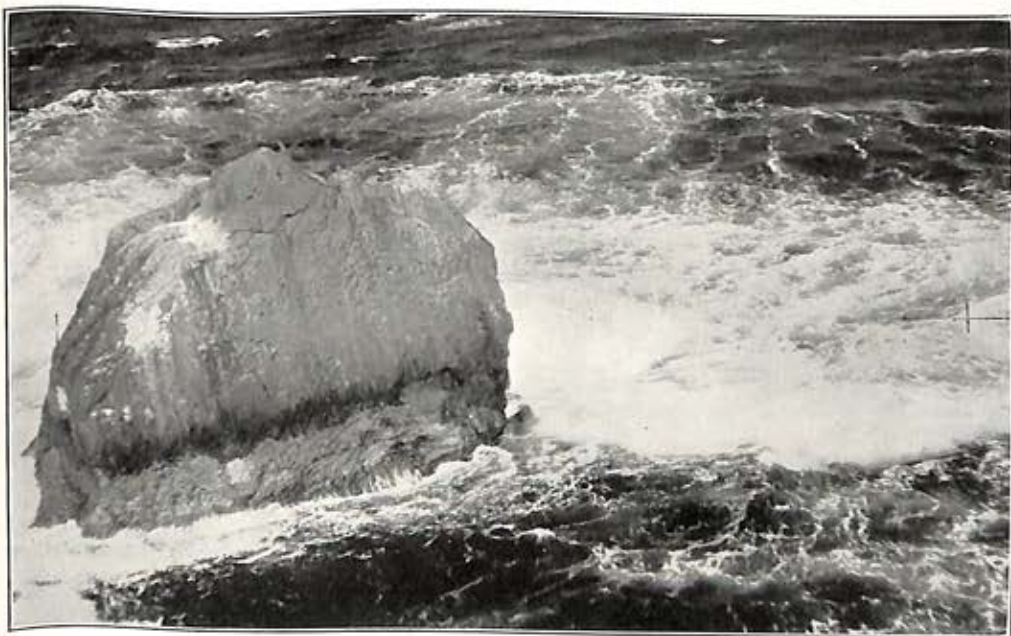
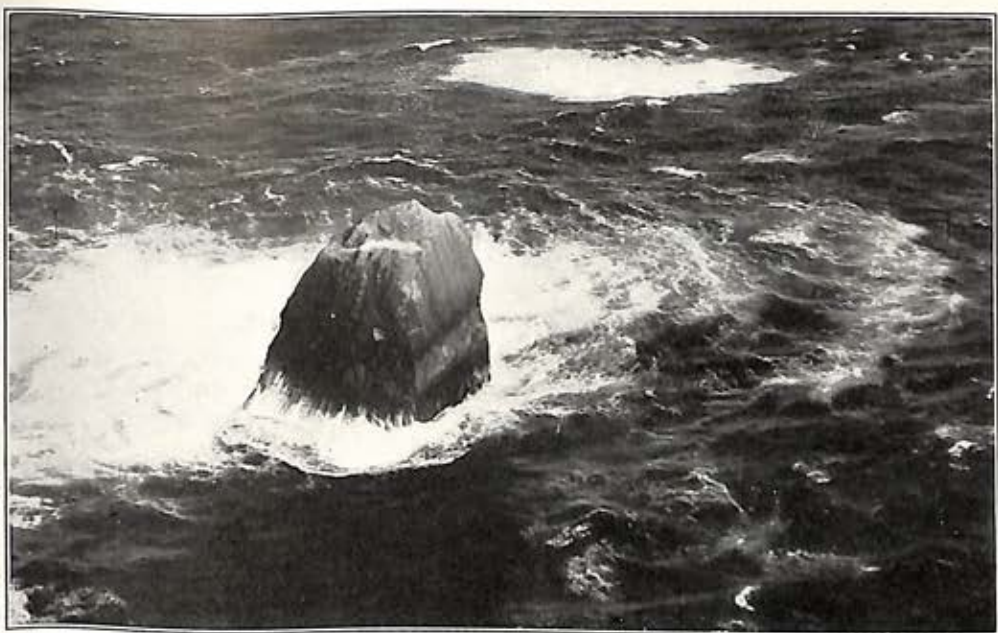
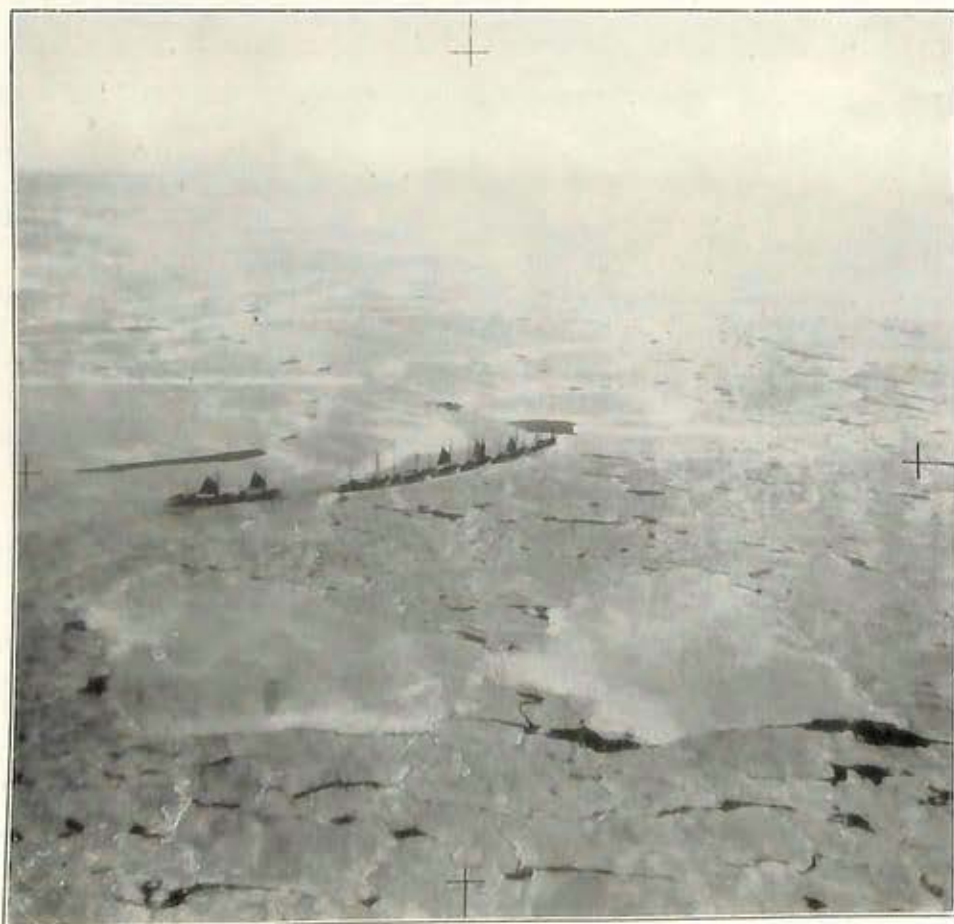


