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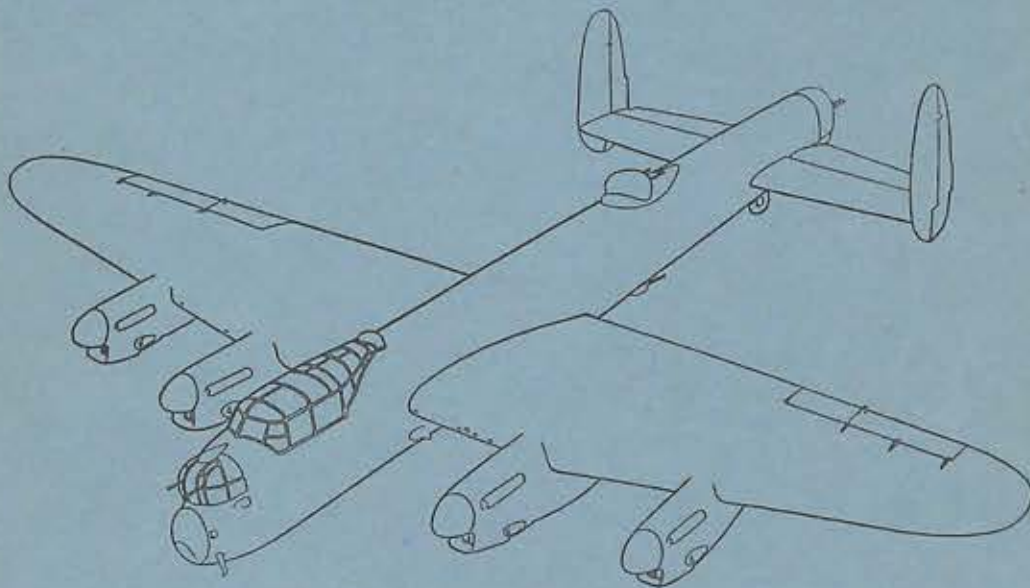
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BOMBER COMMAND QUARTERLY REVIEW

July—September, 1944

No. 10



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HEADQUARTERS
BOMBER COMMAND
ROYAL AIR FORCE

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FIG. 1.—COURTRAI Marshalling Yards (Belgium). Devastation here included the destruction of one of the vital turntables serving the Locomotive Depot.



FIG. 2.—SAUMUR Tunnel from within. The damage caused by a 12,000-lb. bomb, as seen after the Allies had cleared the fallen earth and masonry. A vertical photograph of this incident appeared as Fig. 12 in *B.C.Q.R.*, No. 9.



FIG. 3.—AULNOYE Marshalling Yard. A burnt-out train loaded with turrets for German fortifications remained at this railway centre when it was occupied by the Allies. Comparison with the vertical view published in *B.C.Q.R.*, No. 9 (Fig. 7) shows that much clearance had been carried out by the time the above photograph was taken.



FIG. 4.—HASSELT (Belgium). Thirty-six out of the 50 locomotives housed in the depot were rendered unserviceable as a result of B.C. and U.S.A.A.F. attacks.



FIG. 5.—AMIENS/LONGUEAU. A wrecked locomotive depot (formerly roofed) as it fell into Allied hands. Although much wreckage had been cleared before this photograph was taken, many locomotives remained in the ruins. A total of 110 locomotives was found to have been either destroyed or damaged in the course of Bomber Command raids on this important railway centre.



FIG. 6.—General view of MALINES Marshalling Yard, Belgium. Here wreckage of rolling stock was on a particularly heavy scale, and the important railway workshops (centre of photograph) were entirely ruined.

SEVEN GERMAN CITIES WRECKED WITHIN EIGHT DAYS



FIG. 7.—DARMSTADT burning after a night attack, 11/12.9.44.



FIG. 8.—MÜNCHEN/GLADBACK. Seven large factories heavily damaged, 19/20.9.44.



FIG. 9.—KIEL. The central town area after the night raid of 15/16.9.44.

"The enemy has stepped up his 'terror' attacks against the Reich in a degree never witnessed before . . . OUR WORST HEADACHE IS THE AIR WAR. The test to which the enemy is putting our people, particularly in the West, is severe and grievous."—Goebbels, 1944.

The photographs on this page show seven German industrial cities attacked by Bomber Command within a single eight-day period—11th–19th September, 1944. Within the same period additional attacks were made in support of the Armies, and against oil plants, airfields, etc.



FIG. 10.—BREMERHAFEN. Above: The close of the attack in which 809 tons of incendiaries were dropped, showing the whole town and dock area ablaze (18/19.9.44). The outline of the docks has been sketched in. The area enclosed by a broken line is shown on a larger scale (below) in a photograph taken the following day. Almost the whole of the buildings in the city centre were seriously damaged. Some 38,000 people are believed to have been rendered homeless in this one attack, and about 30,000 more had their houses damaged.



FIG. 9A.—KIEL. Low-level oblique view of same area before bombing.

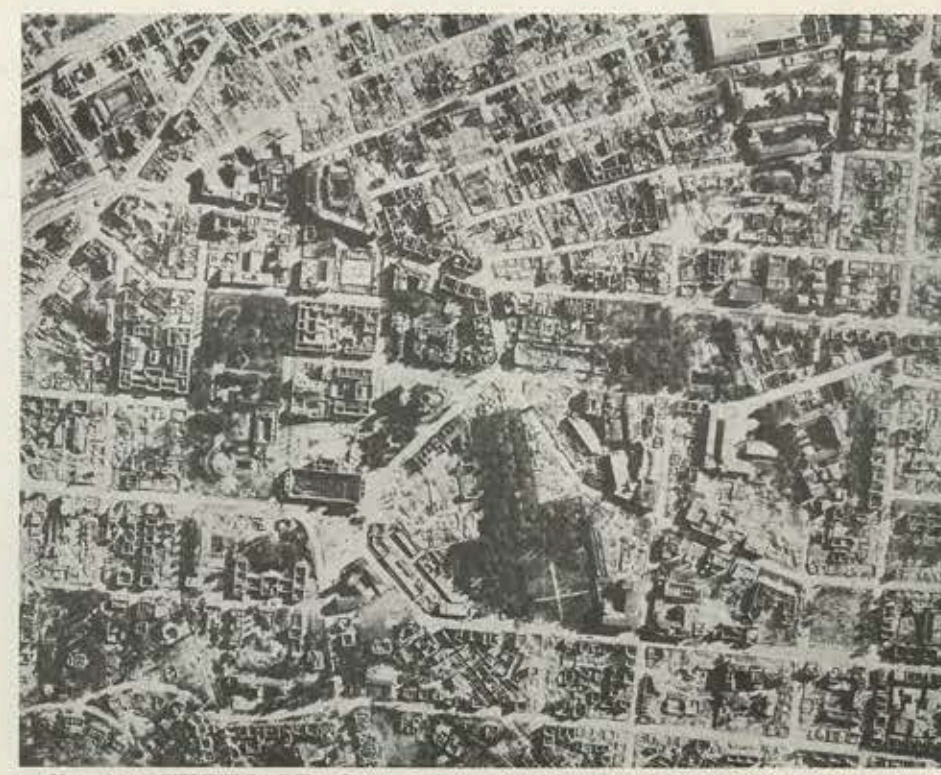


FIG. 11.—STUTT GART. Devastation caused by the night attack on 12/13.9.44.



FIG. 12.—OSNABRÜCK. The daylight attack on 13.9.44 caused much fresh damage.



FIG. 13.—MÜNSTER burning after the daylight attack on 12.9.44.

