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COASTAL COMMAND REVIEW

December 1944

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HEADQUARTERS,
COASTAL COMMAND
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COASTAL COMMAND REVIEW

Vol. III, No. 12—December 1944

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

Summary of the Year's Work—1944

Anti U-Boat

During the year 1943 the U-Boat suffered a decisive defeat, a defeat so crushing that to some it seemed that it must be final. The tale of the achievements of that year made impressive reading in the December, 1943 issue of the *Coastal Command Review*, but in the January number a note of warning was struck. Despite a loss equivalent to 50 per cent. of their first line strength, and in the face of Allied bombing, U-Boat building and development during that crucial year had reached such a pitch that the enemy began 1944 with more U-Boats than he had possessed at the beginning of 1943, and it was even then apparent that the U-Boat was still the major, indeed almost the only, offensive weapon left to the Germans. With its aid the enemy hoped not only to repel the liberating forces of the United Nations, but also to stage a comeback, and postpone indefinitely the defeat which is now threatening. He has not yet given up the attempt to achieve this latter object.

1944 opened fairly quietly for Coastal Command, but in the latter part of January a spell of fine weather, improved Radar tactics, and lack of caution on the part of the U-Boats produced a number of promising attacks, particularly in the Bay of Biscay and off the west of Ireland where U-Boat concentrations were located. Most of these attacks took place by night, with the aid of the Leigh Light or flares including the recently introduced 1.7-in. flare. Despite some successes, it soon became apparent that our Radar homing technique was far from perfect, and that it was necessary to put a greatly increased effort into training in this field. It was also about this time that the enemy began to achieve satisfactory results with his 10 cm. Search Receivers (first fitted in the Autumn of 1943) using improved amplifiers and aerials, and for this reason too the difficulties of locating and killing U-Boats at night increased. Despite these limitations, however, a satisfactory rate of sighting and attack was maintained in the first part of 1944, and by the end of April the Command had been credited with the destruction, or probable destruction, of twelve U-Boats plus two shared with surface escorts, a figure which was not unreasonable considering the comparative scarcity of targets, the difficulties of night attack, and the season of the year. The overseas groups of the Command in the Azores, Iceland and Gibraltar, as well as the home groups, all made notable contributions during this period, and the enemy's attacks on shipping in the Coastal Command operational area produced negligible results. Nevertheless, convoy escort was given whenever circumstances warranted. But by April it was obvious that the enemy was following an even more cautious policy with the clear intention of conserving his U-Boats for use when the inevitable invasion took place. Consequently, in the spring and early summer, Coastal Command took the opportunity of stepping up training even further, in order to make everything ready against the testing time which lay ahead.

Meanwhile a number of technical developments were taking place. Although the 250 lb. Torpex depth charge still remained the principal weapon, the 6-pounder cannon carried in the special Mosquito achieved its first success when, during March, two special Mosquitos in combination with a Mosquito strike force destroyed a U-Boat within sight of the enemy naval base of St. Nazaire. On the enemy's side certain changes had taken place in the flak armament. The quadruple 20 mm. mounting had proved unsatisfactory and was replaced by a fully automatic 37 mm. gun, which has also proved somewhat too delicate for U-Boat work. This meant that the U-Boat's flak by now consisted of two twin 20 mm. on the forward bandstand, a 37 mm. on the after bandstand, and a number of machine guns on the bridge. To counter the U-Boat's flak, efforts had also been made to strengthen our aircraft's forward armament, the most notable step in this direction being the fitting of four fixed Brownings in the Sunderland.

Even more important developments had occurred in the field of Radar. 10 cm. equipment had by the summer come into general use, and later improved versions including attenuators were also being introduced. The initial advantage which centimetre Radar had given us in 1943, however, had now to a large extent been neutralised by the enemy's introduction and development of 10 cm. G.S.R. The first "Tunis" search receiver also made its appearance in U-Boats at this time, giving the enemy warning cover not only on the 10 cm. but also on the 3 cm. waveband. Further, U-Boat commanders were at last given permission to use their Radar in certain circumstances, and a new Radar set called the Hohentwiel, a development of an aircraft set, made its appearance as a substitute for the relatively bulky and unsatisfactory Gema. However, supplies of equipment were so short that many U-Boats carried no Radar at all.

It was clear that all the enemy's efforts were being devoted to the object of defeating or evading his principal enemy, the aircraft, and an even more significant device which was brought into general use before the Invasion was the Schnorkel, which was in fact fitted to a proportion of U-Boats by D-Day. A full description of this device has been published elsewhere and there is not space here to do more than point out that, after the initial difficulties had been overcome, difficulties which resulted largely from lack of experience in operating with the new equipment, the Schnorkel has provided the U-Boat with the means to traverse with comparative safety areas which had hitherto been denied to him. To date, however, it has not greatly increased the U-Boat's offensive capacity.

The battle of the Invasion opened for Coastal Command about three weeks before D-Day. From May 16 onwards the U-Boats moving out from Norway to reinforce Atlantic and Arctic flotillas were attacked in the continuous daylight of the northern summer. Few of these northern U-Boats were at that time equipped with Schnorkel and, in the period of mid-May to the end of July, 73 U-Boats were sighted, 51 attacked, and 17 sunk or probably sunk, including one killed by a Sunderland of 4 O.T.U. In addition, 11 were damaged. The percentage figures of these operations are of some interest. Seventy per cent. of all U-Boats sighted were attacked, while 33 per cent. of the U-Boats attacked were killed, a rate of destruction which has never been achieved over such a prolonged period in Coastal Command before. (The best kill percentage hitherto had been 30 per cent. in October, 1943.)

These operations were extended far and wide in the waters north of Scotland up to a point over 850 miles from the aircraft bases. The signal achievement of the 18 Group and Iceland aircraft at this time was marked by the only two V.C.s awarded to Coastal Command aircrew engaged in anti-U-Boat operations. In each case the aircraft succeeded in killing its U-Boat despite the most intense, accurate and damaging flak.

The main anti U-Boat operations in the English Channel and its western approaches opened on D-Day. Previous to that date single U-Boats had penetrated into coastal waters with the aid of Schnorkel, but both equipment and experience were lacking, and when the Invasion came the U-Boats put to sea from the Biscay ports and made their way to the western approaches of the Channel on the surface. This resulted in a record rate of sighting and attack. A particularly notable achievement was the destruction of two U-Boats within 20 minutes at night by a Liberator of 224 Squadron. During those first vital four days from D-Day, Coastal Command sighted 37 U-Boats, of which 24 were attacked. In every case the U-Boats fought back desperately with flak, but despite this, and the limitations imposed by the difficulties of night attack which applied in the case of no less than 18 attacks, 6 U-Boats were destroyed and 5 damaged.

These successes were decisive. A blow was inflicted on the enemy from which he never really recovered in so far as the invasion operations were concerned. From now on the enemy again adopted extremely cautious tactics and the opportunities for killing became less and less as his skill with the Schnorkel became greater. Nevertheless, aircraft continued to make numerous sightings and attacks, so that by the end of June a grand total of 83 sightings had led to 48 attacks in the area of the Channel operations, and a further three U-Boats were sunk, the credit for two of these being shared with Naval forces, while five more were damaged. Naval escort groups, who had soon taken a hand, were now adding to the quota with kills achieved sometimes as a result of an aircraft sighting. Taking the score from all areas, June was Coastal Command's best month in 1944, with a total of 15 kills. This figure has been surpassed only once previously, in May, 1943, when 18 kills were recorded.

In July the number of sightings and attacks in the Channel fell off, and by August it was clear that the enemy was beginning to evacuate the Bay ports under pressure from the military situation, with Norway as the ultimate destination. The result was that a number of successful actions were fought in the Bay of Biscay, and two U-Boats were accounted for by Coastal Command aircraft, while the credit for three other kills was shared with the Navy. By the end of August it could be said that the battle of the Invasion had been fought to a decisive conclusion. In the whole campaign, extending from the Lofotens to the west coast of France and lasting from mid-May to the end of August, not less than 49 U-Boats were destroyed by the sea and air forces. Of these, Coastal Command was credited with 31 kills, while damage assessments were awarded to Coastal Command aircraft in 28 other attacks. These 28 damage assessments were particularly useful at this time, as it meant that many U-Boats were neutralized from further action during the critical period when the invasion force was establishing itself in France and its strength was being built up by men and supplies from England. Thus ended the most decisive phase in 1944, a period as fateful as the extraordinarily successful May-August killing season of 1943; and as in 1943, operations seemed to slacken off as the enemy once more strove to conserve his forces and the morale of his crews against a day when they could fight yet once more.

The enemy now had to operate from bases in Norway and so Coastal Command squadrons were redispensed to meet the new situation. Enemy U-Boat operations were on a comparatively limited scale. There have been no signs of a revival of the pack attack in the Coastal Command area, but a small number of bold commanders have penetrated with the aid of Schnorkel into inshore areas, particularly in the approaches to the North Channel and the English Channel, and sinkings have sometimes taken place within a few miles of our air and naval bases; but the weakness of the enemy forces engaged and the weight of air and sea cover, both in the U-Boats' operational areas and in Northern waters, has been such that the overall rate of sinkings has not increased to any appreciable extent. It is true that the enemy's growing skill in the use of Schnorkel has during the latter part of 1944 led to a considerable reduction in the rate of sighting, attack and killing—since 1st September our aircraft have only destroyed five U-Boats; but despite the lack of positive results, there is no doubt that during this period Coastal Command has achieved as great a measure of success in protecting our shipping as at any time in the past.

It will be of interest to sum up Coastal Command's positive achievements during the past year. No less than 29,345 sorties were flown on anti U-Boat operations giving a total number of hours of 273,404. Largely owing to the development of Schnorkel and the use of improved Search Receivers by the enemy, only 451 U-Boats were sighted as against the 930 of 1943. Of these 451 sightings, 292 were attacked giving a percentage of attacks to sightings of 65 per cent., which compares favourably with the 58 per cent. of 1943. Out of the 292 attacks made, about 50 resulted in kills, giving a percentage of sinkings to attacks of 17 per cent. as against the corresponding figure of 16 per cent. for 1943. In addition to these positive sinkings, 58 U-Boats have so far been assessed as damaged or slightly damaged in 1944; so that, of the U-Boats attacked, 37 per cent. were killed or damaged. This

compares with a corresponding figure of 29 per cent. for 1943. Altogether 1944 was an unprofitable one for the German U-Boat command. Not only did they lose about 170 U-Boats, a total not far short of the 1943 figure, but also the rate of exchange was worse than ever. For the allied tonnage sunk by enemy action averaged little more than 70,000 tons per month against an average of 270,000 tons per month in 1943, and 650,000 tons in 1942.

Meanwhile, increased emphasis is again being placed on Radar training, particularly in picking up and homing on to Schnorkels. Three centimetre A.S.V. has already made its appearance in squadrons and the conversion of aircraft to the night role, which has continued right through the year, is still proceeding. The Warwick aircraft is beginning to replace the Wellington and once again the opportunity is being taken to improve our efficiency before the next storm breaks. That the enemy is in fact preparing such a storm there is little doubt.

During the last fortnight of December there have been signs of a much more offensive spirit among the U-Boats at sea—14 targets either merchant ships or escort vessels have been torpedoed with little loss to the U-Boats. It may be only a coincidence that this coincides with the German Army's counter-offensive in Belgium, but it seems that a new chapter is opening and a fresh struggle is imminent, with the U-Boat command about to throw in his modernized fleet strengthened by the new pre-fabricated high performance types and manned by re-vitalized captains and crews. Photographic evidence indeed has revealed that at least 50 of the new Type XXI and nearly half as many of the Type XXIII U-Boats are completed, and a fair number of these must already be worked up and ready to put to sea when the enemy thinks fit. With their high underwater speed and aided by Schnorkel they may create a very serious problem. The smaller Type XXIII U-Boats will constitute a threat primarily to our convoys in coastal waters and are not likely to operate outside the North Sea and English Channel, while the Type XXI has a greater range and may ultimately be encountered on the main North Atlantic convoy routes. To achieve real success in the open waters of the ocean it is probable that some form of pack tactics may have to be revived, in which case the U-Boats may still have to surface in order to concentrate.

Nevertheless conditions are not so favourable for either aircraft or surface craft against this new threat, and it is as well to face the fact that, although it is expected to be the final show down, it may well be the hardest and bitterest struggle we have had to go through. Losses of shipping, exasperation at the elusive target, and disappointing hours of flogging the air without sightings must be faced without relaxing a keen visual lookout by day and readiness to bring off a snap attack by night. Morale and psychology count for a great deal in U-Boat warfare, and attacks even on dimly located possible U-Boat traces are of value—depth charges are cheap and plentiful.

How near the enemy will get to achieving the devastating rate of sinking that he attained in 1942-43 cannot be foreseen, but there is little doubt that the new U-Boat threat is potentially as serious as any in the past, a threat which will in fact call for every resource and ingenuity from the officers and men of Coastal Command.

Anti-Shipping

The anti-shipping offensive by Coastal Command grew in strength during 1944. The mobility of the strike squadrons and the flexibility of their tactics were revealed in the number of widespread bases from which they operated and the variety of their tasks.

During the early months the North Coates Wing continued to operate off the Dutch coast, perfecting the Wing Strike technique with such effect that enemy shipping began to sail more frequently by night. This led to the experimental development of night torpedo attacks, with Wellington aircraft, to find and illuminate the target for Beaufighters to run in and drop their torpedoes. The problem was, and still is, difficult, but the hard work put in by 16 Group in the early part of the year sowed the seeds of the more successful tactics at present employed.

In the north, the Wick Wing, operating off the Norwegian coast, was reinforced by the newest Beaufighter wing based at Leuchars. Owing to lack of waters in which the torpedo can be used, there were few successes with this weapon, although the Leuchars Wing, operating in small numbers at last light between Stavanger and Kristiansand South, had a run of successes before the enemy learned his lesson and ceased to offer targets.

Lack of torpedo work naturally turned attention towards the R.P. The results with this weapon up to early 1944 had been disappointing, mainly owing to the difficulties of ranging and sighting, but the Wick Wing, having no alternative weapon, tried out new tactics. The torpedo squadron became the anti-flak half of the wing. Armed with only their cannon, they changed roles with the R.P. squadron, and, diving in first, quelled the flak so that the R.P. aircraft could press home and make an accurate attack on the main target. These new tactics were suited admirably to the Leads and thus began the development of the R.P. as a main weapon, which was to reach its climax and finally establish the 25 lb. "J" type head as a "sinking projectile" in the epic strikes of August.

During those first five months there was a curious feeling of expectancy in the anti-shipping squadrons. What part were they to play in the invasion of Europe? In April, the Commander-in-Chief visited the Strike Wing bases and gave the crews the answer to their question.

The Strike Wings were to be responsible for the protection of the great invasion convoys from attack by E-Boats and whatever minor Naval units the enemy chose to employ. The planning of the Anti E-Boat Campaign presented several difficulties: not the least was choosing the weapon to be used. At first it was thought that the 20 mm. cannon would be best, but it was finally decided to use 250 lb. and 500 lb. M.C. bombs, fused with a special air-burst pistol. The results were to prove the wisdom

of the decision, but the tremendously enthusiastic training effort of the Beaufighters during May had much to do with their later successes in this type of operation. In two or three weeks they devised a shallow dive-bombing technique for use by night and brought themselves to a high standard of efficiency. In addition to this training, they continued to operate off the Dutch and Norwegian coasts on the usual scale.

For the opening phase of the invasion operations, the Strike Wings were disposed as follows. The Wick Wing was based on Davidstow Moor with the primary duty of preventing the German destroyers in the Brest and Biscay ports marauding in the Channel, and, in addition, to undertake night patrols against E-Boats, expected to operate from Cherbourg and Brest. The North Coates Wing remained where it was, to continue operations against Dutch convoys, but one of its three Squadrons, specializing in anti-E-Boat bombing, moved to Manston to help the Fleet Air Arm Squadrons in that role. The Leuchars Wing moved to Langham, where it could operate primarily in the Anti-E-Boat Campaign, at the same time joining in the daylight strikes against convoys off the Dutch and German coasts.

The Invasion Plan unfolded during June, July and August and the anti-shipping squadrons did what was expected of them. During those three months, 49,281 tons of enemy merchant shipping were sunk and a further 22,120 tons damaged. In addition, our aircraft sank two destroyers and 33 other naval vessels of various types and damaged a further 135 naval vessels.

On June 15 the North Coates and Langham Squadrons flew together in the first combined Wing Strike against a large convoy off the Dutch coast. Although 18 escort vessels attempted to protect a valuable 8,000 tons merchant vessel and a 3,800 tons naval auxiliary, both vessels were sunk without the loss of a single aircraft. This operation was the pattern for many such strikes during the following months and it showed what can be done by torpedo aircraft when they are provided with a really adequate anti-flak force.

By July, the Davidstow Moor Wing was finding few targets in the west and was promptly moved to Strubby, in Lincolnshire, where, as a lodger unit on a Bomber Command Station, it was given every assistance and played its part alongside the other two Beaufighter Wings in the intensive campaign on the Dutch and German coasts. But the enemy was wary of exposing his shipping to the risk of air attacks, and targets for daylight strikes had to be sought further afield. Patrols were made right into the Heligoland Bight, and towards the end of the month a combined Wing appeared and struck hard at a convoy off the south-west tip of Norway. All these Strike forces were provided with escorts of Mustangs or Spitfires of Fighter Command, and although the Luftwaffe made only one attempt to interfere with these operations, the Beaufighter crews were always greatly cheered by the presence of our own fighters.