Plate 12. ROCKALL (page 32). 140 kittiwakes have been counted in the lower photograph.



Plate 13. A WATERSPOUT near Rockall, 22nd April. A waterspout is really a cloud of 100 per cent. humidity rising rapidly and, therefore, in a trunk; cumulus behind.



FISHING VESSELS CAUGHT IN ICE off Esbjerg, 8th March.

All the species mentioned are great ocean wanderers especially the gannet, kittiwake, fulmar and great shearwater. Other birds stated to have been seen, but not confirmed by any reliable report, are cormorants, Brännich's guillemots and various gulls.

One new point of particular interest to ornithologists is the proof that the gannet does not breed on Rockall. This bird is one of the few species in the world of which all breeding places are known, and of which an approximately accurate census of population can be taken. As the largest sea-bird of the north Atlantic, the gannet has been somewhat naturally the subject of particular study, attention being focussed upon distribution and population. There are not more than twenty breeding colonies. Only four are outside the British Empire—those being in the Faroes, and off the coast of Iceland (on Grimsey, Eldey and the Westmann Islands)—and they hold only one-sixth of the population. Two-thirds of the total adult population, which in 1939 was 165,000, reside in the British Isles, with the remaining one-sixth on the Atlantic coast of Canada and Newfoundland.

At the first census in 1913 the total was estimated at 101,000 excluding those younger than eight months, and during the great increase in the following twenty-six years, new colonies were formed; but the question whether Rockall had a breeding colony remained open until answered by Coastal Command in 1941.

SECTION 5

THE ENEMY

(i) Enemy Shipping Routes

Norway and Denmark

Roads and railways being few, Norway relies to a greater extent than most countries on water as a means of transport, and in addition to domestic trade a large and important export trade is carried on by this means. The domestic trade employs comparatively small vessels, mostly of 1,000 tons and under, which ply between the many small ports along the coast. Occasionally, when convenient, the Germans may use these vessels for the carriage of war stores and ammunition, but it is probably fair to say that they are mainly engaged on trade for Norwegians.

The larger vessels carry on the important import and export trades, which are now harnessed to the German war effort. Ore shipments from the extreme north, and from Narvik, are of considerable importance. On past experience, it might be expected that some 950,000 tons of Norwegian ores will be shipped from Norwegian ports in the course of a year, while some 750,000 tons of Swedish ore pass through Narvik. Fish products, pulp and paper, certain other ores, and war stores, complete the total of southbound cargoes.

A rough estimate of the southbound traffic destined for Germany is composed of some 60 per cent. ores; 13 per cent. fish products; 13 per cent. war stores; 7 per cent. pulp; 7 per cent. tankers in ballast.

In the reverse direction, war stores form the principal cargoes, that is to say that some half is under the direction of the K.M.D. or Naval Shipping Service, so the total is made up roughly as follows:—50 per cent. K.M.D.; 30 per cent. coal; 6 per cent. salt for refrigeration; 7 per cent. corn; 7 per cent. loaded tankers.