BOMBER COMMAND QUARTERLY REVIEW

No. 10

I. REVIEW OF OPERATIONS

July—September, 1944

Introduction

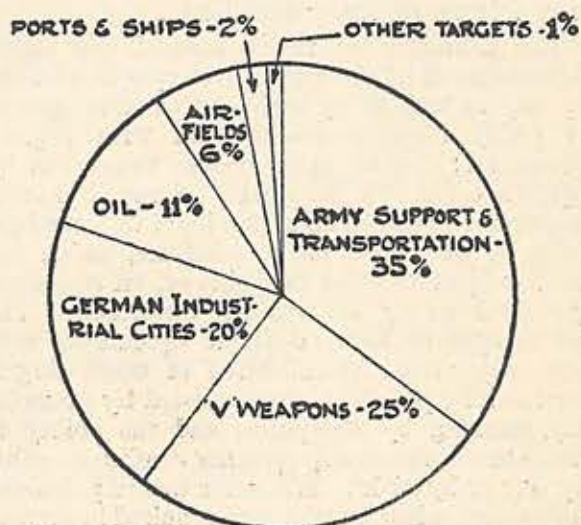
During the April-June quarter the greater part of the Command's effort had been diverted from the strategic bombing of German industrial cities to the paralysing of the railway system serving the invasion area. During the quarter under review, although the total tonnage dropped was nearly 40 per cent. greater than for the preceding quarter, continuous demands for attacks in support of the armies in the field and on targets associated with "V" weapons together absorbed more than 60 per cent. of the total effort. Of the remaining effort one half, or 20 per cent. of the whole, was employed against a variety of targets for the most part directly or indirectly concerned with the battle on land and in particular against synthetic oil plants and oil storage depots. Thus only 20 per cent. of the total was able to be directed against the main sources of the enemy's war production—the German industrial cities.

The weight of bombs dropped during the three months far surpassed anything previously achieved, being nearly three and a half times the total for the corresponding period of 1943 and nearly 20,000 tons more than the total for the whole of the year 1943. An appreciation of the real meaning of these figures can probably best be obtained by the fact that the quarter's effort represented a weight some two and a half times the total weight of everything dropped on this country over five years by the enemy, using bombers, flying bombs and rockets.

The actual figures of sorties and tons are set out below together with a table giving the distribution between the various classes of targets, and a diagram showing the relative distributions expressed as percentages of the whole.

		All Sorties.	Bombing Sorties.	Tons.
July/ September Quarter	1943	19,748	17,902	51,551
	1944	57,011	47,959	176,057
Year 1943	66,295	47,880	157,457

DISTRIBUTION OF EFFORT.
for **JULY, AUGUST, SEPTEMBER,**
1944.



Distribution of Tonnage, July-September, 1944

	Tons
(i) Targets attacked in support of the armies and transportation ..	60,432
(ii) Targets associated with "V" weapons	44,335
(iii) German industrial cities	37,262
(iv) Oil plants, refineries and dumps ..	18,941
(v) Airfields	10,243
(vi) Port areas, U-Boat and E-Boat pens, shipping and blockships ..	3,907
(vii) Other targets	937
Total	176,057
Total on Germany	48,687
Total on enemy-occupied territory	127,370

Altogether well over 250 separate attacks by heavy bombers against targets other than German industrial cities were carried out during the 92 days. It is not practical therefore to give a detailed description of each attack made and it becomes necessary in reviewing the results achieved to give a broad outline of the general war situation as it affected the tasks of Bomber

Command and, no less important, the effect that the successful completion of those tasks had upon the general war situation.

When the period opened the allied armies were hemmed in a small area of Normandy with a maximum penetration of about 20 miles.

The contribution that Bomber Command made to the general Allied thrust, which during the period sent the main body of the enemy back from the coast of Normandy to his own frontiers, was outstanding not only for its weight and accuracy but also for its wide diversity, for the number of different types of targets attacked, and for the vastness of the area over which it operated. The tasks were diverse, and the targets were to be found as far apart as Le Havre and Koenigsberg, or Bordeaux and the Arctic Circle. The immense weight that the Command could put down in a compact area, and the deadly accuracy of individual precision bombing, were turned aside from their strategical purpose to achieve tactical victories. Time and again the Command was held ready to strike in whatever direction or in whatever manner the naval or military emergency of the moment might demand, with the result that because a large force was standing by awaiting an opportunity to deliver some critical blow, opportunities to attack German strategic targets were forgone on many occasions.

The flexibility of the Command was again demonstrated by the decision to operate in force by day as well as by night. This development of policy required co-operation with Fighter Command; for daylight attacks uncovered by fighters could not be made. Some limitation was therefore placed upon the size of the attacking force by the fighter escort available, which was itself subject to other demands or, on occasions, grounded owing to weather conditions. The advantages of these daylight operations were primarily visual identification of small targets for marking purposes, often assisted by preliminary marking by Mosquitos, and the ability to make use of favourable weather conditions either by day or by night. The latter was of particular importance when attacks were required in support of the army.

These demands for the delivery of the heaviest concentrated blow that the Allies had available in the shape of a full-scale attack by heavy bombers, were given precedence over the necessity for bombing the main source of enemy supplies, the German industrial cities. In fact, no German city was attacked for a period of two months prior to 23/24 July. Nevertheless, although the start was late, 18 towns shared between them 33,790 tons.

In Bremen, Stuttgart, Kiel, Koenigsberg, Darmstadt and other German towns, the standard of existence was reduced to a new low level far below the social and economic threshold at which well-organised efficient war work is possible. A series of photographs illustrating the effects of one week's bombing of German industrial towns is reproduced, facing page 1.

(a) In Support of the Armies

When the quarter began, the front line of battle for the enemy was still in Normandy. Already Cherbourg, the first of the deep-sea ports to be recaptured, was lost to him and, except for the Cap de la Hague area, where a few isolated

elements survived, the whole of the Cherbourg peninsula was occupied by American Forces. Moreover, with Carentan and Bayeux fallen, the gateway to the Low Countries was almost forced. Even if the hinge at Caen still held it was creaking badly under the pressure of the 1st Canadian and 2nd British Armies.

To force the gateway, the Allied Armies had first to destroy the remaining enemy resistance at Caen, which was yet sufficiently strong to resist our powerful armoured ground forces. For this purpose Bomber Command was called upon and what had happened at Villers Bocage was to happen again at Caen.

At Villers Bocage it will be remembered that, as recorded in *Bomber Command Review* No. 9, a projected enemy attack was frustrated by the timely concentration of a thousand tons of H.E. on the general supply and assembly point for two S.S. Panzer Divisions. It was the first occasion when heavy bombers had been so employed, causing havoc in the enemy's lines and reducing his organisation to chaos. The heavy bomber, designed and equipped for its primary work of strategic bombing, served also as a tactical weapon on occasions when the enemy dispositions could not be overcome by ground forces without risk of heavy casualties.

On 7 July, therefore, the heavy bombers were used to open the way for the Army at Caen. 457 heavy bombers dropped 2,350 tons of H.E. in the space of 38 minutes; and so intense was the concentration on strong-points and centres of resistance that the enemy was unable to recover from its shattering effect. Dazed and bewildered, suffering still from the effects of concussion long after the attack, his troops were able to offer but scant resistance when, on the following morning, our armour broke through east of Caen; and in less than an hour our troops were almost at Cagny.

To appreciate the value of air bombardment it is helpful to think of its equivalent in terms of massed artillery, and to make comparison between the ease with which the air forces can assemble their might at a focal point and the great difficulty attendant upon the concentration of artillery, which by its nature must move through or with other traffic along congested roads or, with hardly less difficulty, over sodden fields. Once assembled, a concentration of artillery cannot, as an air force can, remuster on the same day hundreds of miles away to throw its full weight on another target, nor can it achieve surprise. In Normandy the enemy, almost without air support, was put even more seriously at a disadvantage by the wholesale destruction of railway facilities, road bridges and traffic choke-points on through-routes.