August will be remembered for the magnificent work by the R.P. Squadrons against the remnants of enemy shipping in the Biscay ports and anchorages. The R.P. components from Strubby and North Coates were taken out to form a special Wing based at Davidstow Moor. This Wing used the 25 lb. "J" type head with such success that R.P. was established once and for all as a very effective sinking weapon. Among the victims of the masthigh attacks by these Squadrons were two destroyers and two large sperrbrechers. These results were gratifying because of the task ahead, when shipping would have to be hunted relentlessly through the Norwegian Leads in waters where torpedoes would be unsuitable.

Throughout June, July and August a strange nightly battle was fought between a force under No. 16 Group consisting of a Beaufighter Squadron, a Canadian mixed Wellington and Albacore Squadron, and two Fleet Air Arm Squadrons on the one hand, and flotillas of German Coastal craft moving down the French and Belgian coasts on the other. It was the enemy's intention to operate from his great base at Le Havre, which lay only 15 miles from the huge mass of British shipping at anchor off the Normandy beachhead. The work of these Squadrons was not spectacular, but it was in deadly earnest, and the defeat of the E-Boats was in no small measure due to their untiring efforts, and to the skill of those Fighter Command and Tactical Air Force Ground Interception Controllers who, sometimes from Dover under the bombardment of the Griz Nez batteries, and sometimes from a dug-out in Normandy, directed the aircraft to their targets. Their greatest opportunity came in August when, on one hectic night, as the German coastal shipping attempted to escape to the Dutch ports there were no less than 70 attacks.

By September, the anti-shipping campaign had shifted eastward in the wake of the Allied armies. The nightly anti E-Boat effort had continued, since before D-Day, vigorously, but it became increasingly difficult to find targets for daylight strikes off the Dutch and German coasts. The Wings tried every ruse to get at any enemy shipping that dared to use this stretch of coast. On one occasion, 70 aircraft penetrated the heavily defended Den Helder to attack a variety of naval auxiliaries lying at anchor. The technique, known as the Drem System, was devised to enable a big Strike Force to fly out individually to the vicinity of the patrol area in the darkness and form up at first light round a circle of flame-floats. This meant that the wings appeared on the enemy shipping route before dawn; but targets remained scarce.

As the Dutch and German targets faded away the Norwegian coast naturally came into the limelight. At the beginning of September, the Strubby Wing said goodbye to the Fen Country and moved to Banff, in the north of Scotland. They were joined by two Mosquito Squadrons from the south-west of England. This Wing had originally been engaged in long-range fighter patrols in the Bay of Biscay and had accounted for some 16 enemy aircraft, besides playing its part in the anti-shipping operations during August, before moving to the North.

The combined Banff Wing quickly made a name for themselves and the reaction of the enemy was true to form. A brilliant attack by Beaufighters and Mosquitos early in October off Egersund, after a difficult form-up over a Drem System forced the German convoys to take advantage of every facility offered by the long nights and rugged coast to avoid interception by our Strike Wings.

It became obvious that more aircraft were needed to intensify operations against these elusive Norwegian targets, and the Langham Wing was moved very quickly to Dallachy, where it was joined by the Beaufighter element from Banff. The Beaufighter Squadron, which had belonged to North Coates when it was taking a part in the E-Boat campaign in the Channel, was re-equipped with Mosquitos, armed with R.P., and sent to join the Banff Wing. To increase the striking power of this Wing, the other two Mosquito Squadrons were also re-equipped with R.P. aircraft, and the strength of the Norwegian Squadron responsible for all the reconnaissance of their coast was increased.

When it was found that shipping seldom sailed by daylight, even in the Leads, and that attacks on the many small land-locked anchorages were imperative, the knowledge and experience of the Norwegian crews became of great value to us. They acted as "Outriders" or guides to the striking forces. This entailed flying ahead of the main striking force, finding a target and returning to lead the Wing, sometimes across land and snow-covered peaks, to attack the ships which might be lying in narrow fjords surrounded by sheer cliffs. To counter the attempts made by the enemy to sail from Kristiansand South to Stavanger under cover of darkness, a special night torpedo flight was formed at Dallachy, and a technique similar to that used in the operation of the Dutch coast was devised. Weather is the governing factor in such work, and to date there have been few opportunities to try out the new tactics. It is hoped that the use of special Pathfinder flares and concentrated training will produce good results when weather conditions improve.

In addition to the Norwegian operations and the anti E-Boat war, a third phase of operations began in the Skagerrak and Kattegat, at the beginning of October when two Halifax Squadrons began operations against important convoys making night passage between Oslo and the Danish ports. They carry 500 lb. M.C. bombs, using a flare technique and the Mark XIV bombsight. The interruption of the transportation of troops from Norway to the Western Front is very important and, despite the bad weather, the Halifax Wing has done, and is doing, much to interfere with these convoys.

So the close of the year finds the anti-shipping squadrons of Coastal Command engaged in three distinct campaigns. The 16 Group Squadrons, two of which are now based in Belgium, continue to hunt the E-Boats threatening our convoy routes to the Continent, and to attack shipping on the German North Sea coast, whilst 18 Group employs the Beaufighter and Mosquito Wings to destroy enemy merchant shipping on the Norwegian coastal routes, and the Halifax Squadrons to harass the nightly traffic in the Kattegat.

It is hoped that 1945 will see the final application of the lessons learned in this and previous years as the Strike Wings deal with what remains of the German merchant fleet, and the enemy's one reliable ally, "the hours of darkness," afford him less and less help as our latest Radar equipment comes into use and as the nights become shorter.

A Tribute from the Cargo Liners

The following letter has been sent to the A.O.C. 15 Group by Colonel D. H. Bates, Chairman of Thomas and John Brocklebank, Ltd., "The oldest shipping line in the world still afloat."

Some are seen and not heard, some are heard and not seen, others are both heard and seen, and many more are neither seen nor heard—something like that, seems to me to be the role and constant routine of Coastal Command as they keep unremitting watch and ward over our sea routes.

It is to you and those under you that I have been asked by my men to say "Thank you," but when I think of all the vast organization which lies behind the role of Coastal Command my task is impossible. I feel I must leave it at "Thank you all," hope you realize that we mean it, and send our Best Wishes for Christmas and for all Good Luck for 1945.

I.—ANTI U-BOAT

SUMMARY OF ANTI U-BOAT OPERATIONS BY COASTAL COMMAND AIRCRAFT (Including Iceland, Azores, Gibraltar and U.S. Moroccan Sea Frontier)

DECEMBER, 1944

Duty and Base or Area.	Total Sorties. (1)	Hours Flown.		U-Boats Sighted.		U-Boats Attacked.		Hours per Sighting.		No. of Sorties.		
		Base to Base. (2)	On Patrol. (3)	Day. (4)	Night. (5)	Day. (6)	Night. (7)	Base to Base. (8)	On Patrol. (9)	When U-Boat Sighted. (10)	When U-Boat Attacked. (11)	
<i>Convoy Cover</i>												
United Kingdom	117	1,170	745	1 (1)	—	1	—	585	372	1 (1)	1	
Iceland	20	158	135	—	—	—	—	—	—	—	—	
Gibraltar and Moroccan Sea Frontier	105	825	466	—	—	—	—	—	—	—	—	
Azores	6	63	38	—	—	—	—	—	—	—	—	
TOTAL CONVOY EFFORT	248	2,216	1,384	1 (1)	—	1	—	1,108	692	1 (1)	1	
<i>A/U Patrols</i>												
<i>Northern Transit</i>												
United Kingdom	361	3,579	2,435	— (4)	—	— (1)	—	895	609	— (4)	— (1)	
Iceland	54	537	260	—	—	—	—	—	—	—	—	
<i>Northern Convoy</i>												
United Kingdom	280	2,109	1,503	1 (2)	1	1 (1)	—	527	376	1 (2)	1 (1)	
Iceland	74	695	448	—	—	—	—	—	—	—	—	
Azores	14	148	57	—	—	—	—	—	—	—	—	
<i>Bay of Biscay and Channel Approaches</i>												
United Kingdom	926	7,182	5,689	4	4 (3)	—	2 (1)	653	517	7 (2)	2 (1)	
<i>Central Convoy</i>												
Gibraltar and Moroccan Sea Frontier	216	1,303	935	— (1)	—	—	—	1,303	935	— (1)	—	
Azores	13	147	68	—	1	—	—	147	68	1	1	
TOTAL A/U PATROLS	1,938	15,700	11,395	5 (7)	6 (3)	1 (2)	3 (1)	747	542	10 (9)	4 (3)	
ADD CONVOY EFFORT	248	2,216	1,384	1 (1)	—	1	—	—	—	1 (1)	1	
TOTAL A/U EFFORT	2,186	17,916	12,779	6 (8)	6 (3)	2 (2)	3 (1)	778	555	11 (10)	5 (3)	
				12+ (11) U-Boats Sighted.		5+ (3) U-Boats Attacked.						

Notes—(1) In the above table sightings and attacks have been divided into Grade "A" where some part of the U-Boat was visually identified and Grade "B" where only a swirl, wake or smoke believed to have been caused by a U-Boat was seen. Grade "B" sightings and attacks are shown separately in brackets and are not included in the main totals.

(2) The above figures do not include six chance sightings (4 Grade "A" and 2 Grade "B"). Five of these (4 Grade "A" and 1 Grade "B") were made by Coastal Aircraft, on other duties, 1 of which attacked.

(3) Hours per sighting under columns (8) and (9) include both Grade "A" and Grade "B" sightings.

Assessments

(Received up to 8th January, 1945.)

Month.	Known Sunk.	Probably Sunk.	Damaged, "A".	Damaged, "B".	Slight Damage.	Insufficient Evidence of Damage.	No Damage.	Insufficient Evidence of U-Boat.	Unassessed.
October ..	1*	—	—	1	—	—	1	—	—
November..	—	—	—	—	—	3	5	3	—
December	—	—	—	—	—	—	1	—	4 (3)

Note.—*The October Known Sunk is shared with Shipborne Aircraft of the Fleet Air Arm.

Analysis of U-Boats Sighted by A/U Aircraft during December

Particulars of Incidents.	U-Boats.		Sorties when Aircraft.	
	Sighted.	Attacked.	Sighted.	Attacked.
<i>Grade "A"</i>				
On 10 occasions 1 U-Boat was sighted by 1 aircraft—5 aircraft attacked.	10	5	10	5
On 1 occasion 2 U-Boats were sighted by 1 aircraft—no attack was made.	2	—	1	—
<i>Grade "B"</i>				
On 9 occasions 1 Target was sighted by 1 aircraft—2 aircraft attacked.	(9)	(2)	(9)	(2)
On 1 occasion 2 Targets were sighted by 1 aircraft—1 target was attacked.	(2)	(1)	(1)	(1)
TOTALS	12+(11)	5+(3)	11+(10)	5+(3)

Squadron Results—December, 1944

Sightings by A/U Aircraft

			Sorties when U-Boat Sighted.	Sorties when U-Boat Attacked.
202	Catalina L.L.	Castle Archdale	— (1)	—
220	Fortress	Lagens	1	1
53	Liberator L.L.	Reykjavik	— (1)	— (1)
110 U.S.N.	Liberator	Dunkeswell	1	—
112 U.S.N.	Liberator	Port Lyautey (U.S. Moroccan Sea Frontier)	— (1)	—
114 U.S.N.	Liberator S/L.	Dunkeswell	— (1)	— (1)
120	Liberator L.L.	Ballykelly	2	—
206	Liberator L.L.	Leuchars	— (2)	—
10 (R.A.A.F.)	Sunderland	Mount Batten	1 (1)	1
201	Sunderland	Castle Archdale	— (1)	— (1)
330 (Norwegian)	Sunderland	Sullom Voe	— (1)	—
423 (R.C.A.F.)	Sunderland	Castle Archdale	2	1
179	Warwick L.L.	St. Eval	1	—
36	Wellington L.L.	Chivenor	— (1)	—
407 (R.C.A.F.)	Wellington L.L.	Chivenor	3	2
			11 (10)	5 (3)

Chance Sightings by Coastal Aircraft on Other Duties

			Sorties when U-Boat Sighted.	Sorties when U-Boat Attacked.
489 (R.N.Z.A.F.)	Beaufighter	Dallachy	1	1
517	Halifax	St. Davids	1	} No weapons.
282	Warwick	St. Eval	2	
407 (R.C.A.F.)	Wellington L.L.	Chivenor	1	

RECENT ATTACKS ON U-BOATS

Sighted with Binoculars

In the afternoon of November 5, **Canso X/162 (R.C.A.F.)** was flying on anti U-Boat patrol on track 144° at 1,000 feet. The sea was very rough, visibility 10 to 20 miles reduced to 2 miles in snow showers and 7/10 cloud at 2,000 feet. The captain, scanning with binoculars from the right seat, sighted a disturbance in the sea, bearing Green 20°, distant 5 miles, in position 60° 12' N., 20° 40' W. The aircraft altered course to investigate. Some unusual movement was seen in the sea by all members of the crew, even with the naked eye. The engineer, using binoculars in the port blister, saw what seemed to be a barrel-shaped object. He drew the attention of the navigator to this. The navigator thought he could see an object enveloped in vapour, but he could not make out its outlines. When the aircraft had closed to within half or three-quarters of a mile, a long line of fairly large frothy bubbles was seen making a straight track, approximately 15 feet wide and 100 yards long, leading to the disturbance. The head of the track appeared to be travelling on a course of 160° at a speed of 5 knots. The captain made a sharp turn to port around the disturbance and attacked from Red 80° and released from 50 feet three depth charges, set to shallow depth, spaced at 80 feet. The long trail of bubbles was still visible. The first two depth charges were seen to straddle the disturbance. The first fell approximately in line and 30 feet to port of the target and the second 30 feet to starboard, slightly in advance of the target. The third depth charge entered the sea approximately 90 feet to starboard and in line with the disturbance. The aircraft circled and dropped a marine marker on the point of the attack and continued to circle for ten minutes,

but there was no evidence of damage. Almost immediately after the attack **R/162 (R.C.A.F.)** arrived on the scene and dropped a Sono buoy. R/T contact was established and communication revealed that Sono buoy results were negative. At 1657 hours X/162 began laying pattern of buoys. The rough sea made fluorescent markers invisible, so marine markers were dropped with each Sono buoy. Only water noises were heard at first from each of the buoys as they were checked in turn, but after a lapse of about an hour, three of the crew detected a faint whirring sound on one of the buoys. The navigator and wireless air gunner thought it similar to the distant sound of motors of a U-Boat. There were no more buoys, so it was impossible to attempt to localize the sound. By 1900 hours the buoys had died out so X/162 flew on patrol A until relieved by **C/53** at 2219 hours. After establishing that C/53 was the proper relief and that it had located the markers, X/162 set course for base.

Comment

This excellent binocular sighting was the result of a carefully organized visual lookout. The evidence and photographs (see Plate I) confirm the presence of a Schnorkelling U-Boat. Further photographs reveal that the nearest depth charge exploded in the wake at least 200 feet from the smoke of the schnorkel and thus 100 feet astern of the U-Boat's tail. No damage would be inflicted.

It is unfortunate that this excellent sighting was followed by an attack which failed because of a tracking error. It may be that this error was caused by a rather short final run in after a steep turn, together with failure during the final approach to appreciate the forward speed of the target.

A Moving Hump of Whitish Water

At 1432 hours on the afternoon of November 15 the captain, sitting in the second pilot's seat of **Sunderland G/423 (R.C.A.F.)**, sighted a whitish disturbance on the surface of the sea, bearing Green 10°, distant 6 miles, in position 55° 51' N., 09° 30' W. The aircraft was on convoy escort flying on track 115° at 2,000 feet. The weather was good, with a calm sea and visibility 12 miles. At the time of the sighting the convoy was 45 miles away. The aircraft at once altered course to investigate and the A.S.V. scanner was stopped in the rear facing position, thus no Radar contact was obtained. Meanwhile the captain, who had made the sighting from the second pilot's seat, moved to the first pilot's seat. The aircraft lost height and binoculars were used to scrutinize the disturbance, which appeared to be a hump of whitish water moving towards the aircraft in a direction of 305° at a speed of about 2 knots. By the time the aircraft had closed to 1½ miles the hump had subsided, leaving on the surface a smooth, glassy patch about 60 feet long by 30 feet wide. The aircraft approached along the track of the target from ahead and went straight in to attack. Two depth charges were released from 75 feet, set

to shallow depth, spaced at 60 feet. One flame float was also released. The points of entry of the depth charges relative to the smooth patch were not observed and there was no evidence of damage, although the aircraft remained in the vicinity for about four hours while homing on the escort group. At 1730 hours an ungraded Disappearing Radar Contact was obtained bearing approximately 008°, distant 13 miles from position of attack. At 1800 hours two escort vessels arrived in the area and at 1828 hours a second ungraded Disappearing Radar Contact was obtained in a position approximately three miles from the first contact. Escort vessels were informed by R/T of both contacts and at 1932 hours the aircraft set course for base.