In ordinary weather conditions, the southbound traffic turns into the Skagerrak, and proceeds through the Kattegat and Great Belt, after which it disperses either into the Baltic ports, or through the Kiel Canal into the North Sea. But when the Great Belt and Sound froze, in February, the Baltic traffic came to a standstill, and ships destined for north Germany and Rotterdam had to take a less usual route down the west coast of Denmark. As the freeze-up spread to some of the north German ports themselves, even this traffic was somewhat reduced.

Associated with these weather conditions and a consequent reduction in shipping movements, abnormally large concentrations of shipping were seen in certain ports, notably Bergen, Stavanger, and Kristiansand (south Norway), and to some extent also in north German ports. As expected, the thaw in April led to a gradual dispersal, and generally speaking the number of ships in the larger Norwegian ports has now reached usual proportions. It is possible, however, that some of the ports notably Trondheim, may remain busier in view of naval developments in that area.

Upon the reopening of the entrance to the Baltic, southbound shipping destined for north Germany and Rotterdam probably reverted to its old winding route into the Baltic and through the Kiel Canal, and the route along the west coast of Denmark is only used by coastal shipping visiting ports in that country.

North-west German and Dutch Ports

In normal conditions, as stated above, the southbound convoys pass through the Sound and then divide, part going to ports in the Baltic, and part through the Kiel Canal into the North Sea, to unload at Hamburg, Rotterdam and less important places. This latter section is joined by a large amount of shipping from Swedish ports, carrying iron ore and timber from Sweden and also timber from Finland. In certain seasons, too, grain cargoes are shipped from various ports in the Baltic.

Of that portion of the traffic that penetrates through the Kiel Canal, a most important part proceeds to Rotterdam. It is estimated that iron ore to the amount of some 3,500,000 tons each year is unloaded there and transferred into barges for its journey onwards to the Ruhr. This represents about a third of all the iron ore originating from Norway and Sweden. Other cargoes reaching Rotterdam include 100,000 tons of fertilisers, 150,000 tons of pulp and paper, 100,000 tons of pyrites and copper ore, 400,000 tons of grain, and 100,000 tons of timber. This traffic all appears to approach along fairly well defined routes outside the Frisian Islands; at certain times of the year it assumes large proportions.

A far less important section of the traffic passes into Delfzijl, consisting of ships carrying timber, pulp, and paper, destined for Holland and France and other occupied countries. A certain amount also passes to Emden, though this port is probably more concerned with export of a general character.

On their return voyage northwards, the vessels carry coal, coke, and general cargoes. They pass along the Frisian Islands and through the Kiel Canal, after which some proceed to Swedish and Finnish ports, and some go through the Skaggerak to reappear along the Norwegian coast.

It will be appreciated that the cargo tonnages are not spread evenly over the twelve months of the year, but reach a peak in the early autumn and slowly decline until they reach the lowest ebb of the year in February and March. Then comes a gradual, and fairly fast, recovery in the amount carried, and in the tonnage of shipping to be found in these waters.

Biscay Area

As far as commerce is concerned, there is a hiatus from Rotterdam to the Biscay ports. It is true that there is a traffic, but little tonnage passes through the Straits of Dover, and what does is comparatively unimportant. In the Biscay area, however, considerable activity is found, and once again, iron ore is one of the most important cargoes carried. Unlike the iron ore traffic at the other end of the European coastline, these ships travel comparatively short distances, usually from Bilbao to Bayonne. Large amounts of very rich ore are carried by small ships, which can make the trip several times a week.

In addition to the small vessels engaged in this iron ore trade, there has recently been a tendency for larger vessels to be employed; these are too large for Bayonne and probably go to Bordeaux. Periodically there may be some diminution in the carriage of iron ore, while the vessels usually thus employed are engaged on other, temporarily more pressing, traffic, such as zinc blende, pyrites, and fluorspar; they are probably being used to a certain extent in a transshipment trade that may be developing between Bilbao and Bayonne, of goods brought to Bilbao in Portuguese and other coasting vessels.

A more serious development, that is probably just starting, is the threat of blockade runners trying to link up Japan and Germany, passing through the Bay of Biscay to and from ports in Occupied France. There are certain commodities that are so important to Germany, that the arrival of one of these blockade runners in a French port can mean that all the advantage gained by the successful bombing of, say, a synthetic rubber factory in Germany, is lost overnight; one cargo of rubber may be sufficient to supply the needs of several divisions of mechanised German troops for many months. Likewise, Germany has got the precision machinery that Japan must have for the continued maintenance or expansion of her war industry, so in the reverse direction it may be found that a vessel, having unloaded a cargo from the Far East, picks up another for the return trip.

With iron ore of a high iron content being shipped in large quantities, and the increasing threat that the Bay may be used for blockade running, that area may well develop into one of the most important focal points of the Blockade against the Axis.