In the Caen attack the number of enemy troops killed was not great; for protection against splinters or blast can usually be provided by slit trenches or fox holes. What was of far greater importance was the effect on morale. All reports from prisoners tended to show that, after these heavy attacks, there was almost unbelievable confusion in the enemy's lines and complete loss of offensive power and will. After one heavy attack it was said that a division was without food or supplies for a whole day. It can hardly be doubted therefore that if military considerations had allowed an attack by troops to follow

immediately upon aerial bombardment, the enemy would have been found in a state of chaos. As it was, even with the attacks following after a short interval, the opposition was found to be so broken and confused that the objectives were taken with the minimum loss of life to the attackers.

Another assault of this kind was made a month later on 7/8 August in the area of Bretteville, when the enemy, by means of strongpoints on either side of it, was threatening the route which advancing Allied armoured columns were to take. In view of the seriousness of this threat, it was decided to saturate these various areas with bombs, and in all five aiming points were selected, each the centre of a circle of 700 yards radius. Of these, two were to the westward and three were to the eastward of the route, which at the narrowest was 5,000 yards wide. Allied leading troops having been withdrawn prior to the attack along a start line some 2,000 yards from the aiming point, the attack was timed to be made successively, creeping forward in the line of advance. As troops would be advancing into the areas of targets already attacked at the same time that other target areas were still under bombardment, a high standard of timing and bombing accuracy was imperative. This was achieved, and to such good purpose that the troops were able to pass through the gap almost without loss.

In all there were six occasions during the quarter when this type of attack was called for, a total of 4,076 sorties being flown, and little short of 16,000 tons dropped on troop concentrations for the loss of 24 missing aircraft. Statistical details of these attacks are given in Table IA.

The Channel Ports and Strongholds

Linked with these attacks, since they too were made at the request of the Army, are the sieges of

Boulogne, Calais and Le Havre, the strong points in the defences of which it fell to the heavy bomber to destroy.

As the enemy retreated, taking with him what he could of valuable stores and equipment, a widespread Allied mopping-up process eliminated the small pockets of resistance that he had left. The strongest pockets were naturally the ports, not only because on one side there was the sea providing natural defence, but also because their strategic importance had led to their being heavily fortified and strongly garrisoned with determined troops.

However effectively our artificial docks and harbours functioned, their capacity was insufficient, nor could they be relied on to withstand really bad weather. With the channel ports in our possession we should be able to reduce the strain on them; and the danger of weather interrupting our supplies would be averted. The importance to the enemy of denying us these ports was so great that he was prepared to sacrifice their garrisons to the last man.

On Boulogne in one raid on the strongpoints 762 aircraft dropped 3,347 tons of H.E. This was on 17 September and within the week the town surrendered with 8,000 prisoners. The garrison of Calais did not surrender until six heavy assaults had been made in which 8,000 tons of bombs were dropped by 1,637 aircraft. The most spectacular victory of all, however, was the reduction of Le Havre. In all, seven attacks were made within a week, one attack alone providing nearly half the aggregate tonnage of 9,790. The town was finally occupied by the Army with a loss of 50 soldiers. The gain in terms of personnel was the capture of the garrison of over 11,000 men; for after such an onslaught organised resistance was impossible.

TABLE IA
TROOP CONCENTRATIONS IN BATTLE AREAS

Date.	Target.	Aircraft.		Bomb Tonnage.		Total.	Aircraft Missing.
		Despatched.	Attacked.	H.E.	Incendiaries.		
July 7 ..	CAEN	467	457	2,350	13	2,363	2
July 18 ..	COLOMBELLES, MONDEVILLE, SANNERVILLE, CAGNY, MANNEVILLE.	1,056	1,032	4,980	27	5,007	6
July 30 ..	VILLERS BOCACHE, CAUMONT, JURQUES AREA.	692	379	1,361	19	1,380	4
Aug. 7/8 ..	FONTENAY, LEMARNION, LA HUGUE, HAY SUR ORNE, MARE DE MAGNE, SECQUEVILLE/LA COM-PAGNE.	1,018	651	3,434	27	3,461	10
Aug. 12/13	FALAISE	144	138	656	5	661	—
Aug. 14 ..	QUESNAY, SAUMONT ST. QUENTIN, BOIS TAS-SILLY, AISY AND POT-IGNY AREA, FONTAINE LEPIN.	699	672	3,031	41	3,072	2
	TOTALS	4,076	3,329	15,812	132	15,944	24

TABLE 1b
ATTACKS ON COASTAL STRONGHOLDS IN CO-OPERATION WITH ARMIES AND THE NAVY

Target.	Date.	Aircraft.		Bomb Tonnage.		Total.	Aircraft Missing.
		Despatched.	Attacked.	H.E.	Incendiaries.		
<i>LE HAVRE (i) In support of Armies :—</i>							
Troop concentration ..	Sep. 5 ..	348	335	1,820.7	60.2	1,880.9	—
Strongpoints ..	Sep. 6 ..	344	271	1,479.3	25.0	1,504.3	—
Guns and strongpoints ..	Sep. 8 ..	333	109	520.2	15.1	535.3	2
Guns and strongpoints ..	Sep. 9 ..	272	16	—	7.1	7.1	—
Guns and strongpoints ..	Sep. 10 ..	932	901	4,671.0	48.2	4,719.2	—
Coastal battery ..	Sep. 10 ..	61	60	259.4	6.7	266.1	—
Strongpoints ..	Sep. 11 ..	218	171	864.4	12.7	877.1	—
		2,508	1,863	9,615.0	175.0	9,790.0	2
<i>(ii) Naval Warfare.</i>							
Port Area ..	Jul. 31 ..	57	57	295.1	3.1	298.2	1
Port Area ..	Aug. 2 ..	59	55	310.2	2.7	312.9	—
		116	112	605.3	5.8	611.1	1
<i>BREST (i) In support of Armies :—</i>							
Gun positions ..	Aug. 25/26	334	283	1,183.2	19.1	1,202.3	1
Gun emplacements ..	Aug. 5 ..	66	63	382.7	1.3	384.0	—
		400	346	1,565.9	20.4	1,586.3	1
<i>(ii) Naval Warfare.</i>							
Blockships ..	Aug. 14 ..	156	147	803.3	—	803.3	2
Docks and shipping ..	Aug. 17 ..	79	54	238.8	—	238.8	—
Shipping ..	Aug. 24 ..	53	49	235.7	—	235.7	—
Shipping ..	Aug. 27 ..	24	24	129.0	—	129.0	—
Shipping ..	Aug. 28 ..	23	23	88.9	—	88.9	—
Ships in dry docks ..	Sep. 2 ..	68	64	364.7	—	364.7	—
		403	361	1,860.4	Nil	1,860.4	2
<i>ILE DE CEZEMBRE</i>							
Coastal batteries ..	Aug. 28 ..	30	29	115.2	4.0	119.2	—
Coastal batteries ..	Aug. 31 ..	170	169	800.2	1.8	802.0	1
		200	198	915.4	5.8	921.2	1
<i>BOULOGNE. In support of Armies :—</i>							
Defended areas ..	Sep. 17 ..	762	688	3,347.3	44.0	3,391.3	2
<i>CALAIS. In support of Armies :—</i>							
Defended areas ..	Sep. 20 ..	646	333	3,321.6	50.5	3,372.1	1
Defended areas ..	Sep. 24 ..	188	127	553.1	17.2	570.3	7
Defended areas ..	Sep. 25 ..	872	303	1,289.1	32.4	1,321.5	—
Defended areas ..	Sep. 26 ..	191	183	824.6	14.9	839.5	—
Defended areas ..	Sep. 27 ..	341	323	1,686.0	32.4	1,718.4	1
Defended areas ..	Sep. 28 ..	193	68	250.0	10.7	260.7	1
		2,431	1,637	7,924.4	158.1	8,082.5	10
<i>CAP GRIS NEZ. In support of Armies :—</i>							
Guns and defended areas ..	Sep. 26 ..	531	516	2,808.4	36.8	2,845.2	—
Guns and defended areas ..	Sep. 28 ..	301	198	837.2	13.3	855.5	1
		832	714	3,645.6	55.1	3,700.7	1