Comment

The report of a "white hump" moving along agrees with a similar description made by other aircraft who have obtained photographs of this type of object accompanied by smoke and wake. It is quite possible that a schnorkelling U-Boat was present and that it dived deeper on detecting the approach of G/423. The Captain was quite correct to attack and would have been justified in dropping at least four depth charges.



These photographs show the "smoke and wake" type of target which has recently been encountered by our anti U-Boat aircraft. The top photograph was taken by a Canso of 162 Squadron on November 5 (*see* letterpress, p. 8). The bottom photograph was taken by a Sunderland of 201 Squadron on November 16 (*see* letterpress, p. 9).





These photographs show the attack by Mosquitos of the Banff Wing on shipping at anchor in Nordgulen Fjord on December 5. Considerable damage was done. The *Ostland*, 5,274 tons, *Iucumen*, 4,621 tons, and two vessels of 3,000 and 1,000 tons respectively, were damaged. Three much smaller vessels were also damaged. Thus, the enemy policy of lying up in fjords by day and moving only by night, is not proving entirely remunerative. (See letterpress, p. 14.)



The New Type of Target

In the afternoon of November 16, **Sunderland Y/201** was flying on anti U-Boat patrol when the mid-upper gunner sighted grey smoke in position 55° 44' N., 09° 09' W. Wind was 16 knots from 094°. The weather was good with visibility 15 miles. The aircraft at once turned to investigate and action stations was sounded. As the aircraft closed the smoke was seen moving at a considerable speed, estimated to be 15 knots, on course 295°. The crew was confident of the accuracy of this speed. Just before the aircraft tracked over the smoke, the front gunner distinguished a moving wake with the smoke issuing from the apex. The wake was approximately two yards wide and nearly 100 yards long. At the apex was a small horizontal wave, or splash, rising to two feet. This possibly screened the object causing the wake. There were also distinct bow waves on either side of the apex. Greyish bubbles were seen in the middle of the wake. The mid-upper turret gunner saw a narrow cigar-shaped, brownish shadow or shape beneath the surface of the sea. Its point began at the apex of the wake and it was approximately 40 feet long. This sighting was confirmed by the Captain. The aircraft dropped a flame float and began a climbing turn to port, circling its marker twice to port, then making a further turn to starboard. During this period neither wake nor smoke were seen. Another complete circle to port was made, followed by another to starboard, during which the moving smoke and wake were again sighted bearing Green 40°, distant four miles. The aircraft immediately lost height and made an attack down sun, from Red 130° to track of wake, crossing just ahead of the apex, and releasing from 50 feet, six depth charges, set to shallow depth, spaced at 60 feet. During the attack the wake remained visible. The aircraft turned to port, climbing to 300 feet, and completed two circles to port above the wake and smoke, which were still moving on a steady

course. Photographs were taken with a hand-held camera, then the aircraft descended to 100 feet and flew up track of the wake taking further photographs with the rear-facing camera (see Plate 1). The wake and smoke were not seen again from the time the aircraft flew up its track. The rear gunner saw the points of entry of the depth charges but, at that time, could not see the wake and smoke. When the early depth charge explosions were reaching their maximum height he saw smoke and wake and estimated the smoke as 20 yards ahead of the line of straddle and considered that four depth charges undershot and the fifth and sixth overshot—smoke was seen before the sixth depth charge began to throw up its plume. The aircraft searched the area until 1425 hours. On instructions from Group, the aircraft began homing at 1530 hours and at 1645 hours four escort vessels were detected by Radar to be approaching. They arrived in the area at 1710 hours. R/T contact was established and positions checked, amended and agreed. A Liberator arrived at 1715 hours and Group ordered "Y" to remain in the area until 1900 hours, when course was set for base.

Comment

The excellent visual lookout was responsible for the sighting of this target which, as the photographs confirm, was caused by a schnorkelling U-Boat. The sea conditions were such that the top of the schnorkel must have frequently been dipping as the seas washed over.

The only yardstick available on the photographs by which to attempt to assess the attack is the breadth of the explosion plumes. From this information it is estimated that the stick straddled about 150-200 feet astern of the head of the wake. This would be just out of damaging range of the U-Boat's stern, a theory which is to some extent confirmed by the fact that the U-Boat continued on course and was still schnorkelling some three minutes later.

A Disturbed Patch of Water

In the late afternoon of November 19, **Sunderland B/423 (R.C.A.F.)** was flying at 2,000 feet, almost due south on anti U-Boat patrol. The weather was good, with a calm sea and visibility 10 miles. At 1715 hours the rear gunner reported grey smoke, apparently coming from the surface of the sea, one mile dead astern. The aircraft altered course to investigate, but the rear gunner, the only person who saw the smoke, lost sight of it during the turn and it was not seen again. Two and a half minutes later the Captain sighted a disturbed area of water, bearing Green 60°, distant 4 miles, in position 56° 16' N., 09° 00' W., course southerly and estimated speed 2 to 3 knots. It is not thought that the two sightings were connected as they were 4½ miles apart. Members of the crew suggested that the smoke was probably caused by the wad of a verrey cartridge fired as a recognition signal just before

the rear gunner made the sighting. The aircraft altered course to the position of the disturbed water. At the same time the disturbance was examined through binoculars and by naked eye, and it appeared roughly parabolic in shape, approximately 100 feet wide and 200 feet long. The disturbance was most marked at the head. It tailed off into the smooth sea at the wide, or open end. Swirling eddies were clearly seen as the aircraft passed over the first time, but no bubbles broke surface and there was no white water and nothing resembling a shoal of fish. As the aircraft passed over, a bump was felt which threw up the starboard wing. The aircraft turned 250° to port and attacked from 75 feet. Eight depth charges were dropped, set to shallow depth, spaced at 60 feet, and aimed along the centre line of the disturbance. While making the attack another bump was felt. The entry

and explosion of depth charges obliterated the disturbance, and after the explosions subsided nothing was seen on the surface except the usual depth charge scum. The aircraft remained in the area for 25 minutes. An escort group was bearing 180°, distant six miles from the position of the attack and arrived on the scene at 1740 hours. R/T contact was established and after passing the necessary information the aircraft set course for base as a recall had been received.

Comment

The shape and description of the disturbed patch of water is consistent with a stale swirl mark left by a U-Boat which had dived some minutes before, but it is odd that no Radar contact was made. If a U-Boat was present, the staleness of the swirl indicates that, at the time of the depth charge explosions, the target would have been a long way ahead of the disturbance and too deep to be harmed. It was quite correct to attack.

A Reddish Flame

In poor light at dawn on November 24, **Wellington X/304 (Polish)** was on patrol, flying almost due west at 1,000 feet. The weather was fair, with 8/10 cloud at 1,500 feet, sea moderate and visibility eight miles. The Captain, from the pilot's seat, sighted visually a reddish flame, four to five times the size of a flame float, rising straight up from the sea, bearing Red 45°, distant three miles, in position 58° 42' N., 06° 59' W. The aircraft turned to port and lost height to 300 feet at one mile. At this moment the Captain, the Second Pilot and the Navigator saw slight blue smoke, as well as the flame, in the same position. The course and speed of the flame and smoke could not be estimated. At three-quarters of a mile the flame disappeared, but the blue smoke was still visible and the second pilot saw a slight wake a few feet behind the smoke. But he was still unable to estimate the course and speed of the presumed U-Boat. The aircraft was now on course 220° and attacked from 100 feet, releasing six depth charges, set to shallow depth, spaced 60 feet. The wake and smoke were still visible. The first depth charge was seen by the rear gunner in the turret and the wireless operator in the astrodrome, to enter the water about 60 feet short of the smoke, and the second depth charge to enter just short, and about

15 yards to starboard of the smoke. The depth charge plumes formed a solid mass which completely hid the smoke and when they subsided nothing could be seen but a disturbed patch of water. No further smoke and no signs of damage to the presumed U-Boat were seen. Two Mark II Marine Markers were dropped immediately after the attack and at 0950 hours two further Markers were released, and one Mark III set for two hours delay. At 1005 hours the aircraft set course for base, P.L.E. having been reached. There were no Radar contacts throughout the action. The crew were convinced that, if the light had been better, they would not have seen the flame, and probably not the smoke.

Comment

The crew was unable to give the course of the presumed target although the wake was seen. As far as is known, Schnorkel cannot emit flames even if the exhaust outlet is above the surface: in practice the exhaust outlet is almost always under water. It is therefore considered unlikely that the target attacked was a U-Boat.

It is felt that the flame and smoke were caused by a flame float, but the Captain was quite correct to make an attack as he was under the impression that a U-Boat was present.

Promising after Evidence

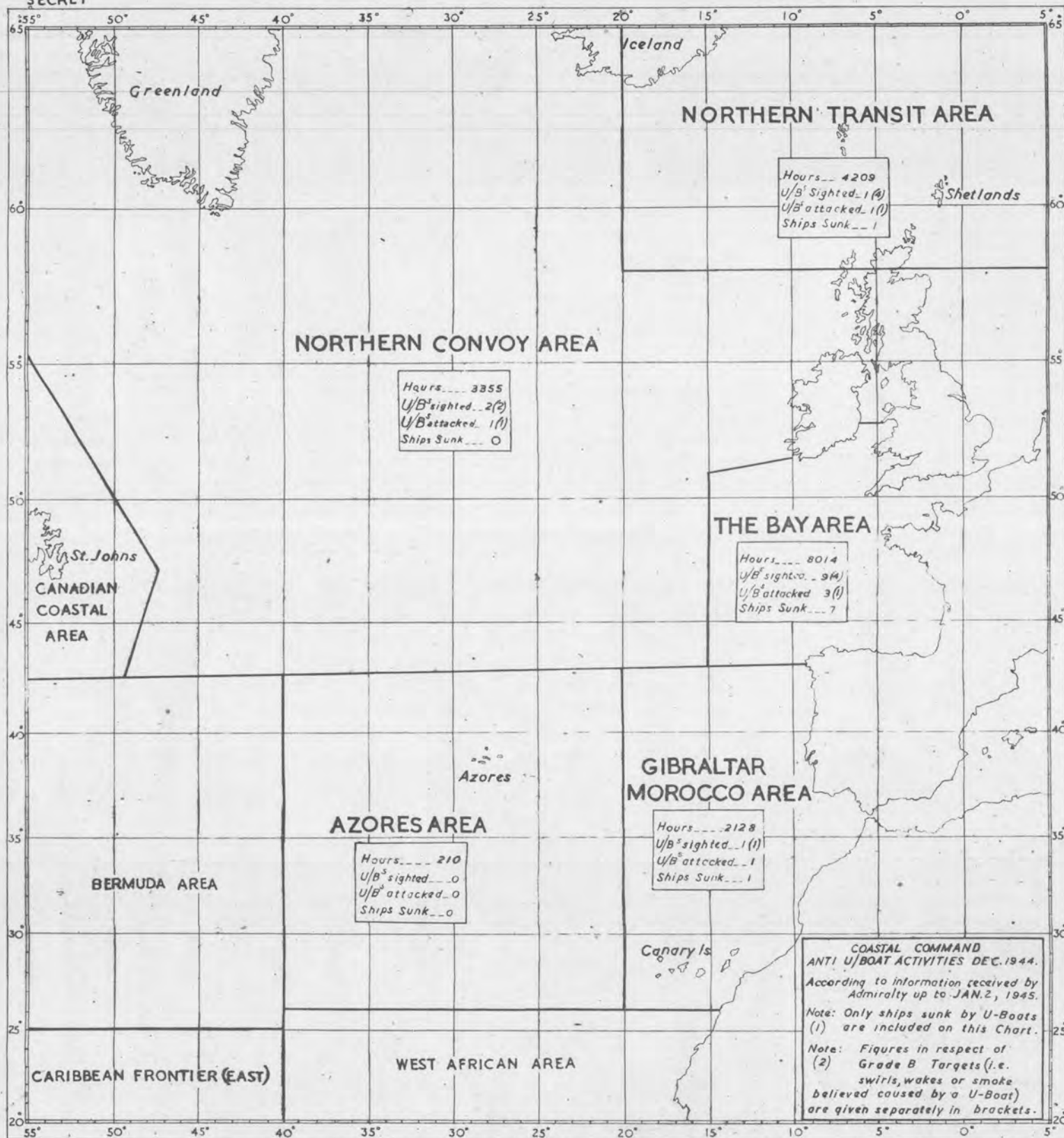
At dusk on December 6, **Sunderland Y/201** was on anti U-Boat patrol near an escort group north of Scotland. Some ten hours earlier one of the escort vessels had been torpedoed and sunk. The aircraft was flying on a south-westerly course at 400 feet with 6/10 cloud base at 2,000 feet, lowering in showers. Sea was moderate, visibility eight miles and wind west-south-west at 20 knots. The captain, from the port pilot's seat, sighted a jet of whitish smoke or steam issuing from the surface of the sea bearing Green 45° distant some five miles. The target was in position 58° 44' N., 04° 29' W. and, when the range had been closed to about one mile, a considerable wake was seen, giving the impression that the source of the smoke was travelling at 10 to 12 knots, course 050°. This estimate was based partly on the wake and partly on the fact that the smoke was being blown only slightly forward of the course by the 20 knot following wind. The apex of the wake and smoke was seen by three members of the crew to overtake the seas, the track of the presumed U-Boat being down sea.

The aircraft crossed the track ahead of the smoke. The crew considered this smoke similar

to what they saw when they made an attack on November 9. The aircraft then turned to port and manoeuvred to attack along track from astern. Height was lost to 50 feet and the bomb release was pressed. The camera functioned but the depth charges failed to release. As the Sunderland passed over the smoke, extremely heavy turbulence was felt and the aircraft became almost uncontrollable. The aircraft then circled to port and made a second attack from the same direction. Six depth charges were released with the second pilot's release switch and a marine marker was dropped at the same time. Turbulence was again experienced when passing over the smoke. Three depth charges were seen to enter the wake and three to enter ahead of the wake, all were dead on track. While the aircraft tracked over the wake, the navigator timed its length which worked out at about 1,100 feet.

The Sunderland continued in straight and level flight in the hope of obtaining photographs, despite the poor light, and then climbed away to port to observe results. The turn was almost completed and the aircraft was about to fly on a reciprocal track when the front gunner saw what he thought

SECRET



to be depth charge scum in a pear-shaped patch which continued to increase in area during the five minutes it was in view.

Attempts to contact the escort group by R/T had failed owing to heavy static so the Sunderland flew to the ships which were eight miles west of the position of the attack and established visual and partial R/T contact. The aircraft then returned to the scene of the attack, and circled to obtain a Gee fix. Some 20 minutes after the attack, the oil patch previously seen by the front gunner was observed by several members of the crew to have expanded considerably. It was of dark ochre coloured oil, flecked with green, oval in shape measuring approximately one mile by half a mile. Its position was estimated to be half a mile ahead of the marker dropped with the depth charges and on track.

While circling the marker, pyrotechnics were fired to guide the escort group and, before the aircraft left for base, the escort group was in-

formed by v/s of the course and distance to the scene of the attack.

Comment

This interesting and well executed encounter was, as in the previous attack by this crew, the result of personal vigilance on the part of the Captain. The up-track attack was correct and the after evidence of extensive oil indicates that, at the very least, the U-Boat was seriously hurt. The fact that a dummy run did not cause the U-Boat to dive suggests that the enemy may be making a practice of schnorkelling without using his periscope although other experiences confirm that some U-Boats are using their periscope to escape attack in similar circumstances. The reports of turbulence over the smoke confirm other similar reports.

The armament failure report suggests that the bombing failure was due to an intermittent break in the first pilot's bomb release circuit. With the present difficulty in finding U-Boats, it is essential that failures due to bad maintenance do not occur.

Correction

The attack made by Sunderland U/201 reported in Coastal Command Review, November, 1944, Volume III, No. 11, was attributed to October 9. The attack was in fact made on November 9.

II.—ANTI-SHIPING

SUMMARY OF ANTI-SHIPING OPERATIONS BY COASTAL COMMAND AIRCRAFT DECEMBER, 1944

Weapons Carried. (1)	Number of Sorties.			Number of Aircraft to Attack			Target.	
	On Reconnaissance. (2)	On Strike. (3)	Total. (4)	On Reconnaissance. (5)	On Strike. (6)	Total. (7)	M/V. (8)	Naval. (9)
DAY OPERATIONS								
Torpedo	23	17	40	70 (1)	—	78 (1)	78 (1)	—
R.P.	344 (1)	46	390 (1)	1	8	1	1	—
Bomb	22	—	22	11 (2)	—	11 (2)	11 (2)	—
Tsetse	16 (2)	4	20 (2)	71 (2)	5	76 (2)	76 (2)	—
Cannon and M/G only	298 (2)	42	340 (2)	—	—	—	—	—
TOTAL—DAY	703 (5)	109	812 (5)	153 (5)	13	166 (5)	166 (5)	—
NIGHT OPERATIONS								
Torpedo	78	—	78	14	—	14	13	1
R.P.	64	—	64	1	—	1	1	—
Bomb	261	3	264	68	1	69	35	34
Tsetse	—	—	—	—	—	—	—	—
Cannon and M/G only	1	—	1	—	—	—	—	—
TOTAL—NIGHT	404	3	407	83	1	84	49	35
ALL OPERATIONS								
Torpedo	101	17	118	14	—	14	13	1
R.P.	408 (1)	46	454 (1)	71 (1)	8	79 (1)	79 (1)	—
Bomb	283	3	286	69	1	70	36	34
Tsetse	16 (2)	4	20 (2)	11 (2)	—	11 (2)	11 (2)	—
Cannon and M/G only	299 (2)	42	341 (2)	71 (2)	5	76 (2)	76 (2)	—
GRAND TOTAL	1,107 (5)	112	1,219 (5)	236 (5)	14	250 (5)	215 (5)	35

Note.—The figures in brackets which are not included in the totals represent attacks on shipping by aircraft on duties other than Anti-Shipping.