TABLE 1c
HOLLAND—IN SUPPORT OF MILITARY OPERATIONS

	Date.	Aircraft.		Bomb Tonnage.		Total.	Aircraft Missing.
		Despatched.	Attacked.	H.E.	Incendiaries.		
Flak Position							
MOERDYCK ..	Sep. 16/17 ..	59	57	294.0	1.3	295.3	2
Gun Emplacements							
WESTKAPELLE ..	Sep. 17 ..	35	34	182.2	4.2	186.4	—
BIGGEKERKE ..	Sep. 17 ..	33	32	169.2	4.2	173.4	—
FLUSHING ..	Sep. 17 ..	32	30	168.3	4.0	172.3	—
DOMBERG (i) ..	Sep. 18 ..	74	8	Nil	1.8	1.8	—
DOMBERG (ii) ..	Sep. 19 ..	55	—	Nil	—	—	—
DOMBERG (iii) ..	Sep. 23 ..	50	49	174.4	10.2	184.6	—
Totals ..		338	210	988.1	25.7	1,013.8	2

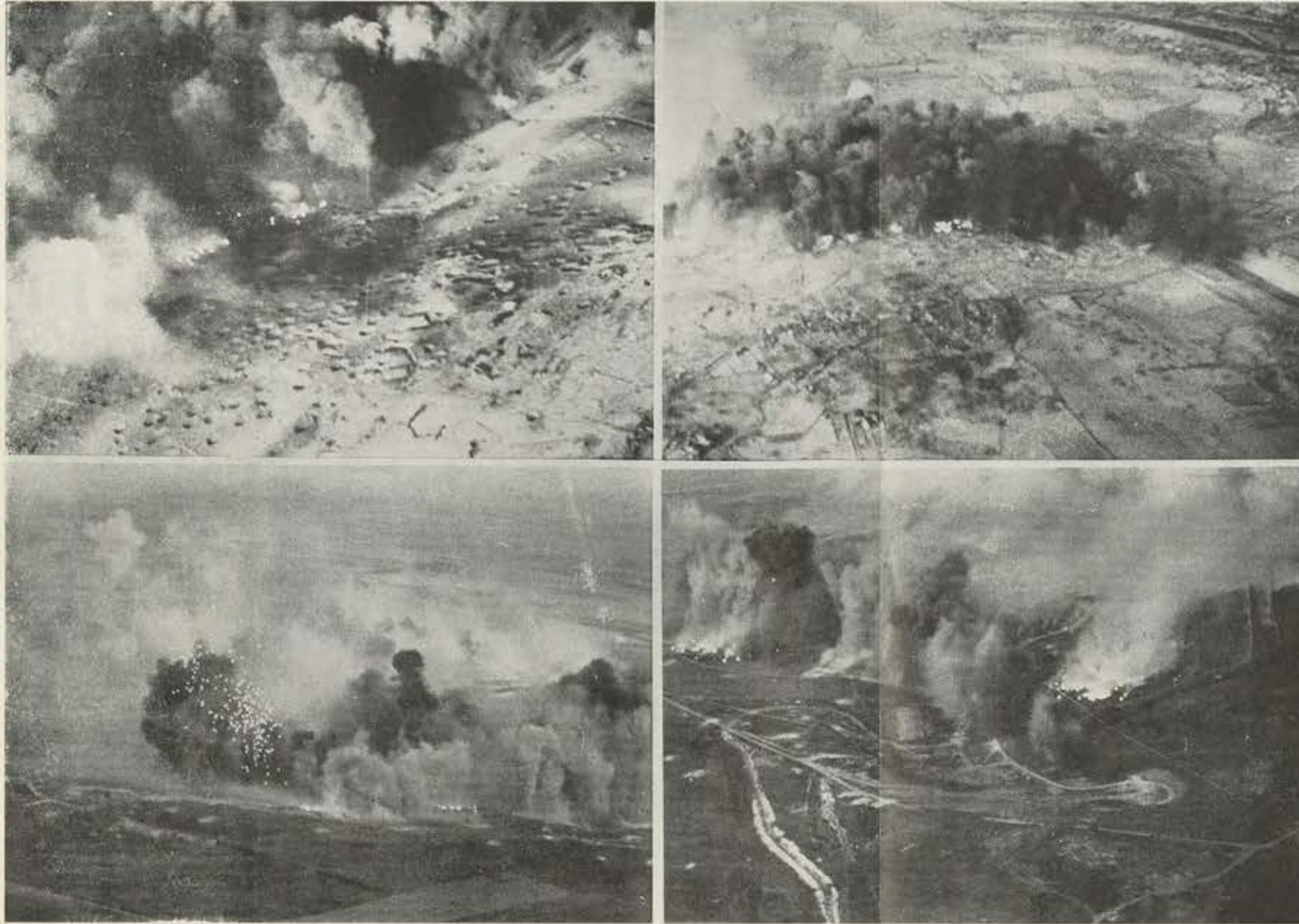


FIG. 14.—REDUCTION OF GERMAN STRONGPOINTS COVERING BOULOGNE (*above*) AND CALAIS (*below*). Stills from cine-films taken during the daylight attack by 762 heavies on strongpoints east of BOULOGNE (17.9.44), and the first of six bombing assaults by daylight on the CALAIS garrison (20.9.44). Target markers can be seen both "cascading" and burning on the ground. The concentration of bomb-bursts is particularly impressive in view of the Boulogne attack (top right).

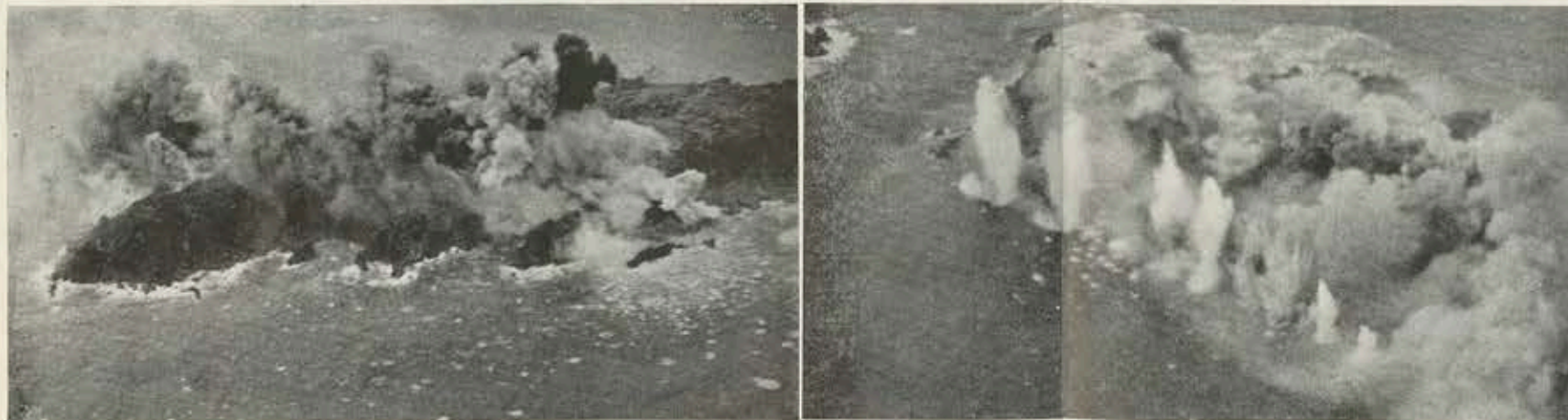


FIG. 15.—ILE DE CEZEMBRE. This fortified island, forming part of the defences of ST. MALO, was reduced as a result of two attacks by Bomber Command heavies. These oblique photographs show an early and a late stage of the second attack, which took place on 31.8.44. The following day the garrison surrendered.



FIG. 16.—GROUND PHOTOGRAPH OF GERMAN ARMoured VEHICLES knocked out in a Bomber Command attack on a concentration of enemy armour near CAGNY, 18.7.44. Wreckage of three A.F.V.s may be detected in this photograph.

The small selection of photographs here reproduced conveys some impression of the part played by Bomber Command in the destruction of the German Army in Northern France. On six occasions, in July and August, our heavy bombers joined in the Normandy battle, more than 4,000 sorties being despatched against enemy troop concentrations. The reduction of enemy garrisons at HAVRE, BOULOGNE and CALAIS was directly attributable to Bomber Command attacks involving some 5,700 sorties. Other attacks were made at BREST, ST. MALO, and CAP GRIS NEZ. (See pages 2-5.)

GERMAN FUEL STORAGE DEPOTS IN FRANCE

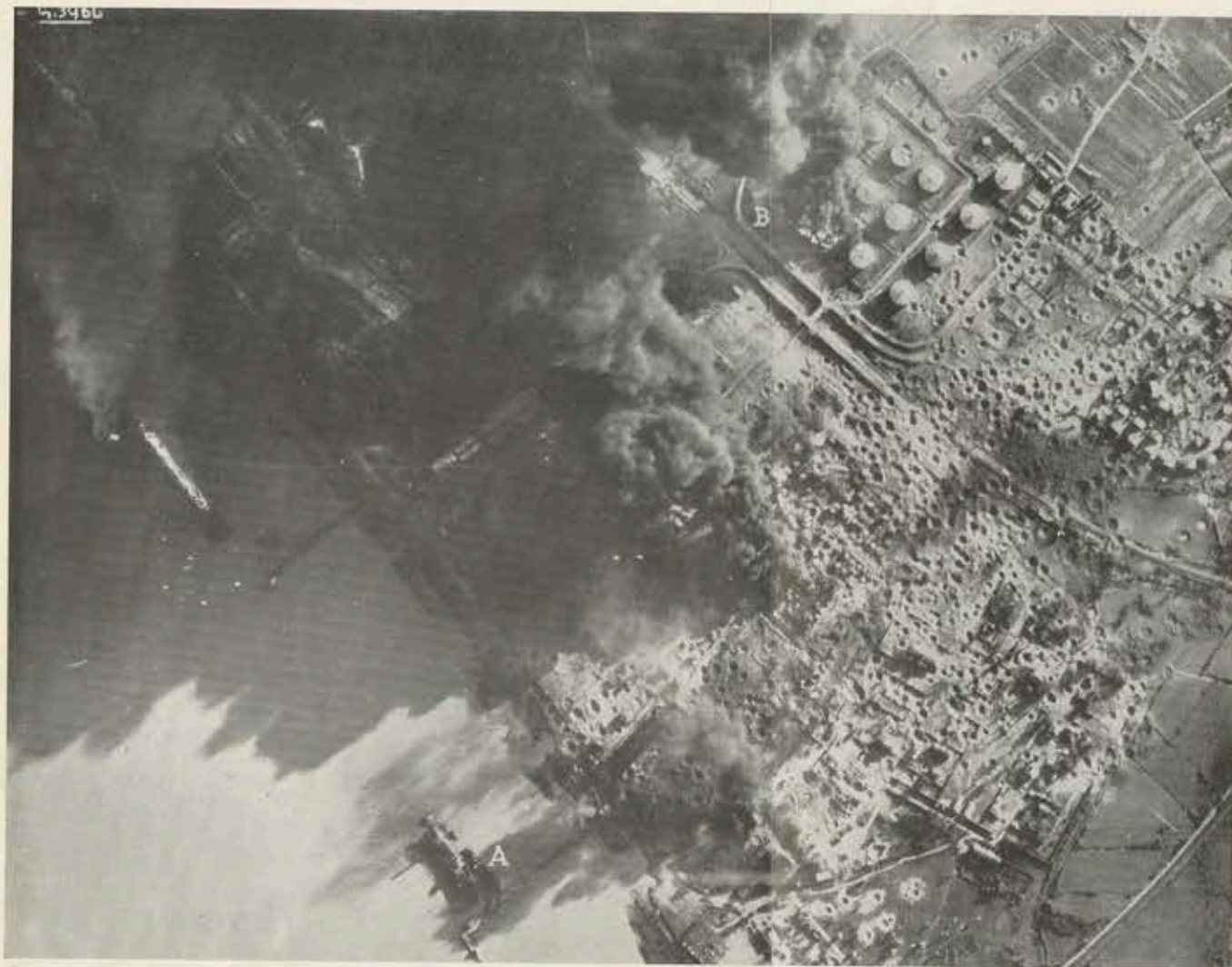


FIG. 17.—OIL STORAGE DEPOT AND REFINERY AT PAUILLAC, NEAR BORDEAUX. This photograph, taken soon after the attack on 4.8.44, shows tremendous damage throughout the area of the refinery, and large oil fires burning. A wharf, and a ship alongside it, were also ablaze. Compare with low-level oblique photograph below, in which points A and B correspond with those so marked above.

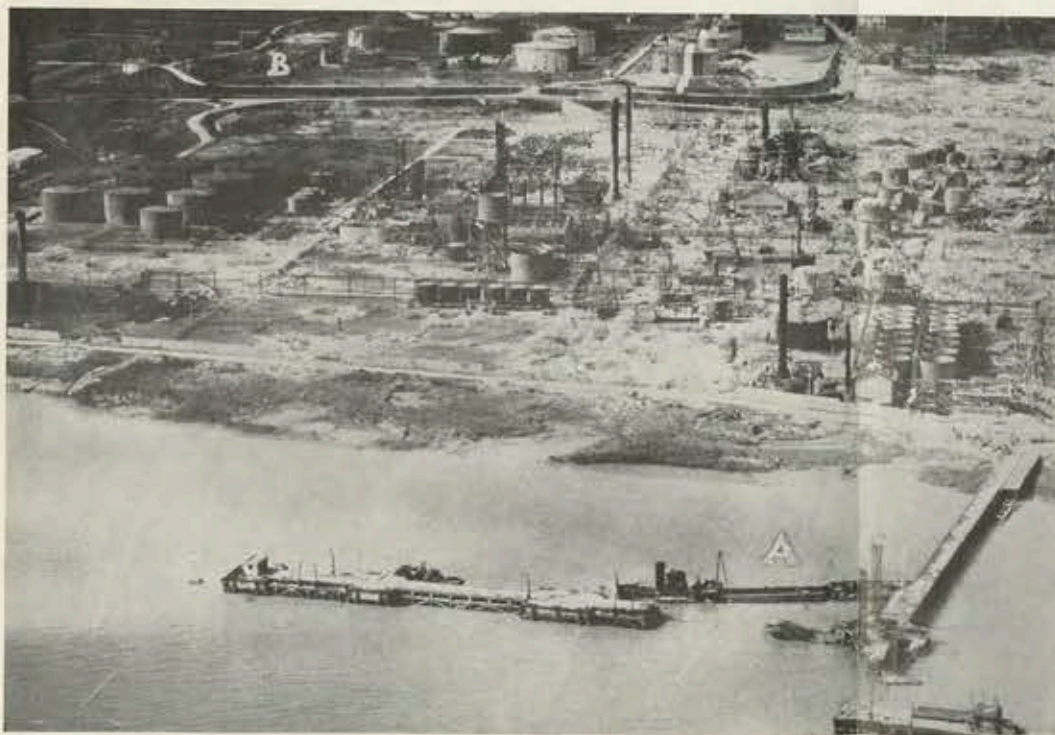


FIG. 18.—PAUILLAC OIL STORAGE DEPOT AND REFINERY. A low-level oblique photograph of part of the area shown in Fig. 17, above.