FINAL ASSESSMENTS FOR NOVEMBER

Day :—

Torpedo

1 M/V (5,740 tons) sunk.

R.P. and Cannon

2 M/V.s (totalling 6,096 tons) sunk.

2 Armed Coasters sunk.

1 " M " Class M/S seriously damaged.

3 M/V.s (totalling 3,066 tons) damaged.

1 " M " Class M/S damaged.

1 E/V damaged.

Cannon

1 Trawler (177 tons) sunk.

1 Coaster (307 tons) seriously damaged.

1 E/V Seriously damaged.

3 Small V/S (totalling 1,500 tons) damaged.

1 Tug damaged.

1 T.T.A. damaged.

1 T.L.C. damaged.

Night :—

Torpedo

1 M/V (3,000 tons) sunk.

R.P.

1 " M " Class M/S damaged.

1 M/S damaged.

R.P. and Cannon

1 M/S damaged.

Bombs

1 M/V (3,703 tons) sunk.

1 E-Boat seriously damaged.

3 M/V.s (totalling 7,500 tons) damaged.

1 M/S damaged.

1 E/V damaged.

RESULTS CLAIMED FOR DECEMBER

(Subject to Assessment)

Day :—

R.P. and Cannon

1 M/V (2,500 tons) sunk.

1 T.T.A. sunk.

4 M/V.s (totalling 7,000 tons) seriously damaged.

3 M/V.s (totalling 7,000 tons) damaged.

2 E/V.s damaged.

R.P. and Tsetse

1 M/V (4,300 tons) sunk.

2 M/V.s (totalling 3,000 tons) seriously damaged.

4 M/V.s (totalling 9,574 tons) damaged.

1 E/V damaged.

1 U/I Vessel damaged.

1 Tug damaged.

Night :—

Bombs

1 Tanker (5,000 tons) damaged.

3 M/V.s (totalling 7,000 tons) damaged.

1 E/V damaged.

TABLE OF ANTI-SHIPING AND FIGHTER SUCCESSES, 1944—COASTAL COMMAND AREA

Sunk.	Seriously Damaged.	Damaged.
45 M/Vs (totalling 138,643 tons).	15 M/Vs (totalling 29,312 tons).	42 M/Vs (totalling 81,405 tons).
3 Destroyers.	64 Naval Vessels.	3 Destroyers.
56 Other Naval Vessels.		168 Other Naval Vessels.
Total : 104 Ships.	Total : 79 Ships.	Total : 213 Ships.

N.B.—" Naval Vessels " include :—Sperrbrechers, Minesweepers, T.T.A.s, E/R Boats, and other armed escort vessels.

**THE FOLLOWING E/A ARE RECORDED AS DESTROYED DURING 1944 BY THE
FIGHTER OR STRIKE SQUADRONS OF THIS COMMAND**

Squadron.	Ju.290.	Ju.188.	Ju.88.	Ju.52.	Do.217.	Fw.190.	Bv.138.	He.115.	Me.110.	Squadron Total.
235	1		2		4	$\frac{1}{2}$			3	10 $\frac{1}{2}$
248		1	7		1	1				10
333							3	1		4
254				1						1
404									1	1
143						$\frac{1}{2}$				$\frac{1}{2}$
Type Total . .	1	1	9	1	5	2	3	1	4	27

Shipping Strikes in December

1. There have been no targets for our strike wings off the Dutch and German coasts during December and not a single attack was made by daylight in these areas. Weather was unusually bad and on many occasions flying was ruled out altogether. This did not prevent the squadrons from operating in the southern area of the North Sea, where they made some 36 attacks at night. Fifteen of these were by 612 Squadron, which changed over to anti-shipping strikes about the middle of the month. On December 23, their first night on the new task, one of the 612 Wellingtons bombed and set fire to an escort vessel off Ijmuiden. On December 30 a merchant ship was damaged in a bombing attack near the Hague by a Wellington of 524 Squadron. The squadrons made no claims for the other attacks, but there is no doubt that our night patrols are a continuous source of worry to the enemy's shipping.

2. Weather in the Skagerrak and Kattegat was equally forbidding, but did not prevent the Halifaxes from continuing their patrols. They also attacked shipping in the anchorages at Aalesund and Kristiansund and, on one occasion, as far north as Namsos. These attacks led to at least three merchant ships being damaged.

3. On the night of December 28/29, Halifax C/502 attacked a 5,000-ton tanker less than 20 miles from the Skaw. Direct hits caused an explosion and clouds of black smoke. About 2 hours later the same tanker was seen by Y/502 and again attacked. "Y" scored direct hits with two bombs and left the ship burning furiously.

4. Beaufighters also flew a number of night rover patrols carrying torpedoes, and making six attacks. Unfortunately, results could not be judged.

5. The strike wings from Dallachy and Banff located a number of targets in Norwegian waters and nine wing attacks were made; seven of these were by Mosquitos and two by Beaufighter formations. December 5 was our most successful day. At 1410 hours 34 Mosquitos of the Banff Wing located several ships at the eastern end of Nordgulen Fjord. The height of the surrounding ground made it necessary for the aircraft to attack in steep dives down the sides of the hills. They used R.P. 6-pdr. and other cannon to good effect, damaging no fewer than six ships. One of these was a merchantman of over 5,000 tons. Less than half an hour later 15 Beaufighters from Dallachy attacked a 2,500-ton merchant vessel, escorted by a trawler type auxiliary, in Orsten Fjord. More than 30 R.P. hits were scored on the merchantman and numerous cannon strikes on both vessels. Later reports advise us that they have both sunk.

6. December 16 was another noteworthy day. Just before noon a force of 16 Banff Mosquitos attacked a merchant vessel of 5,600 tons in Kraakhellesund. Fires were started on the ship with R.P. and 6-pdr. cannon. An hour later six other Mosquitos of the same Wing sighted the smoke from this vessel while they were on anti U-Boat patrol. They found that the ship was already on fire and listing to starboard. Further attacks caused a great sheet of flame which rose from amidships. This was followed by a giant pall of smoke seen when the aircraft were 30 miles away. The ship afterwards sank.

7. The strike squadrons have again been well supported by Mosquitos of 333 Norwegian Squadron, which continue to provide constant reconnaissance of the shipping lanes and anchorages, and also to act as outriders to the main striking forces.

Attacks

On December 5, 34 Mosquitos of the Banff Wing attacked a number of enemy ships in Nordgulen Fjord. The ships included four merchant vessels, ranging from 2,500 to 4,000 tons, two trawler-type auxiliaries and a tug. They were found at the extreme eastern end of the fjord, which is enclosed by very high ground. The Mosquitos had to attack in steep dives down the sides of the mountains and used R.P. and 6-pdr. cannon as the main weapons. They scored many hits with these weapons on two merchant vessels of 3,000 tons each and left them burning fiercely (see plate 2). The usual 20 mm. cannon was also used to good effect, and set fire to the other two merchant vessels and the three smaller vessels. Heavy flak was encountered from the ships and shore, causing damage to several of our aircraft, one of which failed to return. Another aircraft crash-landed on its return to base and the pilot subsequently died from injuries received.

Less than half an hour after the above attack 15 Beaufighters of the Dallachy Wing found a merchant vessel of 2,500 tons, accompanied by a

small escort vessel, in Orsten Fjord. They immediately attacked the merchantman and scored no less than 36 hits with R.P. as well as numerous cannon strikes. The ship caught fire and was last seen with smoke and flames issuing from it (see plate 3). Two of the Beaufighters made cannon attacks on the smaller vessel, but saw no results. Again, much flak was experienced and two aircraft did not return to base. However, the crew of one of these aircraft, which had ditched, was rescued later. Reports since received indicate that both ships sank.

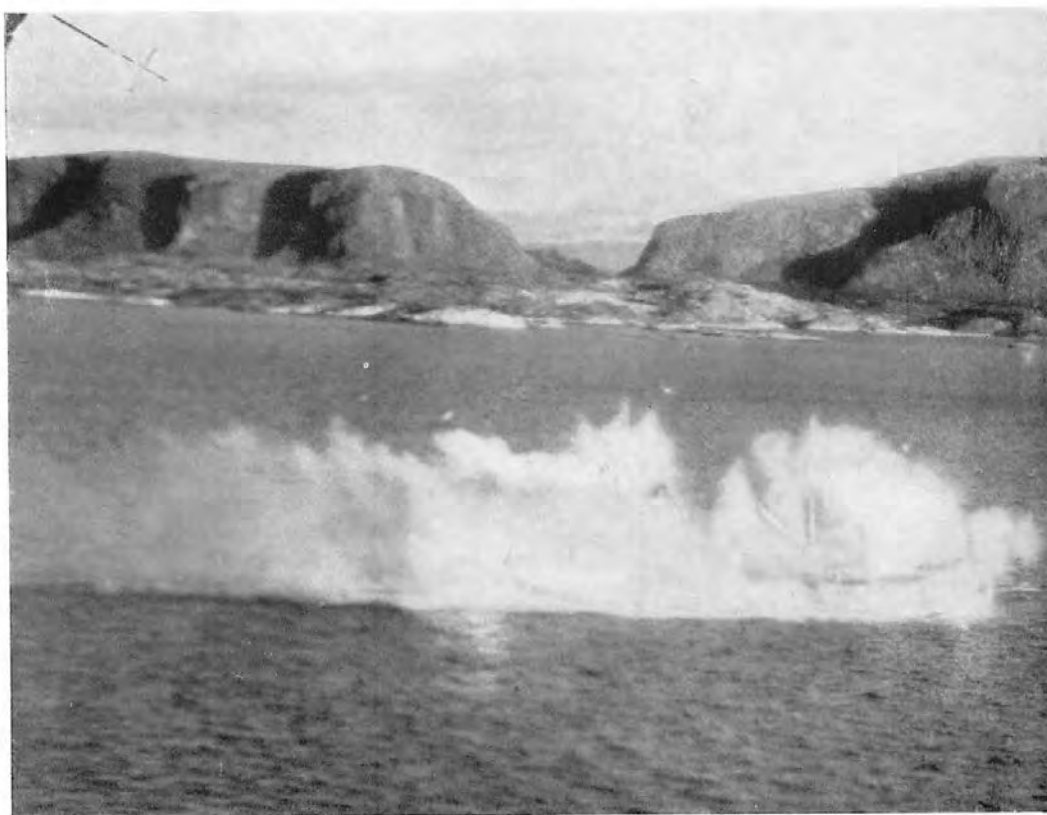
Soon after 1400 hours on December 9, 23 Beaufighters of the Dallachy Wing, on patrol off the Norwegian coast, sighted a merchant ship of 2,000 tons on a southerly course near Vilnes Fjord, and attacked with R.P. and cannon (see plate 4). Nearly 60 hits were scored with R.P., which caused two explosions aboard the ship. Showers of debris were thrown into the air and the vessel was seen to be on fire from bridge to stern, the stern itself being red hot. As the aircraft departed the merchant vessel was seen heading towards the shore under a heavy pall of smoke.



The Dallachy Beaufighter Wing attacked shipping in Orsten Fjord on December 5. The 2,500-ton ship seen above under attack and later, burning, was sunk. A trawler type auxiliary which was attacked further down the fjord, was also sunk. (See letterpress, p. 14.)



These photographs show a vessel of about 700 tons being attacked by the Dallachy Wing on December 9 in Vilnes Fjord. (See letterpress, p. 14.)



The Beaufighters met with considerable flak and several of them received slight damage. One aircraft was seen to dive into the sea after hitting the ship's mast.

An attack against enemy shipping in Eid Fjord was made by **22 Mosquitos** of the **Banff Wing** on December 12. A merchant ship of 2,500 tons, another of 1,000 tons and two coasters were sighted stationary at the eastern end of the fjord, and all the vessels were attacked with R.P. and cannon (see plate 5). More than twenty R.P.s and numerous cannon shells struck the larger of the two merchant vessels and it was left burning furiously. The other merchant vessel and one of the coasters were hit by cannon fire and probably by R.P. They were both damaged and smoke was seen coming from them. All the Mosquitos returned safely to base without having suffered any damage.

A 5,600 ton merchant vessel, stationary in Kraakhellesund, was attacked by **16 Mosquitos** of the **Banff Wing** on December 16. Many hits with R.P. and 6-pdr. cannon were scored on the ship and several small fires were started (see plate 6). About an hour later six more Mosquitos sighted the ship listing and smoking heavily. They also attacked with R.P. and 6-pdr. cannon, and after scoring hits saw a great sheet of flame rise from amidships. Later a giant pall of smoke from the stricken vessel was visible from a distance of over 30 miles. A trawler type auxiliary, which was near the merchantman, was also hit during the attack, and left on fire. One Mosquito from each of the two formations failed to return. The merchant vessel is now known to have sunk.

On December 26, **12 Mosquitos** of the **Banff Wing**, while on anti-shipping patrol along the Norwegian coast, sighted two merchant ships stationary off Leirvik. The larger of these was a vessel of about 2,000 tons, and the other about 1,500 tons. The aircraft attacked both vessels with 25 pound R.P. and 6-pdr. cannon, scoring many hits in each case. The smaller ship was set on fire and, when the Mosquitos left, was sinking by the stern. The other vessel was

smoking heavily. A few minutes after this attack the formation was intercepted by about 24 single-engine enemy fighters, most of them F.W.190s. Several combats ensued, during which one enemy fighter crashed in the sea and another was seen on fire close to the water. One Mosquito is missing from this operation and four others were damaged.

On December 28, the **Banff Wing** attacked an 800 ton merchant vessel off Skudneshavn. Many strikes were obtained with R.P. and cannon shells, causing fire and several small explosions on the ship. When left the ship appeared to be lower in the water and was listing to starboard. Some of the aircraft attacked targets on the shore, and silenced a flak position.

During the early hours of December 29, **Halifax C/502** sighted a 5,000 ton ship, probably a tanker, accompanied by two escort vessels north east of the Skaw. A bombing attack was made on the ship, and one pair of bombs fell on the forward hatch. An explosion followed and bright yellow flames came from the ship and were followed by dense black smoke, billowing up to a height of 3,000 feet.

About two hours later the same tanker was seen by **Halifax Y/502** and again attacked. "Y" scored direct hits with two bombs and left the ship burning furiously.

On the night of December 29, **Wellington B/524**, on anti-shipping patrol near the Dutch coast, obtained Radar contacts and sighted three vessels north of the Hook. The aircraft made two attacks on one of the vessels, a merchant ship, and dropped six 250 pound bombs each time. On the second attack a direct hit was obtained on the merchant vessel; this was followed by dense black smoke from all over the ship.

On the last day of the month the **Banff Wing** made a successful attack on two merchant vessels of 2-3,000 tons each, in Flekkefjord. They scored 34 hits with 25 pound R.P. on one of the ships and left it burning furiously. The other ship was also hit and set on fire. One Mosquito failed to return from the attack, and three were damaged.

III.—OTHER OPERATIONAL FLYING

Air/Sea Rescue

During the month of December 41 members of aircrew were rescued by the Air/Sea Rescue Service.

Outstanding incidents were :—

1. A Beaufighter, returning from a strike off the Norwegian coast on December 7, sighted a dinghy with two occupants, 40 miles east of the Shetlands. Owing to shortage of petrol the aircraft was unable to remain long enough to home an Air/Sea Rescue Warwick to the dinghy and contact was lost. An Anson and a Sunderland continued the search during the night, but with negative results. The next day searches were made by 22 aircraft, two H.S.L.s and a motor gunboat, but the dinghy was not found.

On December 9 the sea was very rough and a trawler was the only available vessel capable of operating. A number of aircraft again searched the area, but it was a **Warwick G/279**, on strike support, which sighted the dinghy and dropped an airborne lifeboat.

The survivors managed to board the lifeboat and set course westwards. They made 37 miles in the five hours which elapsed before the aircraft guided the trawler *Molde* alongside.

The final rescue took place at 2050 hours on

December 9 and the survivors were then identified as belonging to **Beaufighter R/489**.

2. On December 13 a Lancaster of 218 squadron ditched 40 miles east of Walton-on-the-Naze and the crew of seven boarded their dinghy. A Mustang orbited the position until a Walrus of 278 squadron arrived, but the pilot of the latter had to leave at 1649 hours because of engine trouble.

After dark an Albacore, returning from the

Continent, saw red Verey lights and circled the position calling for assistance on V.H.F. A Rescue Motor Launch from Harwich was vectored to the spot, the air and surface craft made contact and the crew were successfully picked up, with no more serious injuries than minor cuts.

The pilot of the Albacore is to be congratulated on his prompt action, which resulted in the speedy rescue of the Lancaster crew, who otherwise might have spent a cold night in their dinghy with perhaps fatal results.