FIG. 19.—OIL STORAGE DEPOT AND REFINERY AT BEC D'AMBES, GIRONDE ESTUARY. This target was attacked on the same day as the Pauillac storage depot (Fig. 17), and with equal effect. Large oil fires were still burning when the above photograph was taken. Compare Fig. 20, below.



FIG. 20.—BEC D'AMBES STORAGE DEPOT. A low-level oblique photograph of part of the area shown in Fig. 19 above. An arrow marking a less-seriously damaged storage tank corresponds with a point similarly marked in Fig. 19.

The bitter defence of Brest was continued until 19 September, after heavy attacks on the gun positions, on defended areas and on the U-Boat pens. This old Bomber Command target, so heavily attacked in the days when it sheltered the *Scharnhorst* and *Gneisenau*, came in for heavy pounding again from our own and U.S.A.A.F. heavies, although the tonnage dropped on it in this quarter was less than on the other ports. While some of these attacks were made in support of the American Army that captured it, the action against it was co-ordinated with the naval plan of the period which was concerned largely with preventing the escape of the enemy vessels, both surface and underwater, and with the sinking of any vessels which the enemy might use as blockships. (See Table 1B.)

Swiftly the coast was being cleared, and with the silencing of the defended areas and gun positions at Cap Gris Nez at the end of September the Straits of Dover were opened, and Dover and other towns were relieved from the sporadic shellfire which they had endured for four years.

By this time Antwerp was in Allied hands, but the enemy still held Flushing and the Dutch Islands at the mouth of the Scheldt, with their strong defences including coastal guns. The capture of these islands from the sea was judged to be impracticable unless the guns had first been silenced. Flushing, Westkapelle, Domberg and Biggekerke were all areas where batteries were sited, and these and other positions were allocated to Bomber Command.

Weather conditions were difficult, the targets were small and, as direct hits were required, they could be attacked profitably only when visual bombing was possible. It was a question, therefore, of taking advantage of suitable

opportunities; when these presented themselves, successful attacks were made with excellent results. (See Table 1c.)

(b) Naval Warfare

Prior to the heavy assaults on Le Havre, the port had been attacked during the earlier part of the quarter in support of the Navy. Our armies then being held in Normandy, the enemy was able to use the more suitable ports in his possession to harbour U-Boats and small surface craft to harry our convoys and interfere with our vital task of unloading supplies.

At the end of August, the E- and R-Boats were using Ijmuiden for refuge, where they had the advantage of serviceable pens. These were massively constructed and resistant to almost anything but the 12,000-lb. penetration bombs that were dropped on them in two small but effective attacks. Two of these bombs scored direct hits, one making a hole 15 ft. across in the roof centre, the other blowing out a large part of the back of the pen, leaving a gap measuring 94 ft. by 30 ft. By such means the Channel and Biscay ports were made untenable, causing the enemy to withdraw his U-Boats. At Brest, La Pallice, Lorient and Bordeaux there was frantic naval activity designed to deny us the ports, or, if we should capture them, to make them useless to us by means of demolitions and blockships. At the same time the remaining U-Boats were prepared for sea. At least eight direct hits were scored in our attacks on the submarine shelters at Brest and six at La Pallice. Some idea of the damage caused is given by Figs. 34 to 37 studied in conjunction with the notes regarding the construction of the pens on page 20. The statistics are given in Table II.

TABLE II
NAVAL WARFARE
(See also Table 1B (ii))

Target.	Date.	Aircraft.		12,000-lb. Bombs.	Bomb Tonnage		Total.	Aircraft Missing.
		Despatched.	Attacked.		H.E.	Incendiaries.		
Bordeaux (U/B) ..	Aug. 11	41	36	—	176·8	·4	177·2	—
Bordeaux (U/B) ..	12	34	32	—	163·4	1·8	165·2	—
		75	68	—	340·2	2·2	342·4	—
Brest (U/B) ..	5	17	16	14	75·0	—	75·0	1
Brest (U/B) ..	12	11	9	8	42·9	—	42·9	—
Brest (U/B) ..	13	28	28	5	148·2	—	148·2	1
		56	53	27	266·1	—	266·1	2
Ijmuiden (E/R Boats)	24	23	23	8	118·8	—	118·8	—
La Pallice (U/B) ..	9	30	30	12	146·9	—	146·9	—
La Pallice (U/B) ..	11	14	13	—	68·8	—	68·8	—
La Pallice (U/B) ..	12	24	23	—	116·1	·9	117·0	—
La Pallice (U/B) ..	16	26	3	—	16·1	—	16·1	—
La Pallice (U/B) ..	18	23	22	6	117·9	—	117·9	—
		117	91	18	465·8	·9	466·7	—
Lorient (Keroman U/B)	6	30	28	11	145·5	·2	145·7	—
	TOTALS	301	263	64	1,336·4	3·3	1,339·7	—
Battleship <i>Tirpitz</i> (Kaa Fjord).	Sep. 15	27	21	15	93·2	—	93·2	—

To these harassing attacks must be added the sea-mining (dealt with more fully below) which largely during this period was planned to trap U-Boats that were being moved from the northern Biscay ports to the comparative safety of those farther south. As a consequence of this and of Naval and Coastal Command activity, the U-Boat traffic was frequently interrupted and some journeys of individual U-Boats terminated abruptly. By the end of August only La Pallice of all the Biscay ports remained effective, and with the Allied occupation of the Channel and Biscay ports in September, even that last refuge was denied to the fugitive U-Boats.

It may have seemed to the enemy that the continuous and urgent demands made upon the heavy bombers on the Western Front were sufficient to absorb their full effort in that theatre of war, allowing only occasional breaks which would be devoted to the devastation of his important industrial cities. That there would be opportunity to attack the *Tirpitz* in her far northern hide-out, Kaa Fjord, must have seemed to him unlikely, even if it were not impossible owing to the vast distance alone. Surprise, however, is a precondition of success in attacks of this kind. It was largely to accentuate this factor that when the operation was decided upon it was planned to be launched from a Russian base, where advantage could be taken of a more accurate knowledge of the weather and of the easterly approach, to catch the quarry before it became covered by a protective smoke screen. In fact, on the morning of the attack, 15 September, the smoke screen started to operate eight to ten minutes before the first bombs fell, and became effective quickly. To this concealment the battleship probably owed her escape from complete destruction. She was, however, hit by at least one bomb and seriously damaged. Another aspect of this enterprising attack, the adventures and experiences in Russia of a member of the ground staff accompanying the Lancasters, is dealt with in an article on page 17. (See also Table II.)

(c) Transportation

The general plan of campaign against marshalling yards that preceded the invasion having been described at some length in the previous issue of the *Review*, No. 9, together with results achieved, the general effect of these similar attacks will be appreciated. There was no diminution of quality in the 29 attacks made against 19 railway centres in Occupied Territory in July and August with 13,706 tons of bombs. In September the retreat of the enemy from the area saw the end of these successful attacks, which absorbed 11 per cent. of the total effort by Bomber Command for the two months and certainly contributed materially to the enemy's defeat. The statistics are given in Table III.

While his road transport was harried unceasingly by the Tactical Air Forces so that the roads were blocked with wreckage, and communications

disorganised, the railways, by which fresh divisions should have been moved to the weakening front, were largely out of action. Hopelessly delayed in consequence, divisions either did not arrive at all or arrived too late. The Germany Army, once so fully mechanised, was reduced to travelling on bicycle, on foot, or to commandeering whatever horse transport was serviceable.

One of the most important means of transportation available to the enemy both for moving supplies north and south and between Western and Central Germany was the Dortmund-Ems Canal. Its importance became enhanced when the enemy was denied the use of the Lower Rhine by the capture of Nijmegen. How important it was even before the war can be judged by the volume of its traffic, which in 1937 amounted to 11,000,000 tons.

On the night of 23/24 September, 99 aircraft made a highly successful attack on the Canal at Ladbergen. As this is a bottleneck through which all traffic between the Ruhr and Central and Eastern Germany must pass, the density of traffic is particularly heavy. Estimate based on regular reconnaissances during 1943 assess it as three times the 1937 figure.

Photographs taken after the bombing show that the canal was breached and rendered unserviceable. The whole 18 miles that stretch from the new aqueduct east of Munster to the junction with the Ems-Weser Canal, east of Rheine, was virtually empty, with some 110 barges stranded. Water-borne supplies of coal, coke, iron ore, oil, heavy goods and crops were all disorganised, and to convey them an extra burden was thrown on to the railways.

(d) Airfields

That the Luftwaffe was able still to function from serviceable Dutch and Belgian airfields was not overlooked, and on 15 August, nine airfields were attacked by a total of 976 aircraft, each airfield being attacked by an average of rather more than a hundred aircraft, carrying very slightly less than 5½ tons of H.E. apiece. The attacks were carried out in daylight in conjunction with the U.S. Eighth Air Force against a total of 20 airfields with the intention of reducing the fighting efficiency of the enemy's air force with particular attention to his night fighters. More than 80 per cent. of the runways were rendered unserviceable and there can be little doubt that the weakness of the enemy fighter reaction to the subsequent attacks on Bremen, Kiel, Stettin and Sterkrade can be attributed to this concentrated attack.

Another heavy attack was made on 3 September on airfields at Gilze-Rijen, Eindhoven, Venlo, Soesterberg, Deelen and Volkel, where the remainder of the enemy's close-support units, driven from France and Belgium, had now taken station with long-range bombers, night fighters and the aircraft used for launching flying-bombs. In each case heavy destruction was caused. Statistics relating to these attacks are given in Table IV.

TABLE III
TRANSPORTATION

Attacks on Railway Centres and Facilities in Enemy Occupied Territory

Target.	Date.	Aircraft.		Bomb Tonnage.		Total.	Aircraft Missing.
		Despatched.	Attacked.	H.E.	Incendiaries.		
AULNOYE (railway junction)	Jul. 18/19	148	135	524.3	4.9	529.2	2
CHALONS-SUR-MARNE (railway junction)	Jul. 15/16	121	106	409.3	4.3	413.6	1
CONNANTRE (railway centre)	Aug. 18/19	124	118	385.7	3.1	388.8	—
COURTRAI (railway centre)	Jul. 20/21	322	312	1,639.5	6.9	1,646.4	9
CULMONT CHALINDREY (railway junction)	Jul. 12/13	161	158	646.1	.6	646.7	2
DIJON (railway centre)	Jul. 6/7	153	151	623.4	1.6	625.0	—
DIJON (railway junction)	Aug. 10/11	124	121	403.3	5.4	408.7	1
DOUAI (railway centre)	Aug. 11	135	124	743.8	7.6	751.4	—
ÉTAPLES (railway bridge)	Aug. 4	28	28	149.6	—	149.6	—
ÉTAPLES (railway bridge)	Aug. 5	14	13	74.6	—	74.6	—
ÉTAPLES (railway bridge)	Aug. 11	49	48	208.1	2.7	210.8	—
GIVORS (Baden railway centre)	Jul. 26/27	186	162	603.5	2.2	605.7	6
GIVORS (Baden M/Y and railway junction)	Aug. 11/12	189	181	679.7	4.9	684.6	—
HAZEBROUCK (railway station and sidings)	Aug. 6	62	58	200.4	3.6	204.0	1
JOIGNY/LA ROCHE (railway junction)	Jul. 31	92	91	452.2	—	452.2	—
JOIGNY/LA ROCHE (Loco sheds)	Jul. 31	29	29	143.8	1.1	144.9	1
LENS (railway centre and Loco sheds)	Aug. 11	133	131	722.1	6.7	728.8	—
NEVERS (railway centre)	Jul. 15/16	108	106	464.0	.6	464.6	2
ORLEANS (Les Aubrais railway centre)	Jul. 4/5	154	146	570.5	1.1	571.6	3
REVIGNY-SUR-ORNAIN (railway junction)	Jul. 12/13	107	57	208.7	1.1	209.8	10
REVIGNY-SUR-ORNAIN (railway junction)	Jul. 14/15	125	18	44.2	.9	45.1	7
REVIGNY-SUR-ORNAIN (railway junction)	Jul. 18/19	115	107	516.3	.2	516.5	24
SOMAIN (railway centre)	Aug. 11	142	140	640.6	4.8	645.4	—
TOURS (railway junction)	Jul. 12/13	117	115	611.8	3.9	615.7	—
VAIRES (railway centre)	Jul. 7/8	128	117	560.0	4.2	564.2	—
VAIRES (railway centre)	Jul. 12	159	14	44.2	1.8	46.0	—
VAIRES (railway centre)	Jul. 18	110	106	366.7	4.4	371.1	2
VILLENEUVE ST. GEORGE	Jul. 4/5	131	124	556.4	3.4	559.8	11
VILLENEUVE (railway centre)	Jul. 14/15	128	122	429.0	2.6	431.6	—
TOTALS ..		3,594	3,198	13,621.8	84.6	13,706.4	82 (2.3%)

(e) The Attack on Oil Targets

One of the many preoccupations of the enemy was the necessity for safeguarding his oil supply. It was estimated by the Ministry of Economic Warfare that his reserves were at a low ebb. Attacks upon his storage depots by the heavies from this country, both by U.S. Eighth Air Force and by Bomber Command, were augmented by heavy blows at refineries and synthetic oil plants. As the enemy's available oil resources extended from Roumania and Austria in the east, and as far north as Politz, they were allocated as targets to whichever of the Allied air forces was best situated to attack them. It fell to Bomber Command to attack the synthetic oil plants in the Ruhr area in addition to carrying out operations against the numerous storage depots in which the enemy had accumulated tactical oil reserves.

It was on 12/13 of June that Bomber Command first took part in the campaign with a major attack on a Ruhr synthetic oil plant at Nordstern, as a result of which the plant was non-productive for nearly two months. No less than 11 per cent. of all the oil that Germany was able to obtain from all sources, including Roumania, was obtained from the 10 Ruhr synthetic oil plants—when they were working at 100 per cent.

permanent capacity. The successful repair of these plants by the enemy necessitates repeat attacks as soon as the plants become active again, and up to the end of September a total of 18 attacks had been made against the 10 oil plants. The total weight of H.E. was little short of 9,000 tons and the sorties nearly 3,000, for the loss of 54 aircraft missing. As a consequence, when the quarter ended, six of the plants had been rendered 100 per cent. unserviceable, and the remaining four between 33 per cent. and 75 per cent. unserviceable.

The enemy's fuel storage depots and refineries in Occupied Territory were also included in the general campaign against oil, and on these some 10,000 tons of H.E. were dropped. The oil refinery and storage depot at Donges after two attacks presented a scene of almost complete devastation, every facility for handling, treatment and storage of oil having been seriously affected, while storage tanks with a capacity of some 125,000 tons were destroyed or seriously damaged and vast quantities of oil were consumed by fire. The photographs reproduced of two of the other targets attacked (Figs. 17 to 20) are typical of all. A detailed statistical statement appears in Table VA and VB.

TABLE IV
ATTACKS ON AIRFIELDS

F—France. B—Belgium. H—Holland. G—Germany.