Photographic Reconnaissance

The break in the bad weather over the Continent during Christmas permitted a renewal of Photographic Reconnaissance. This was done under difficulties, bad base conditions being the principal trouble. Of some 35 operational aircraft which took off from Benson between December 25 and December 28, inclusive, all but one were forced to land at other bases in the British Isles after their sorties were completed. During that period, as long as the aircraft remained serviceable, they continued to operate from the bases where they had landed. On December 29 Benson had approximately 35 aircraft scattered over about 11 airfields in the United Kingdom.

These sorties produced excellent cover of industrial installations, railway centres, airfields and towns for damage assessment purposes. Numerous long photographic covers of important railway lines in Germany were provided for activity assessment.

The following reports were written by members of the air crews concerned.

8 O.T.U., Mosquito

We were briefed for a Photographic Reconnaissance sortie to cover targets on the Norwegian coast between Sogne Fjord and Kristiansund North. We were airborne at base at 0946 hours on December 5, and climbed straight away above 8/10th cu. and cu. nimb. cloud to operational height. Trails were found at 19,500 feet, but we continued to climb to 25,000 feet, then levelled out and set course for our first target.

The coast was reached on track at Bru Fjord at 1110 hours, descending to 19,000 feet below trails. The target area appeared free of cloud and at 1125 hours Sogne Fjord was photographed. We continued to Aalesund where, at 1139 hours on our second run, several other aircraft were observed some distance beneath us. On turning away for Gossen airfield approximately eight bursts of flak were observed, fairly accurate for height, but behind us. After photographing Gossen airfield we saw an unidentified aircraft at our height about 2 miles to the east. The aircraft did not appear to see us and after a while turned away and disappeared.

A run was then made over Molde and we were continuing to our next target when, at 1220 hours, the navigator noticed that the starboard engine was losing oil, so the auxiliary supply was then switched on. At 1225 hours we set course for base from Atloen. Shortly after this the starboard engine ran away (up to 5,000 revs.) and caught fire. The pilot throttled back this engine, set off the Gravinier Extinguisher and attempted to feather the propeller. Although the fire was extinguished the propeller would not feather. At the same time trouble was experienced with the port engine, which cut periodically. As the aircraft was rapidly losing height, the pilot gave instructions to prepare to abandon. The pilot then thought that some height might still be maintained, so it was decided to carry on and, if the worst came to the worst, to ditch.

As we were without a generator it became necessary to conserve our battery by relying on V.H.F. only, and not attempt a W/T distress call, so we called "Mayday."

Eventually an answer was received from an A.S.R. Warwick, which was homed to us, arriving at 1255 hours. Our height above the sea was then 600-800 feet, and the appearance of the Warwick was more than welcome.

We followed the Warwick to Sumburgh, but had a nasty moment when it disappeared in a snow-storm. However, we managed to reach Sumburgh and climbing to 1,200 feet carried out a normal landing successfully at 1350 hours.

Next day the pilot, with the magazines, was ferried back to base in a Dominie, whilst the navigator, after an unsuccessful attempt to get back in a Beaufighter, waited for a Mosquito from Base to pick him up two days later.

541 Squadron, Spitfire

I was airborne at base at 1120 hours on December 28 to photograph targets in the Munich-Ulm area. Because weather at base was likely to deteriorate, and in view of unfavourable winds for return flight, I carried one 90-gallon drop tank and was briefed to land at Falconara near Ancona. There was a fog at base as I took off and I could just see two sodium lights on the runway. The fog cleared when I reached the coast at Manston, but started again at Cap Gris Nez. My drop tank was empty after 80 minutes, and I jettisoned it at 18,000 feet. The fog and low cloud persisted until I reached Karlsruhe where I got my first pinpoint. From Karlsruhe I set course for Ulm, and on the way I saw smoke rising from Stuttgart and since it was on track I made one photographic run over that part which appeared to be smoking. A few minutes after leaving Stuttgart, when I was at 22,000 feet, I looked behind and saw four single



The top two photographs show an attack by Mosquitos of the Banff Wing on shipping off Abelnas at the entrance to Flekkefjord. The German ship *Gudrun*, 1,485 tons, which is seen above, was sunk. The bottom photograph shows another attack by Mosquitos of the Banff Wing. This attack was made in Eidfjord on December 12. A ship of 3,500 tons, seen above, is known to have been sunk, and another ship of about 1,000 tons was seriously damaged. (See letterpress, p. 15.)



Another successful attack by the Banff Wing was made on December 16, when the German controlled *Ferndale*, 5,684 tons, was set on fire in Kraakhellesund. She has since been seen a burnt out wreck lying on a rock in the middle of the fjord. (See letterpress, p. 15.)



engine aircraft at my height closing in on me. I made a climbing turn to port and they must have recognized me as I banked, for they passed underneath me and I recognized them as Mustangs. I reached Ulm without further incident and made two runs over the town and the marshalling yard, and a further run over a target to the south-east. From there I set course for Munich where I made three runs and was pleasantly surprised to encounter no opposition of any sort. From Munich I went straight down to Falconara, crossing the Alps just to the east of the Brenner Pass. From the time I got my first pinpoint at Karlsruhe I was able to map read the whole way until I was over the Adriatic east of Ravenna, where there was strato cumulus at 3,000 to 4,000 feet. I flew southwards across the Adriatic and, gradually losing height, came beneath the edge of the cloud over the sea a few miles north of Ancona. I landed at Falconara at 1635 hours with just over 50 gallons left, after being airborne three hours and a quarter.

On the following morning the forecast was light upper winds, southern France completely clear, some cloud over Northern France, but England fog bound except on the south coast. Had I remembered to switch off my oxygen on the previous afternoon, I should have been airborne earlier but I got away at 1230 hours after chasing all over the airfield for oxygen bottles.

My first pinpoint was at Bologna, and my next Lake Geneva where I was somewhat south of track. Unfortunately I had no maps of the area from Geneva to the French coast. I saw the ground through broken cloud but did not recognize any pinpoint until I crossed the French coast at Caen. I had been compelled to do the return trip without a drop tank, as there were none at Falconara. On checking my fuel, when I was in the Caen area, I found I had approximately 28 gallons which gave me 25 minutes flying. Enough to get in to Tangmere.

I did not start losing height until I could see the Isle of Wight and Selsey and I crossed the coast at Selsey at 1515 hours. I then called up but was told that my base was out. At that time I was over Tangmere with 10 gallons left and I put down there at 1530 hours having done the return trip of approximately 850 miles in three hours. Fortunately, I found some other P.R. Spitfires and Mosquitos at Tangmere. The crews were just leaving for Benson by road and so I joined them and arrived at Benson at 2040 hours.

544 Squadron, Mosquito

On December 23 we were detailed to photograph targets in the Hannover-Magdeburg-Hamburg area. We were airborne at 0905 hours and flew at 40,000 feet over the Continent making a medium length non-persistent trail. We met

10/10 cloud till beyond Hannover and we obtained Gee fixes as far as the town. Several trails were seen on the outward journey at our height, but they did not interfere with us. The weather cleared a little in the Magdeburg area and two runs over the town were made. We had considerable difficulty in seeing the ground on account of a heavy haze and very thick ice formation all over the inside perspex surfaces of the nose. On the second run the starboard engine lost power, vibrated very badly and emitted quantities of glycol and oil. The oil pressure fell rapidly and oil temperature rose alarmingly. The engine was feathered forthwith to prevent risk of fire and we set a course for the nearest coastline, which was close to Cuxhaven. Some miles to the east a trail was seen, but fortunately it proceeded on reciprocal track. Losing height gradually at reduced airspeed we flew towards the coast for what seemed an eternity. In actual time it was about 55 minutes. We watched the sky for enemy aircraft as never before, and luck seemed to be on our side, for until getting practically to the coastline, we saw only one trail circling above. Then our luck broke. When near Emden at 19,000 feet, a F.W.190 dived on to us out of sun, zoomed up underneath, at a range of 500 yards and was in an excellent position to attack. We did a tight diving turn to port and the fighter overshot. He climbed above us, and was seen to have a yellow tail. Meanwhile our screaming dive had been too much for the starboard engine, which came unfeathered, was getting up to 5,000 revs., and gave every indication of wanting to part company with the rest of the aircraft. The nose was pulled up to lose all the excess speed and, after about a minute, the engine feathered again. During this time the enemy aircraft climbed above and circled around, evidently looking for us, but apparently was unable to find us and flew our course 3,000 feet above for a few minutes, then turned away, flew our reciprocal and was finally seen screaming for the ground in an almost vertical dive. By this time we were in a dive again, going flat out for the layer of 10/10 strato cumulus, which lay off the coast, and once again the starboard motor unfeathered. As the enemy aircraft had disappeared there was not quite such a flap in the cockpit, but there was more trouble in feathering the unserviceable engine. Eventually, however, while flying just above the cloud at 5,500 feet, it stopped for good. We headed north-west for 15 minutes, to avoid any enemy fighters from the Frisians and then turned for base hoping that the port engine and Gee would see us home alright. The long sea crossing passed without further trouble. Our engine behaved magnificently. We eventually touched down at base after just over 5 hours' flying, of which 2½ hours were on one engine.

IV. SPECIALIST AND GENERAL ARTICLES

The Organization of Photographic Reconnaissance for Strategic Purposes in the European Theatre

(The following article is a résumé of the main parts of a paper prepared by Headquarters, 106 Group, for the purpose of describing part of the organization of that Group.)

INTRODUCTION

This article is intended to describe the organization of Photographic Reconnaissance for strategic purposes as dealt with by 106 Group in the European theatre at the present date. The wish is not to convey any dogmatic pronouncement of principles, but merely to describe the system which has been evolved after four years of experiment, and which appears to fill contemporary needs. It is, perhaps, a virtue of the existing organization that it is unbound by any supposed principles and is ready to adapt itself to the circumstances of the moment or the future as rapidly as possible.

Photographic Reconnaissance is still regarded by some people as a mystery. If this is so, it is time that the mystery was dispelled, because P.R. has come to be one of the permanent and normal functions of the Royal Air Force.

It is impossible to differentiate clearly between strategic and tactical reconnaissance. As far as P.R. is concerned the same photograph may be of strategic interest to one unit and of tactical interest to another. The purpose of 106 Group is to provide reconnaissance for strategic purposes, and although sometimes, for reasons of expediency, the Group is drawn into work of a semi-tactical nature, it is not their main function and is avoided as far as possible.

The Photographic Reconnaissance Organization is essentially a Service which provides every branch of the Government at War with any information which can be extracted from photographs. The organization requires five stages:—

- (a) The assessing and crystallizing of the job by a Priorities Committee who must be well informed on higher policy.
- (b) The flying of the sortie by aircraft of the highest performance.
- (c) The production of the photographs by well-equipped Photographic Sections.
- (d) The interpretation of the photographs.
- (e) The delivery of information and photographs by a good communications service.

With this organization working smoothly, when weather permits, the customer who urgently requires information is provided with the prints and interpretation reports within 24 hours of the photograph being taken.

Potentialities

Photography has been shown to be capable of providing an enormous amount of information on

enemy territories and activities. Among the subjects normally covered are enemy industry, aircraft movements, rail and road movements, shipping, Radar organization, bomb damage, etc. In providing this information, the photographic reconnaissance organization is essentially a Service, and the servant of every branch of the Government. The following customers normally make direct application for photography: Admiralty, War Office, Air Ministry, Ministry of Economic Warfare, R.A.F. Commands, Army Commands, Naval Commands, S.H.A.E.F., A.E.A.F., etc.

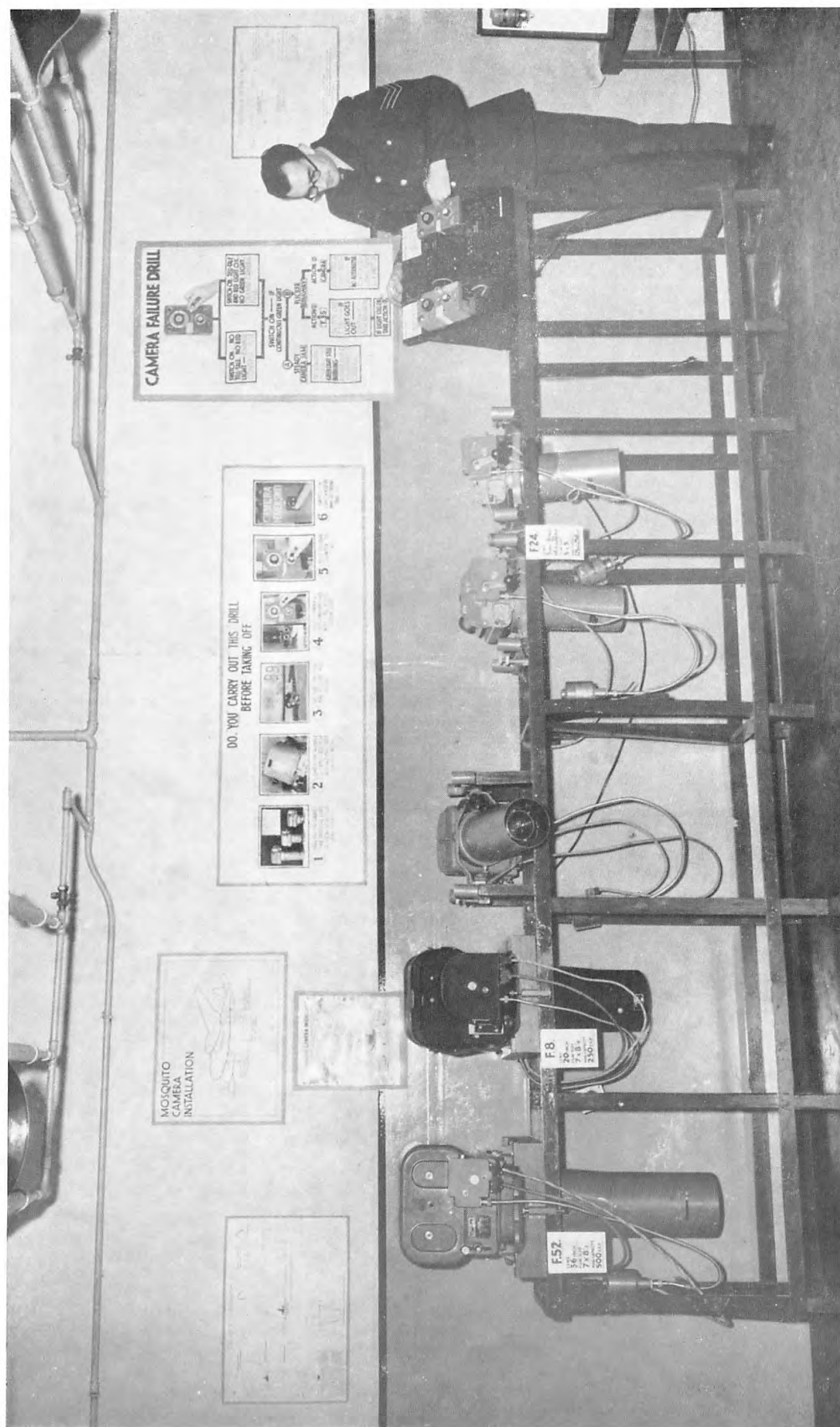
Stage I.—The Joint Photographic Reconnaissance Committee

The Joint Photographic Reconnaissance Committee is an inter-allied, inter-service committee, and a sub-committee of the Joint Intelligence Sub-committee through which it is responsible to the British Chiefs of Staff. It consists of two Army officers, two Naval officers, two R.A.F. officers and two United States officers. As the first and essential function of this committee is to arrange the requirements in the order of their importance, it is essential that the members of the committee should be very fully informed of the higher strategy of the Government. The various members of the committee therefore pay frequent visits to their parent Ministries and to the higher formations to obtain the most recent information on impending events. The committee meets twice a day, goes through the applications for cover and, against the background of their knowledge of impending events, arranges the list in order of importance. Certain classes of jobs, such as Damage Assessments, are authorized automatically.

Stage II.—Flying the Sorties

When the job reaches the Operations Room, the sortie is laid on for a Mosquito, Spitfire, or sometimes a Mustang, according to the nature of the work. With precise information of area and scale, orders are given for the type and setting of the camera to be used and the height at which it should be flown. It is quite normal for a Spitfire to take up to a dozen different targets in the same area, or for a Mosquito, in the course of one flight, to take a convoy in the Baltic with the oblique camera, a ship^{*}building in Königsberg with the 36-inch vertical, a large area with the 14-inch verticals for map correction in Prussia, a bomb damage assessment on an aircraft works near Vienna with the 36-inch verticals, and to land in Italy.

These examples show the advantage of having several different camera installations in the same



This display of camaras was set out at R.A.F. Station Dyce, to illustrate the different types used in photographic reconnaissance. The use of different types and sizes is, of course, dependent on the scale and coverage required. For instance, the large 36-in. F 52 camera on the left takes large scale photographs, but only covers a very small area. This may necessitate many runs to cover a given area. On the other hand a camera fitted with a 6-in. lens will take a small scale photograph covering a large area with one or two exposures. A compromise is usually effected, in which several types are used on the same sortie. In this way all demands can be met.



One of the principal bases from which E-Boats operate in the North Sea is IJmuiden on the Dutch coast. Concrete pens can be seen in the above photograph at the inner end of the Haringhaven. The other pens near the entrance are not yet completed. Bomber Command recently attacked the old pens, and scored hits with 12,000 A.P. bombs, which must have caused severe internal damage.



The remarkable photograph above was taken by a Warwick of 280 Squadron. The photograph shows the trail of a V2 rocket which has just been launched from a site in Holland.

aircraft, and emphasize that with care and forethought in the Operations Room, many different targets can be dealt with successfully in the course of one flight.

Armament

It has been found from experience that the best results are obtained by flying unarmed and relying upon sheer excellence of aircraft performance to do the work unmolested. Attempts have been made at one time or another to provide the aircraft with forward facing armament, but it has yet to be shown that it resulted in the taking of one extra photograph. It is considered that the only form of armament which would be permissible on a P.R. aircraft would be rearward facing, and it is not considered that even this would be technically expedient. It is better to save the weight and gain the speed.

It is necessary, therefore, for the P.R. aircraft to develop over the target a sufficiently good performance to take photographs unmolested. But the P.R. aircraft has to get to the target, whereas the enemy fighter has only to leave the ground at the target. The P.R. aircraft has to develop both range and performance and it stands to reason that the difficulty of producing the necessary margin of performance increases with the radius of action. It therefore says a great deal for the skill of our designers that we have worked with remarkable freedom from interception up to a radius of 1,000 miles. The development of the jet fighter is viewed with some concern from the P.R. standpoint, for it is a feature of the jet engined aircraft that it can produce a very high rate of climb, and high speed for a short time; features which can obviously be exploited in defence.

Height

For some years it has apparently been accepted that photographic reconnaissance for strategic purposes must inevitably be done from a great height. It is certain that long focal length stereo cover from altitude gives extremely good results. For many purposes this is essential, but it is equally certain that there are many times when weather will prevent such photography for days at a time, and there are many targets which can best be tackled from an extremely low altitude. Moving film and continuous strip cameras for low level vertical photography, have therefore been installed, also forward facing cameras in both Mosquitos and Spitfires for obliques.

Stage III.—Production of Photographs

After the flying task is completed, the next stage is to process the film and produce the required number of prints as quickly as possible for the 1st Phase interpretation and initial distribution.

Quality of negatives and prints is all important if the photographs are to give maximum information. A further important consideration is speed of production of the finished prints. The sooner the information obtained from the photographs is in the hands of the customer, the sooner it can be acted upon. Prolonged delays will often render the sortie of little value.

To achieve these objects, research into improved methods of processing and printing, and improvement of the photographic emulsions used for negative and print making, must be continuous.

On arrival at the airfield Photographic Section, the exposed films are processed on a Kodak Continuous Processing Machine. This machine develops, fixes, washes and dries any width of film up to 9½ inches at a rate of approximately 400, 7 by ½-inch negatives per hour. The conditions of processing are such that, given correct exposure, negatives of perfect quality will result. Any length of film can be processed and films can be spliced to each other with the machine running to allow continuous processing.

The film is next viewed by an Intelligence Interpretation Officer who selects negatives of the target area of which rush prints are required. The film is then numbered, after which rush prints are made from the selected negatives. This is followed by routine printing of two complete sets. These are despatched, with the film, to the Allied Central Interpretation Unit, where a 2nd Phase interpretation is made and the area covered is plotted.

Routine sets of prints are invariably made on Williamson Multiprinter machines capable of producing up to 1,000 finished prints, size 7 by 8½ inches, an hour. The printing exposure is adjusted by a grader unit, which measures the negative density through a photo-electric cell, causing the necessary amount of light for correct exposure to reach the negative during exposure. This ensures good print quality and maximum speed of production.

In their present perfected state these processing and printing machines are the result of years of experience and experimental work. Their use enables the vast numbers of negatives and prints dealt with to be produced efficiently, in the shortest possible time and with the minimum of labour. On a busy day as many as 25,000 negatives and 60,000 prints can be produced at the airfield Photographic Section at Benson. The average time for high priority sorties—from the time the aircraft lands to the issue of the films and prints to Allied Central Interpretation Unit—is from 3 to 4 hours. The Form White, or 1st Phase Report, which is made from selected prints, and does not therefore have to await the production of the full sets, will normally be issued about two hours after the aircraft lands.

When the films and initial sets of prints arrive at Allied Central Interpretation Unit, the negative is filed and indexed, and one set of prints used to make a plot of the total area covered. The other set of prints goes to the 2nd Phase section for more detailed interpretation, and then, if necessary, to the 3rd Phase, or specialist sections.

In addition to the normal production of contact prints, Allied Central Interpretation Unit is responsible for a large variety of other photographic work for specialized commitments. These include:—

- (a) Mosaics, enlargements and rectified enlargements.
- (b) Reproduction of target maps and illustrations.
- (c) Duplication of negatives and production of diapositives.
- (d) Photostat, lithograph and rotoprint reproduction.

All orders must be executed promptly and large orders farmed to auxiliary units within the organization to ensure the shortest production times. Both the forward photographic sections and Allied Central Interpretation Unit work on a 24 hour basis.

Stage IV.—Production of Intelligence

The main purpose of Intelligence is to supply the Higher Command with accurate information of the enemy forces, naval, military and industrial, his intended use of these forces, the actual stage of execution of his intentions, and his attempt to mislead us.

Many sources of Intelligence contribute information to the responsible collating department. Photographic Reconnaissance and Interpretation are called upon at many and various stages of collation. "Other Sources" of intelligence are of great value in directing reconnaissance and interpretation to areas or places or industries, while the fruits of such directed Photographic Reconnaissance and Interpretation give a concrete foundation for the further build-up of either pure intelligence (for long term planning) or of operational intelligence (for strategic and tactical military, economic and political propaganda action). Much of this "directed" interpretation may be obtained in any one single sortie.

Beyond this complementary rôle, however, P.I. produces a great volume of intelligence on its own initiative, from photographs originally taken for entirely unrelated purposes, at irregular intervals, extending over periods of months or years. This *research* photographic interpretation, as opposed to *directed* interpretation, can never be achieved by quick and easy inspection of a single photograph or sortie. The essential principle of all photographic interpretation is system, and comparison between photographs, taken at different times and dates.

Some examples of research intelligence obtained from interpretation are :—

A. Recognition of Enemy Shipping. This is the result of the compilation of what is virtually a photographic Lloyd's Register of enemy shipping, slowly built up, by routine photography of enemy ports at regular intervals. From this Register, it is possible to appraise the movements of enemy shipping, to deduce types of cargo, to estimate the frequency, routing, disposition, escort and armament of convoys, and to forecast shipping movements, blockade running, etc.

Further intelligence from systematic interpretation of such routine port cover allows reviews of the trend and volume of enemy merchant and naval construction, the location of main shipyards, types of shipping on which they specialize, numbers, types and speed of construction of U-Boats, types and location of harbour and coastal defences and countless related items of great value. These examples show that the research which enabled the Register to be compiled has, at the same time, made it possible to provide many other details of related intelligence. In other words, one thing leads to another. The more that is known from past photographs, the more will be known from the next photographs.

B. Enemy Railway Movements. Research interpretation over long periods enabled the categorizing of typical or "standard" compositions of enemy trains. By means of a daily interpretation report showing on maps, by countries, all railway facilities covered by photographs on that day, the Supreme Command has known when, where and how the enemy was reinforcing or supplying his troops and from what sources. Similar results have been achieved by a long-term study of enemy airfields.

C. Enemy Aircraft. By long, continuous, systematic study of enemy factory airfields and aircraft factories, it has been possible to identify the individual factory installations or buildings with certain processes, to give warning of new factory locations, extensions to existing factories and types of operational aircraft in production, to describe new experimental aircraft, note the frequency and location of their appearance, check estimates of production and note bottlenecks in assembly, etc.

D. Enemy Oil Production and Storage. Here again long-term organized research in photographic interpretation has built up a clear, accurate picture of enemy oil resources, and of the varied attempts to increase these resources, as well as the amounts by which they have been reduced by bombing.

The second role of interpretation, *i.e.* "directed" interpretation, provides vast amounts of intelligence either on a routine basis or on an isolated "specific query" basis. In both cases, this type of information is in the nature of short, quick answers to questions framed by the requesting authority. For example : "What types of, and how many, aircraft are present on this airfield?" "What visible damage was caused by a bombing attack, by a new weapon, by a shipping strike, by new tactics, by naval or artillery bombardment, or by a specific piece of sabotage?" or, "Is there an ammunition dump, or specific type of factory, or wireless station, or railway in a certain neighbourhood?" The fund of such directed queries is obviously without limit, but for almost any such query, interpretation can provide an answer.

Stage V.—Delivery of Information

It will be realized from the outline of Stages III and IV above that the ability to produce photographs and intelligence quickly, accurately and in greatly varying volume and form, is of little value unless there is an efficient "delivery of information" service. This service has to be sufficiently flexible to despatch completed small or large photographic or interpretation orders simultaneously to many formations and Commands. Flexibility is achieved by extensive use of direct speech and teleprint landlines, W/T facilities and an efficient and comprehensive despatch rider service. In addition, an air courier is required for delivery to overseas formations and headquarters, and the whole of this complex "delivery of information" service has to run with the maximum smoothness and accuracy if full use is to be obtained from photographic reconnaissance and interpretation.

United States Strategic P.R. Force

This article is mostly confined to the R.A.F. side of photographic reconnaissance in the European theatre, but we must not close without referring to the work of the United States Strategic P.R. Forces. This Force is known as 325 Wing (Recce.) and forms the U.S.A. equivalent of 106 Group. Briefly, it operates, in addition to other units, the 7th Photo. Group, consisting of three Lightning and one Spitfire Squadrons.

The requirements for this "Photo. Group," as

well as for 106 Group, are dealt with by the Joint Photographic Reconnaissance Committee. All accepted requirements are then passed to Air Staff, 106 Group, who allot the tasks for action, either to Benson or 7th Photo. Group. This depends on the nature of the task, the formation making the request, etc. In order to do this satisfactorily, an American Officer with operational and staff experience, occupies an Air Staff appointment in Headquarters, 106 Group. There is close liaison between all sections of 325 Wing and 106 Group and the good from this is reflected in their work together, towards a common end.

Signals in 1944

Communications—General

One of the chief advances in Signals during the year has been in Homing Technique. To-day it is the exception rather than the rule for Escort aircraft not to make a successful "Meet," using procedure "B." There has also been marked success in the use of procedure "C," with both aircraft and Escort Groups.

Co-operation with Naval units has improved considerably, and reports from Naval sources invariably stress this point. The formation of 247 Group in the Azores introduced one more link in the already extensive lines of communications, which have now become highly efficient. In this connection W.A.A.F. Operators have played a very important part in our point to point organization.

No.1 Group, R.C.A.F., St. John's, Newfoundland, who have co-operated so well during the past year with 15 Group and Iceland on VLR frequencies, joined our North Atlantic Point to Point Organization last October.

Airborne Communications Equipment

There has been little modification in the Telecommunications equipment fitted to aircraft of Coastal Command during 1944. It has been a year of consolidation rather than of changes. Changes are sometimes necessary, but there must be good reasons to justify the work and reorganization involved. In British type aircraft, the Marconi equipment still provides our main long range communications. The TR1196B has fulfilled expectations and improved our R/T on G.R. aircraft. The TR1143A (V.H.F.) still satisfies the crews of our L.R. Fighters, although the limitation to four channels has been recognized as a great disadvantage. It is interesting that over half the operational aircraft in the Command now use V.H.F. for R/T. It is the same with American type aircraft. The equipment has not altered except that the new Liberator VIII's have the American V.H.F. (SCR522) installed, in addition to the normal H.F. R/T set. A new installation is expected for the Catalina before the end of the year. The present one has not been entirely satisfactory.

What is new on our aircraft? Most important is "Sono Buoy" equipment, installed in most Liberators, and shortly to be fitted in all other

types of anti U-Boat aircraft. This equipment, which will be the subject of a future article in the Signals Review, is a very important addition to anti U-Boat weapons. It is believed that "Sono Buoy" is the first equipment in the Service to use frequency modulation.

On O.T.U. aircraft the work of fully dispensing with the TR9 has progressed, and, except for a few, all aircraft are now fitted with the appropriate mark of TR1196.

The provision of up-to-date equipment in A.S.R. High Speed Launches has been one of the most satisfactory results of the year. These craft are now being fitted with an installation similar to that of a standard British aircraft, *i.e.*, T1154/R1155, a separate R1155 with D/F Loop, V.H.F. and a reasonable interphone system.

Communications equipment requires a high standard of maintenance. The Centralized Radio Maintenance scheme has enabled this high standard to be maintained in spite of shortage of man-power. Every effort is being made to provide the workshops with a more comprehensive scale of standard Test Gear, which will enable equipments to be adjusted to give the maximum standard of service. The necessary authority is expected shortly. This new Test equipment, together with a basic holding of component parts known from defect postagrams to cause trouble, will permit minor repairs to be made efficiently on every station. Stabilization of equipment enables a higher standard of maintenance to be achieved as members of the service become more conversant with the equipment.

Ground Communications Equipment

There have been no revolutionary changes in Ground Signals installation in 1944, but there has been progressive improvement in the quality of equipment.

Throughout the summer, stations have been equipped with the Type 75 Rack Assembly, a twin channel TR1196 Ground Installation, which is a considerable improvement on the old TR9. This has led to considerable improvement in airfield control R/T, which will improve still further with the introduction of V.H.F.

In the early part of the year a completely new four channel ground installation system was designed and prototyped, and tests have been

made on the latter installation. The system is designed as a post-war V.H.F. layout and production has already begun. Unfortunately, this Command is not receiving first priority, and the use of the equipment cannot be expected before the end of 1945.

Throughout the early part of the year the Azores Ground installations was being transferred from a temporary to a permanent basis. This work was completed on July 6, and since when, apart from a few power difficulties, all services for the Azores have been working smoothly, in spite of the disturbing influence of Atlantic gales.

The efficiency of the Azores service justifies the work put into the design of the equipment used, and the investigation into suitable frequencies. In the spring of the year an M/F link between Prestwick and Iceland was completed to act as stand-by to our H/F circuit. This is an important addition to our point to point facilities and ensures a measure of security against H/F black-out.

The invasion of Europe created many troubles, mainly concerned with the rapid fitting of ground stations with V.H.F. and W/T facilities, and provision of landline communications. All these were done in remarkably short time, and the Command is greatly indebted to the General Post Office and 26 Group for their excellent work. During this time a considerable strain was put on everyone, and those who were called upon to open up remote stations with insufficient equipment and too few men, did so with commendable ability.

Signals Security

This year has seen the introduction of a new method of using aircraft call signs and numbers instead of aircraft letters, which can be accepted, according to R.A.F. Monitoring analysis, as the most advanced call sign system, from the security angle, in existence.

This system is a Coastal invention which, after most satisfactorily trial in 19 Group for approximately nine months, was introduced throughout the Command in November, 1944. Its main function is to prevent any detailed disclosures of our order of battle.

In order to prevent interference on the common convoy wavelength, and to achieve the highest possible degree of security, all signalling on this wavelength has ceased, except in cases where the signal is of sufficient urgency to preclude waiting until the normal routine W/T period of the Group concerned. This is a most valuable step, as the use of the convoy wavelength in conjunction with the convoy type call sign, reveals most vital information, unless closely controlled.

The W/T and R/T States have, of course, the highest function in this respect, and place security right to the forefront on all convoy escort orders.

Other measures include the instructions covering security requirements contained in all signals ordering Moves of aircraft by this Headquarters, the verification of cancelled S.O.S.s, the Control of Meteorological Broadcasts, and, over riding all previous methods of tackling the analysis of W/T traffic, the establishment of the R.A.F. Air Monitoring Section, which, in the hands of expert operators

and interpreters, maintains a record as an independent witness of R.A.F. traffic, and what can be gathered therefrom.

Search Radar

1943 was a year of revolutionary change for search Radar in Coastal Command aircraft. By the end of that year almost all types of reconnaissance aircraft had changed from the old 1½ metre Radar to the entirely new 10 centimetre type of equipment.

There has been no such revolutionary change in 1944, but there has been steady and consistent progress in Radar development. The highlights have been the introduction of the Mark VI A.S.V. series in Leigh Light Wellingtons.

The first of this Mark incorporated high power with attenuator, while the later version, Mark VIA, has lock and follow and blind bombing facilities.

At the end of the year the first of the Liberator VIII's fitted with A.S.V., Mark X, were brought into service. This equipment operates on 3 centimetres and has a most creditable performance; it also has a new feature termed Sector Scan, which very much simplifies homing. It is hoped that the American Radar bombsight will soon be in service with the A.S.V., Mark X.

This combination has put up a magnificent record against shipping at night in the Far East.

Catalinas have been rejuvenated by the installation of A.S.V., Mark VIIIA, another 3 centimetre American Radar equipment.

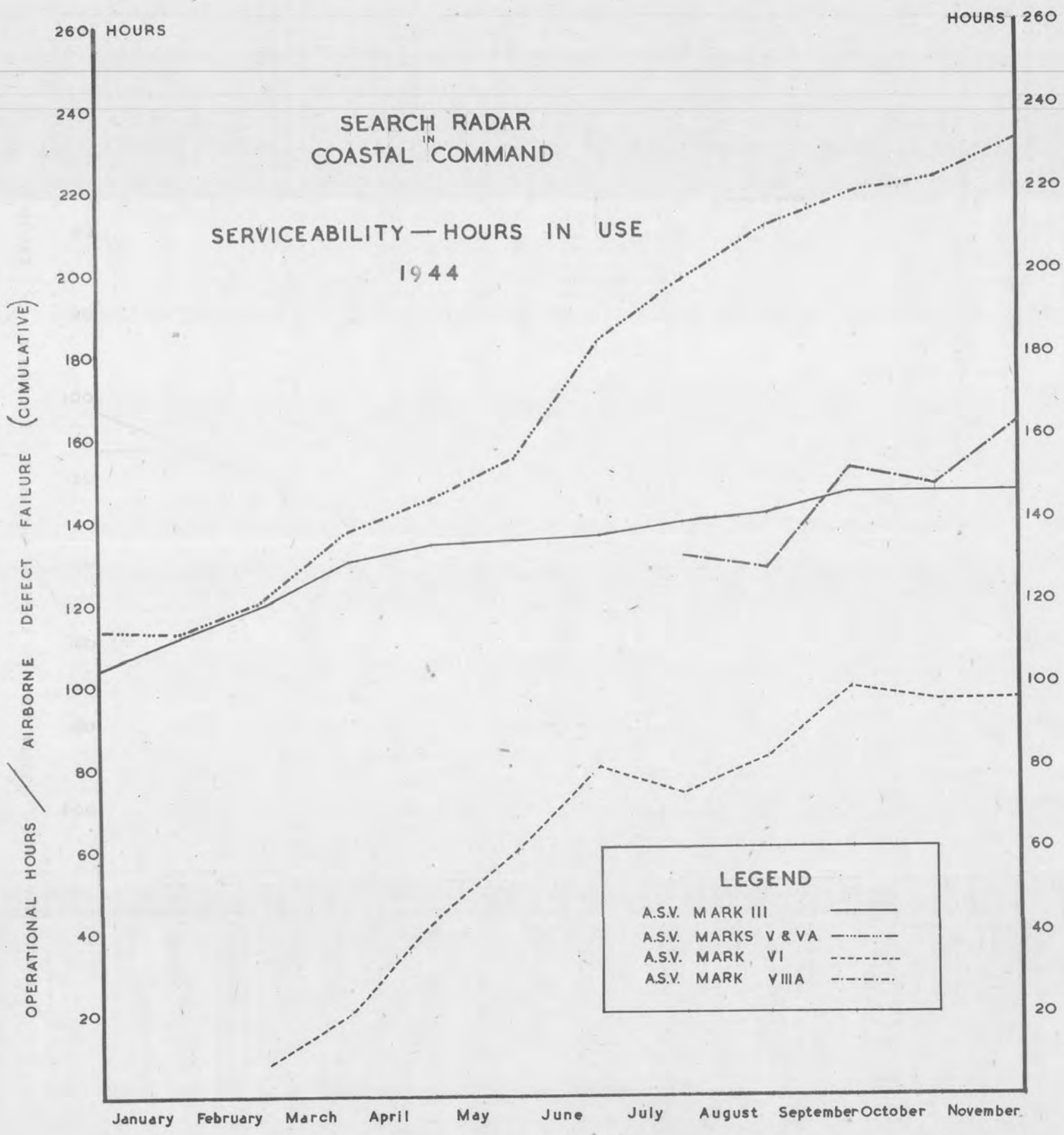
The introduction of these new and relatively complicated equipments has called for intensive efforts in the training of maintenance men. Unfortunately, the man-power situation has not permitted an increase in establishments comparable with the increased maintenance tasks. In spite of this, the standard of reliability has been high. This is shown in the graph opposite. This graph is plotted on a cumulative basis, i.e., the figures for any particular month show the overall average reliability of the equipment from the time of its introduction.

Strike Radar

Two new types of Radar are shortly to be introduced for strike aircraft. The first will be A.S.V., Mark XII, which will provide both search facilities and Range Finding. The second equipment will be a much smaller set for Range Finding only, and will be called Mark XVI.

Radar Aids to Navigation

The year has seen the bringing into use of the North-West Atlantic Loran chain, which has proved of great value, both to anti U-Boat aircraft and to Meteorological aircraft. A requirement has been agreed for a North-West GEE chain, which, it is hoped, will be in operation by the end of January, 1945. The South-Western chain is being modified to improve the cover in the South-Western Approaches by the addition of a station in the Brest Peninsula, instead of the station at Worth Matravers.



Radio Altimeter

During 1944 the AYD and AYF Radio Altimeters, have been fitted almost universally. The high range of the AYF has not yet been cleared, but it is hoped that this will be done shortly. Reports from America of the latest version are most promising.

A new Radio Altimeter is now being fitted in the Meteorological Squadrons, called SCR718, capable of reading up to 40,000 feet.

Radar Beacon

All the old interim Beacons have now been replaced, and the new Beacons, after a few early snags, are now giving excellent service.

The year has seen the fitting, in special cases, of

the American B.G.S. and B.G.X. Beacons, which work directly with A.S.V., Mark V, and A.S.V., Marks VIIIA and X respectively.

A.S.V./B.A.

Here again the replacement of the interim models is now almost completed, and a useful service is available, although the use of this equipment has been limited by the difficulty of reading the small cathode ray tubes used in Lucero and SCR729. This is being overcome by the introduction of a magnifying lens, which gives the same sized presentation as with A.S.V., Mark II, but with higher discrimination. A new design of B.A.B.S. has been produced at T.R.E., although it is not yet available for service use. Its presentation is much easier to read, and its high serviceability and low maintenance effort make it most attractive.

Engineering in 1944

A year ago something of the "why and wherefore" of planned flying and maintenance was described. 1944 has seen the system more firmly established and results in the Command speak for themselves. In spite of the increasing complexity of aircraft it has been possible to increase the tasks of the majority of the squadrons without any material increase in maintenance staff.

There have been major changes in the structure of the maintenance organization made during the year; the formation of the aircraft preparation pools, and the establishment of an engineer officer on each servicing echelon.

The pools were formed in the early summer before the start of the intensive operations, to relieve squadrons of the preparation of replacement aircraft. The idea was that when an aircraft was lost, a replacement could be fed into the squadron from the pool, completely modified to command standards and ready for operations, thus eliminating the time loss of the past. The pools form reserves of operationally serviceable aircraft, and although the way has not all been smooth, they have certainly proved their worth. It is hoped soon to establish the pools properly so that they will become a permanent feature of the command maintenance organization.

Up to recently, all engineer officers have been established on the station servicing wing. This is still the case on training stations but on operational stations experience has shown that some modification was desirable. On the administrative side the policy of having no officer established on a servicing echelon has been a drawback, and from a technical point of view, the advantage of the mobility of servicing echelons was impaired by the engineer officers not being equally mobile. It is hoped, therefore, that the establishment of an engineer officer on each servicing echelon will cure these weaknesses. But it cannot be stressed too often that this innovation does not alter the established servicing wing organization and that the echelon engineer officer may be used in any post within the servicing wing.

Airframes

New types and later marks of aircraft have appeared in the Command. Notable amongst these, are Sunderland V, Liberator VIII,

Catalina IV, Warwick V, new and improved Mosquitos, and photographic reconnaissance aircraft. Our very old and trusted friend, the Fortress, has been most honourably discharged from the U-Boat hunt, but it has taken up duty with the meteorological squadrons.

During the past twelve months there has been much work done in order to facilitate the introduction of new equipment into our aircraft.

Under command modification procedure it has been possible to meet our most urgent operational requirements in aircraft equipment, and this has contributed in no small measure to the success of the Command as a whole in the anti U-Boat and shipping warfare.

It will be of interest to all concerned that approximately 5,000 modification sets have been produced within the Command during the period January-December, 1944. These sets have enabled instruments, armament, cameras, etc., to be installed in aircraft, which could not otherwise have been modified without great delay. It is hoped that arrangements now in hand will make the development and manufacture of Command modifications simpler and swifter during 1945.

The introduction of the standard of preparation lists is considered to be a material step forward in easing the problems with which units have been faced in the past when re-arming. This fact, in conjunction with the setting up of the preparation pools (mentioned above) has already paved the way to squadrons receiving aircraft that can be put on operations with the minimum delay.

The introduction of airborne lifeboats gave rise to a number of technical difficulties in operating and servicing, but these difficulties are being overcome and many successful drops have been made. To improve safety equipment installation on aircraft, a number of dinghy blow-out trials have been made, notably on Liberator, Sunderland and Fortress aircraft.

Engines

1944 has seen the introduction of some engines new to the Command, e.g., the Double Wasp in

the Warwick I, the Centaurus in the Warwick II and V and the Rolls Royce Griffon in P.R. Spitfire aircraft. The Double Wasp has not been as successful as could be wished, but with the introduction of a number of modifications it has shown an improvement. The Centaurus, which is the first engine to be installed in Coastal Command aircraft for initial service trials, has not been in use long enough to be able to pass judgment, but as it has been designed basically from previous Bristol sleeve valve engines, it is hoped that, apart from initial teething troubles, it will give good service.

The Sunderland V Twin Wasp engine is now in production and a number of Sunderland IIIs are being converted to Mark V. The installation of the Twin Wasp engine in the Sunderland is mainly due to the efforts of No. 10 R.A.A.F. Squadron, who undertook to carry out the first conversion. With technical advice, and some assistance from Short Brothers, the aircraft was completed and flown successively for 150 hours on trials and training. It was unfortunate that the aircraft was lost, for reasons other than enemy action, before any great amount of operational flying had been done. However, the suitability of the aircraft had been proved and it was most encouraging to learn the decision of higher authority to install Twin Wasp engines retrospectively and produce the Sunderland V aircraft.

A year ago it was confidently expected that de Havilland rack type fully feathering propeller would be fitted to Sunderland aircraft, but owing to a number of unexpected snags the installation has been temporarily dropped. The chief trouble was due to faulty constant speeding and feathering because of oil pressure troubles due to air lock in the system. During the past month a modification has been introduced to the propeller shaft incorporating a bleed to release the trapped air and four of these modified reduction gears are now being fitted to one aircraft of this Command for service trials.

Merlin XX and 22 engines of the Halifax II and V aircraft have not given satisfactory service under Coastal Command operating conditions, and action has been taken to improve the engines by the incorporation of a number of essential modifications, but as these Marks are now out of production, some modifications cannot be incorporated. It has therefore become necessary to ask higher authority for a later mark of engine for these aircraft, and it appears that this will be approved.

During October carburettor icing was experienced on the Twin Wasp engine in Liberator VI aircraft. These aircraft are not fitted with the hot air system in the carburettor air intake, as in most other type of aircraft, but had to obtain heat from the turbo-superchargers to dispel ice. The Mark VI aircraft are fitted with electronic turbo-supercharger controls, which do not permit sufficiently high turbo-boost increase to give adequate heat to deal with carburettor ice. A temporary remedy was found in the modification of the boost regulator to permit higher boost at

lower altitudes. A hot-air installation has now been designed which will permit hot air being used continuously under icing conditions. It is now being used on one aircraft of this Command for service trials. If successful it is expected that all turbo-electronically controlled engines will be modified retrospectively at an early date.

Electrical

Each year sees the introduction of more new electrical and instrument equipment and 1944 has been no exception. Among the many new items has been the Gyro Fluxgate Compass, which has used the medium of electronics as the form of motive power to give remote indication, eliminating many of the moving parts and mechanical links. Some trouble was encountered with this equipment in the earlier stages, which was ultimately traced to a poor installation by the aircraft contractors. A modification has been introduced and it can be confidently stated that this difficulty has been overcome.

The Electronic Control System for superchargers is also a newcomer. The purpose of the system is to maintain constant carburettor inlet pressure by automatically regulating the position of the exhaust waste gate. This "gadget" is a half-cousin of "Minnie" and is made by the same company. Another product of this company is a most interesting and instructive series of films on the maintenance of "Minnie" and the electronic control of superchargers. These films have been shown to all units interested in this equipment.

After many trials for providing hot drinks, etc., for aircrews, at last a suitable apparatus has been made. The "Electric Urn" consists of an inner and outer container with a capacity of 3 and 3½ pints of liquid respectively, which can be brought to the boil in 35 to 40 minutes. This equipment is now being issued to all long-range aircraft, so the "hot cup of char" will be available in 1945.

The major alteration in British aircraft has been the "Earthing of the Negative," which became necessary due to the introduction of American equipment (which operates on an earth return system) and involved the Sunderland, Wellington, Beaufighter and Mosquito aircraft in particular.

Several new features have been developed within the Command, of which perhaps the most outstanding item has been automatic night photography. The control panel and trials have now been completed and production has commenced and will be embodied at an early date as a Command modification. In order to keep abreast of all the latest "gadgetry" two instrument servicing vans have been established in the Command, with specially trained staffs. These staffs give instruction in the maintenance of the Mark XIV and TI Bomb-sights, A.P.I. and A.M.U., automatic pilots, D.R. compasses and other specialized equipment.

There is no doubt that 1944 has been a year of hard endeavour, but the results achieved have made it worth while. The way in which everyone has played his part shows the possibility for providing the aircrews with even better service in 1945.

Armament in 1944

The corresponding article to this, published in the last December's issue of the *Review*, ended with a note on the expected future of Planned Flying and Planned Maintenance in relation to Armament, and it therefore seems appropriate, in reviewing the armament work in 1944, first to mention the progress made in this direction.

The introduction of the Serving Wing Scheme has been of undoubted benefit to the armament branch; it has aided continuity and simplified the application of methods in armament maintenance and servicing. The scheme has gone a long way towards better understanding and co-ordination of work with the other technical specialists, in particular the Engineering Branch. At the same time, the more definite policy concerning the responsibilities and duties of the station armament officer in relation to the armament staff in the Servicing Wing has clarified the workings of what, at first sight, might appear to be two distinct armament sections on the station. This policy, which lays down the direct chain of responsibility for the technical control and methods to be employed at all formations, has established the station armament officer as the chief technical authority on the station in regard to all armament matters and equipment; at the same time, it leaves a clear field for the armament officer in the Servicing Wing to conduct his work in the best manner to meet the task programme issued and co-ordinated by the officer in charge of the Servicing Wing. It can be said that throughout the year the relations between all armament sections and the other technical services have advanced in mutual goodwill and understanding, with the result that maintenance and servicing has become increasingly efficient.

Another factor which has influenced the standard of maintenance is the introduction of Coastal Command Armament Maintenance Instructions relating to guns, compiled and issued under main principles laid down by Air Ministry and adjusted to meet the circumstances peculiar to Coastal Command operations. It is hoped that this system will be extended in the near future to cover other items of armament equipment.

Station armament organization also has been constantly under review throughout the year, and with the present maintenance systems paving the way, it is intended to introduce a standard and more detailed organization, to be applied to armament sections on all Coastal Command stations. Although progress has been slow, preliminary investigations, which have brought groups and stations into discussions, have already done much to improve and assist the station armament officers in conducting their work along more defined and efficient lines, with the result that the information now accumulated is being compiled for issue as a standard instruction for the guidance of all concerned.

The year has seen few fundamental changes in the weapons and equipment used on operations. But there have been a number of important improvements, both in design and application, which have increased the effectiveness and striking power of our aircraft. The 250 lb., Mark XI, depth charge continued as the main anti U-Boat weapon, and apart from an improved pistol design (the Mark XX), it retains its familiar form and features. For anti-shipping attacks, D-Day saw the introduction and extensive use of the 250 lb. and 500 lb. M.C. bombs fused with the No. 44 air burst pistol, which were first used for attacking E-Boats by Beaufighter aircraft not equipped with any aids to accurate bombing. It was expected that the fragmentation effect from near misses would cause both material damage and casualties. This expectation was realized, a number of incidents showed that considerable damage was inflicted on even large ships by air burst bombs. In consequence, the use of the pistol was extended to all bombing attacks against every type of shipping, and the results achieved in November and December by Halifax aircraft, fitted with the Mark XIV bombsight, have shown a marked improvement.

Throughout the year there has been steady progress in the fitting of bomb sights to all aircraft, with the result that all anti U-Boat aircraft (with the exception of Wellingtons) are provided to take, either the Mark III low level bombsight, or the Mark XIV bombsight, or both, as alternatives.

The 1943 "fighting back" tactics of the U-Boats resulted in fitting, under Command arrangements, additional front guns in practically all types of anti U-Boat aircraft, and also, in a formulated policy for improved nose armament, in all new aircraft coming into the Command. In the present year the fruits of this policy have become apparent in Liberator, Wellington, Sunderland and Catalina, which are now being supplied to the Command with turrets or twin gun mountings fitted. Difficulties in American turret supply unfortunately resulted in a number of Liberators being fitted with three different types of nose turret (the Consolidated, Motor Products, and Emerson) and this caused quite a number of maintenance problems which had to be overcome before satisfactory operation was obtained. However, the standardization of the Emerson turret in the later Marks of Liberator has greatly eased these problems, which should completely disappear when all aircraft are replaced by the newer types. Installation difficulties and the need for extensive airframe modifications made it necessary to accept a less satisfactory solution for the Sunderland, Wellington and Catalina, in twin .303 gun installations, all of which are based primarily on Command modifications. In the Catalina and Wellington the extent of the airframe modifications are such that improvements on the existing twin .303 gun

mountings are unlikely; for the Sunderland, however, a new twin .5 inch gun turret has been approved as replacement for the F.N.5 and will make its appearance in Sunderland IV in 1945.

The installation of additional guns has not been confined solely to aircraft. Air Sea Rescue Launches, whose work often brings them into close contact with the enemy, have also received attention. Many designs of .5 inch and 20 mm. gun mountings have been tried, and a big programme for equipping high-speed launches with .5 inch Browning guns has been undertaken during the year, and many guns are now fitted. The increased armament on these boats has naturally called for extended armament facilities, both for supply and maintenance, at Air Sea Rescue Bases, and this problem has been met by the establishment of additional armament staff and armoury facilities at each of the bases. The requirements of Air Sea Rescue have also entered the pyrotechnic field, and boats are being supplied with two types of illuminating flare and with a rocket carrying a buoyant line to assist in rescue work by day and night.

The pyrotechnic development work, which is undertaken by M.A.P. for the Command, is now considerable, and during the year has resulted in a number of new stores coming into operation. Of particular note is the new series of slow falling Reconnaissance and A.S. flares fitted with twin parachutes and providing alternative delays. Also the 1.7 inch Flare Aircraft Illuminator, supplied to G.R. aircraft not equipped with Leigh Light, which has been successfully used on a number of occasions by Sunderlands in carrying out attacks on U-Boats. Another development associated with pyrotechnics is the electrically fired 1½ inch Signal Pistol for Photo-Flash Cartridges for night photography. A satisfactory scheme has been evolved for use in Sunderland, Wellington and Liberator aircraft, and provision of modification parts is now progressing well. Navigation, also, is a competitor in this field, with exacting requirements for flame floats which have been met, to a limited degree of satisfaction, by the introduction of the No. 3 Mark II float. This is an improvement over earlier Marks, but is not yet perfect.

Akin to the pyrotechnics as a spectacle, but considerably more lethal, is the R.P., which by its outstanding performance during 1944 has been firmly established as an anti-ship weapon of considerable merit. The improvement in operational results achieved with it during the year can be attributed (in so far as material factors are concerned) to the use of the 25 lb. solid head in place of the 60 lb. H.E. head, and to the introduction of the joint harmonization scheme for R.P. and 20 mm. guns. An arrangement which lends itself to the attack of shipping, since it enables the guns to be sighted accurately during the early stages of the attack by using the

same line of sight as that required for the R.P. at closer range. Furthermore, observation of the 20 mm. bullet strikes in relation to the line of sight affords an indication of the correct release point for the R.P. Another factor which increased the power of the R.P. weapon was the introduction in July of the 25 lb. "J" type shot, which, owing to its shape, has less tendency to ricochet and in consequence may be fired at shallower angles of dive; also the R.P. fitted with this head retains a higher under-water velocity over a greater range than does the standard type shot. In addition to improvements in the R.P. weapon, progress has been made in its launching equipment, and although changes in this have been slow to appear in squadrons, advance has been made by the fitting of the Mark IIIA Beams on all Beaufighters, with a consequent reduction in drag. Further improvements in the form of jettisonable equipment and tier stowage are a requirement of the Command, which is being vigorously pursued.

Although much prominence has been given to R.P. strikes, the torpedo has continued to do good work and any curtailment in its use has been due mainly to lack of suitable targets rather than any technical shortcomings in comparison with the R.P. Few changes of any note have taken place in the torpedo during 1944, but it is of interest that a heavier type warhead has been successfully used in operations, and successes go to confirm the lethal power of this weapon. Further developments are proceeding; in particular, a torpedo specially designed for air use which will be constructed to meet the more stringent conditions imposed by release from modern high-speed aircraft.

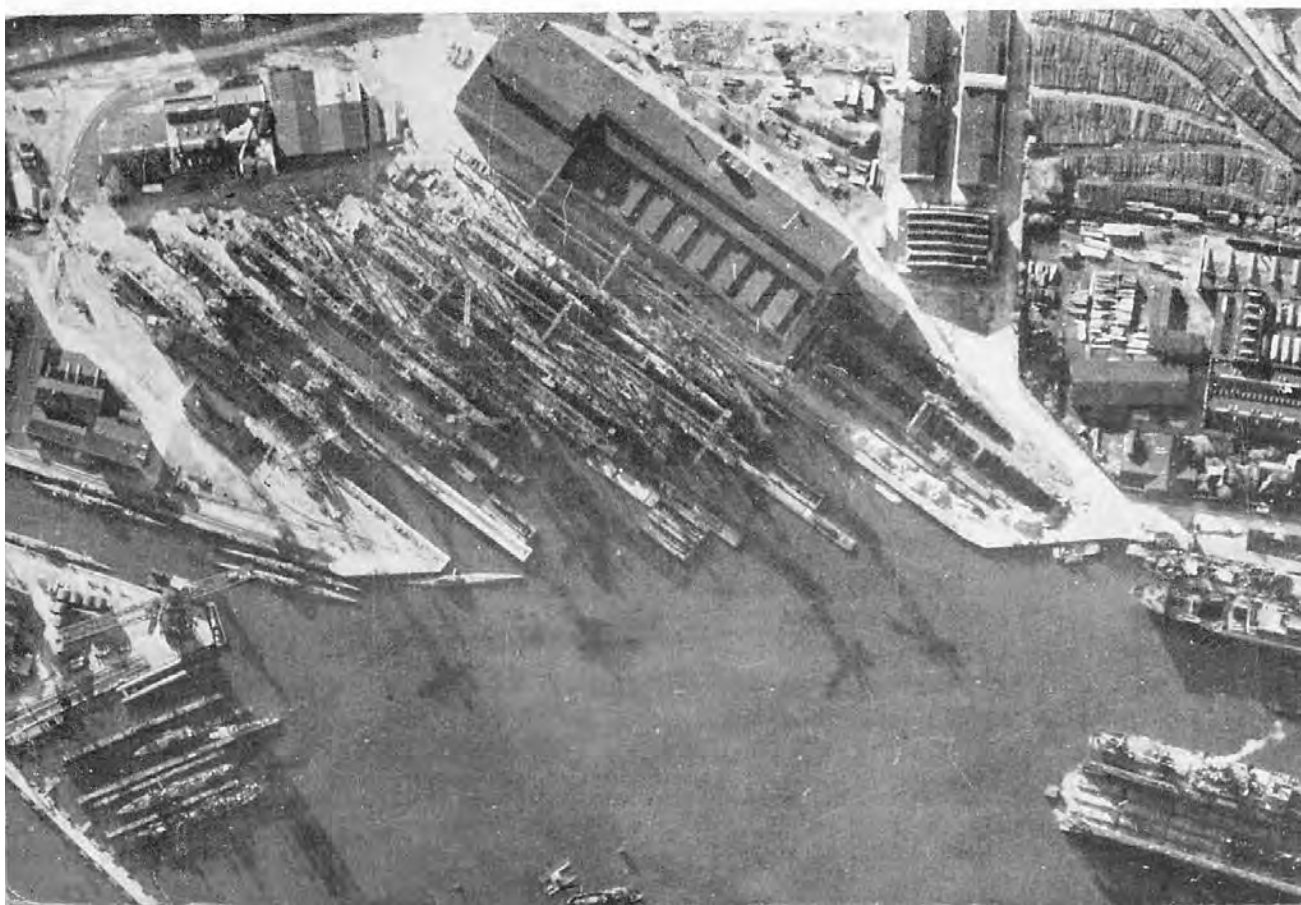
Performance of weapons during the year has been, on the whole, good; the number of operational failures has been kept to a satisfactory low figure. In regard to 20 mm. guns the year's aggregate shows a definite improvement in the stoppage rate, which declined from an average frequency of 1 in 600 rounds during 1943 to 1 in 1,500 during 1944. This achievement is a credit to all concerned with the maintenance and upkeep of this equipment which, owing to operational conditions requiring exceptionally long bursts of fire, may be expected to have a prevalence towards stoppages. On the other hand, the number of accidents caused by improper handling of guns and practice bombs has been a matter for concern, especially in the early months of the year. This led to a special "weapon mindedness" campaign designed to impress upon all concerned the absolute necessity for rigid adherence to the precautions and regulations which must be observed in dealing with explosives of all kinds. A reduction in the number of accidents in the latter months of the year suggests that this campaign is succeeding. With the continued and resolute support of all air and ground crews, it is hoped that all avoidable accidents will be eliminated in the coming year.



In previous numbers of the *Review*, reference has been made to the new type XXI U-Boats, which the enemy has been building for some time. These are assembled very quickly from prefabricated sections. Although the sections are made at a number of points there are only three assembly yards. The Blohm and Voss Yards at Hamburg, seen above, are one. A number of U-Boats can be clearly seen on the slips,



PLATE 10 The other two assembly points for type XXI prefabricated U-Boats are the Deschimag Yards at Bremen, seen above, and the Schichauwerft Yards at Danzig, seen below. In the lower picture a number of U-Boats can be seen fitting out. The unusually pointed bows and sterns are notable.



Navigation in 1944

In five years of war, Coastal Command has learned much about long-range over-sea navigation. At the beginning and before the war, for obvious reasons the study of long-range problems was in its infancy. These problems affected all commands as well as civil aviation. They were: the lack of the necessary Direct Aids such as Gee/Loran/ASV; the lack of Safety Aids—W/T Beacons, H/F D/F, Responder Beacons, Occults, Pundits, and so on; and lack of a co-ordinated safety organization. As a corollary to all these, and exaggerated by them, was the peace-time habit among the general public to be disturbed by loss of crews and aircraft in training. The problems of long-range navigation could not therefore be clearly examined, and few fully understood just how much could be expected of the long-range navigator. Certainly, by the majority it was expected that he would perform feats, which to-day would be regarded as little short of miracles, considering the equipment he then had.

The problem which faced Coastal Command was always that independent aircraft were operating "away from their Aids" and over featureless ocean. Bombers also flew "away from their Aids" but could sometimes expect pinpoints en route, or at the target, and, by the nature of their operations, abundant data was speedily provided by which the success, or otherwise, of the navigation could be judged. With this information it was immediately possible to improve facilities, develop new techniques, and to check results without loss of time at every stage. Coastal, unable to analyse satisfactorily, perforce continued as before. Meanwhile data was collected to prove the reliability of undisturbed D.R. Navigation over-sea, and so later it was possible to reap the benefits of the amazing advances in electrical science.

None the less, even with better Aids, experience has shown that, over featureless sea, without accurate and painstaking work by navigators, sorties may be navigated inaccurately and nobody be the wiser. This is because there is yet no continuous feed of position, such as map reading by eye, or H2S, to guide navigators between fixes and the navigator is therefore for a large part of his time still a slave to that hardest and most wearing of Masters, D.R. Navigation. D.R. Navigation is, to a great extent, the assessing of numerous variables beginning with the ever-changing wind, and allowing for small inaccuracies, and is dependent for its success on the constant co-operation of most of the crew. This co-operation is gladly given by crews, and indeed, except when actually attacking the enemy, the navigator is the peg on which hangs crew co-operation.

Perhaps the best demonstration of the reliance placed in the work of the Coastal navigator was in the introduction of co-ordinated patrols, such as were flown for the first time to cover the invasion of the Normandy coast. Here was taken the unprecedented course of ordering aircraft which never saw each other (except perhaps as

momentary blips on a screen) to fly in what amounts almost to formation. These operations were made possible by the invaluable GEE and ASV, but the navigator's problem was still great and was the hardest he has ever been called upon to face. He met it, and overcame it so successfully that the "Box" patrol has been added as a new weapon to the armoury. In passing, at the beginning of the year only two squadrons were equipped with Gee, but by the end of the year there is hardly a squadron that hasn't been given either Gee or its transatlantic cousin, Loran. This latter is an aid to navigation which has great possibilities.

So far there is little evidence to show that reliance is being placed on the main Aids to the exclusion of all else. The danger is only too real, but it is hoped that crews are too well trained to make this mistake, and realise, very clearly, that electricity can fail. The aim has been, during the past year, to make Radar into a very Jeeves among aids, the perfect servant who never forgets his place, "God Bless the Gee-Box and its Relation, and keep them in their proper station."

Navigation analysis has laid emphasis on the colossal amount of work that is involved in navigating a modern Coastal sortie, and proved beyond doubt that one man cannot maintain the necessary output of work throughout the whole of a V.L.R. sortie. Figures showed plainly that efficiency drops quite markedly after some ten hours. Accordingly, early in the year the experiment of carrying a second navigator in Liberators was tried, despite forecasts of the inevitable chaos that would arise. It was thought that the navigator was such an individualist that it would be unreasonable to expect him either to hand over his work to someone else in mid-sortie, or to expect him to take over from another navigator. So successful has the experiment proved, even before the introduction of Loran permitted a "hand-over" Fix, that a second navigator has been made a requirement for other long-range aircraft. Now all that is required is a navigational George to do the work. . . .

That it is possible and practicable for one man to take over from another is largely due to the Drill. This first came into being in 1943, but by the end of that year, on the most generous assessment, it was being followed only to the extent of some 70 per cent. By the end of November, 1944, on a far stiffer basis of assessment, the figure has reached 88 per cent; while, reassessing the month's work on the old basis, the figure is some 93 per cent. This speaks volumes for the work of the Training Group. In 1943, navigators arrived in squadrons with only the haziest idea of what they were expected to do; yet at the present time the "new" navigators, fresh from the O.T.U.s, have in many cases proved as efficient as some of the "old hands." The time is past when a three-hour triangular trip over land was considered an adequate training for over-sea night trips of 10 and 15 hours' duration. Today every operational flight exercise

is made to resemble, as closely as training time and conditions permit, the type of sortie the navigator is being trained to fly. In fact, many of them are actual operational sorties, and it is not long since an O.T.U. Sunderland sank a U-Boat. After every O.F.E. the navigator's log is subjected to the most rigid scrutiny, and assessed by a carefully designed marking scheme which ensures rigid adherence to the Drill.

After years of research further measures to reduce the inaccuracy of the basic data for D.R. Navigation have been put into service. The D.R. Compass, meeting many troubles a year ago, has now reached such a stage that failure is very rare. Credit here is due to those maintenance staffs who have, by their untiring diligence, made the most accurate compass into the most reliable in service today. In the strike squadrons, where there used to be a tendency to underrate the importance of navigation, ideas have changed too. The old direct reading types of compass were rendered very unreliable by the magnetic peculiarities caused by the firing of the cannons. Lease-lend came to our aid with the Magnesyn, still the lightest remote indicating compass in service, which, it is hoped, will eventually prove to be the answer.

The Air Position Indicator is proving an invaluable aid to accuracy, and its installation is rendered all the more essential because inaccuracy due to the turning circle of the modern aircraft, *vis-à-vis* the requirements of modern patrols, make old-fashioned plotting methods unreliable. The Liberator, making its usual George-controlled "rate $\frac{1}{2}$ " turn, is flying a circle whose diameter is little under 3 miles in still air, and when one is trying to fly accurately a "cross-leg" of a box-patrol only some 7 miles long, all these little things add up. With U.S.A. Drift Meters, D.R. Compasses and Gee or Loran, the properties of navigation error that lies in the chart work and in manual plotting methods is becoming larger and larger, and only a mechanical gadget like the A.P.I. can increase accuracy to the necessary degree.

A most important facility, the Wind Finding Attachment, is now coming into service. As this reduces the number of flame floats to be dropped it will be popular both with operations staffs and with crews. It will give the navigator better and more convenient wind-finding facilities than he has ever had before.

The quest of accuracy has been carried further in many small ways. So minor a matter as the

scale division of a computer may seem insignificant; yet as soon as the U.S.-type Dalton Computer became available about the middle of the year most navigators appreciated at once the possibilities of an air and ground-speed scale divided at every 2 knots instead of every 5. Hard-working Compass Adjusters were driven harder still to remove the last odd degree of deviation. Work on new compass bases has been pressed forward. New plotting charts have been produced by the Directorate of Military Survey in place of older and less accurate ones. Loops have been swung and swung again, and are being tested out against Gee to determine, more closely, their probable errors.

Perhaps the most significant thing of all is the breaking down of the old tradition that "My D.R. is always right." A year ago a fix that was some way from the navigator's D.R. was automatically, and for that reason alone, a "bad" fix; one that lay close to the magic square on the chart was a "good" fix; but the D.R. was always "right." Today the navigator realises very clearly that the D.R. position is merely an opinion about the aircraft's position, and that a Fix is a second opinion, arrived at by different means. Realization of error instead of merely shutting the eye to it is perhaps the most significant, if the least spectacular, advance that has been made in 1944. Despite what enthusiasts may say, aerial navigation is not yet an exact science, but every effort is being made to make it more exact.

For the future the prospect is bright. The creation of a Directorate of Navigation to recommend navigation policy, and direct the policies which are adopted, is a great advance.

Big things are expected of the Empire Air Navigation School at Shawbury, which has already done much to aid this Command, and which is planning to do even more. Work is still going forward both there and at C.C.D.U. which will tell us even more about the purely scientific aspect of the modern aids. More work, too, is being done to determine the operational accuracy that can be expected from D.R. Navigation and from the various Aids.

1944 has seen more fundamental progress in navigation than almost any other year, and it is hoped that 1945 will be as fruitful. The spirit which brought these advances is still alive and strong, and progress must continue.