Target.	Date.	Aircraft.		Bomb Tonnage.		Total.	Aircraft Missing.
		Despatched.	Attacked.	H.E.	In-cendiaries.		
(F) St. Cyr	July 25 ..	100	96	462.5	1.7	464.2	1
(B) Brussels Melsbroek	Aug. 15 ..	110	107	506.2	3.1	509.3	—
(H) Deelen		98	96	542.4	1.3	543.7	2
(H) Eindhoven		117	114	543.8	4.5	548.3	—
(H) Gilze Rijen		107	104	583.0	.9	583.9	—
(B) Le Culot		116	111	671.2	3.1	674.3	—
(H) Soesterberg		113	111	562.6	4.4	567.0	1
(B) St. Trond Brusthem		109	108	605.5	3.6	609.1	—
(B) Tirlemont Gosson-court.		118	115	564.7	3.6	568.3	—
(H) Volkel		114	110	654.4	4.4	658.8	—
		1,002	976	5,233.8	28.9	3,262.7	3
(H) Venlo	Sept. 3 ..	120	112	536.8	3.6	540.4	1
(H) Volkel		118	112	494.6	5.4	500.0	—
(H) Soesterberg		114	112	539.3	3.6	542.9	—
(H) Eindhoven		110	103	623.2	3.6	626.8	—
(H) Gilze Rijen		108	105	654.7	4.5	659.2	—
(H) Deelen		105	88	501.7	.4	502.1	—
		675	632	3,350.3	21.1	3,371.4	1
(G) Hopsten	Sept. 16/17	58	51	218.8	.9	219.7	—
(H) Leeuwarden		56	50	214.3	.9	215.2	—
(H) Steenwijk/Havelte		55	54	222.3	1.8	224.1	—
(G) Rheine		54	51	214.1	1.3	215.4	—
		223	206	869.5	4.9	874.4	—
(G) Handorf	Sept. 23/24	113	33	160.7	.2	160.9	1
TOTALS ..		2,113	1,943	10,076.8	56.8	10,133.6	6 (0.3%)

TABLE VA
ATTACKS ON OIL TARGETS
Synthetic Oil Plants in the Ruhr

Target.	Date.	Aircraft.		Bomb Tonnage.		Total.	Aircraft Missing.
		Despatched.	Attacked.	H.E.	In-cendiaries.		
Gelsenkirchen (Buer) ..	July 18/19 ..	170	154	785.5	1.8	787.3	4
	Sept. 12 ..	167	141	510.0	4.0	514.0	3
Gelsenkirchen (Nordstern)	Sept. 11 ..	129	114	393.9	4.3	398.2	7
	Sept. 13 ..	140	100	362.2	4.0	366.2	2
Homberg (Meerbeck) ..	July 20/21 ..	158	146	746.0	4.5	750.5	20
	Aug. 27 ..	243	220	767.9	7.3	775.2	—
Wesseling	July 18/19 ..	194	183	695.9	14.7	710.6	1
Dortmund	Sept. 12 ..	119	110	400.0	2.7	402.7	—
Bottrop/Welheim ..	July 20/21 ..	166	154	530.3	6.3	536.6	8
	Sept. 27 ..	175	134	489.3	.9	490.2	—
	Sept. 30 ..	136	4	3.6	1.3	4.9	—
Kamen	Sept. 11 ..	116	116	583.7	2.7	586.4	1
Wanne Eickel	July 25/26 ..	135	115	416.8	3.6	420.4	—
	Sept. 12 ..	140	120	433.3	4.8	438.1	4
Sterkrade Holten ..	Aug. 18/19 ..	234	217	765.5	4.5	770.0	2
	Sept. 27 ..	171	83	282.3	3.5	285.8	—
	Sept. 30 ..	139	24	69.2	3.1	72.3	1
Castrop-Rauxel ..	Sept. 11 ..	134	121	436.2	3.1	439.3	1
	TOTALS	2,866	2,257	8,672.6	76.1	8,748.7	54 (1.9%)

TABLE VB
ATTACKS ON OIL TARGETS
Fuel Storage Depôts, Dumps and Refineries in Enemy Occupied Territory

Target.	Date.	Aircraft.		Bomb Tonnage.		Total.	Aircraft Missing.
		Despatched.	Attacked.	H.E.	In-cendiaries.		
Donges	July 23/24 ..	119	116	395.7	4.6	400.3	—
	July 24/25 ..	113	112	567.1	3.1	570.2	3
Aire-Sur-Lys	Aug. 8/9 ..	56	51	284.8	1.9	286.7	—
	Aug. 4 ..	107	104	404.3	2.7	407.0	—
Bordeaux (Pauillac) ..	Aug. 4 ..	181	180	818.1	5.2	823.3	—
Bordeaux (Pauillac) ..	Aug. 5 ..	96	94	427.5	3.6	431.1	1
Bordeaux (Blaye) ..	Aug. 5 ..	96	95	425.9	3.6	429.5	—
Bordeaux (Bassens) ..	Aug. 5 ..	114	112	442.0	3.6	445.6	—
Bordeaux	Aug. 10/11 ..	67	62	258.5	3.1	261.6	—
	Aug. 13 ..	15	14	73.2	—	73.2	—
	Aug. 18 ..	26	24	126.4	—	126.4	1
Forêt de Chantilly (oil dump).	Aug. 7/8 ..	202	199	723.0	7.0	730.0	1
Forêt de Chattelerault	Aug. 9/10 ..	190	174	865.1	.6	865.7	2
Forêt de Lucheux ..	Aug. 8/9 ..	124	123	459.4	6.1	465.5	1
Forêt de Mormal ..	Aug. 9 ..	160	156	702.9	7.6	710.5	—
Forêt D'Englos ..	Aug. 9/10 ..	124	120	670.5	4.5	675.0	—
La Pallice	Aug. 10/11 ..	159	151	522.3	6.7	529.0	—
La Pallice	Aug. 19 ..	52	43	218.8	—	218.8	—
Paris (Dugny: Aircraft fuel tanks)	Aug. 10 ..	103	99	606.7	5.4	612.1	—
Reime/Ertvelde ..	Aug. 18 ..	43	42	206.2	4.5	210.7	—
Reime/Ertvelde ..	Aug. 18/19 ..	113	109	637.5	4.2	641.7	—
	Totals ..	2,260	2,180	9,835.9	78.0	9,913.9	9 (0.4%)

(f) The Flying Bomb

The Allied offensive began to threaten the enemy's continued use of his new "V" weapon, the flying bomb, for owing to the short range of the weapon, the location of sites for launching it was limited to the north coast of France.

From 1 July until 3 September, when the last flying bomb was launched from a ground site, there was no idle 24-hour period, and the total launched was estimated to be 6,032, of which 2,965 were destroyed and 1,685 reached the London area. These numbers were but a small fraction of the tremendous attack that had been planned by the enemy when he set to work building the numerous launching sites, supply sites and supply depôts that were either under construction or had been completed at the beginning of July, 1944. Attacks made on these sites earlier in the year by both Bomber Command and Eighth U.S.A.A.F. had so severely hampered both the constructional work and the building up of supplies, that the enemy changed his plans and built large numbers of simple launching sites protected mainly by concealment, and used natural caves for storage purposes.

Bomber Command was given the task of smashing his launching sites, disrupting his supply lines or destroying the supply sites and dumps themselves. The launching sites were very small targets and, in general, well concealed so that they were not easily identified by aircrews, especially in the prevailing weather conditions, which were

so dismal that for exactly half the period during which these attacks were made there was cloud below 5,000 ft. Only 14 out of the 64 days were clear. In these circumstances (favourable to the operation of the sites but less suitable for attacks on them) special marking was necessary once the target had been located, and the highest operational skill was required of the crews. Despite the difficulties of the task, however, the majority of the launching sites attacked were made in-operative.

Reconstruction of demolished sites or erection of them elsewhere was, however, all too easy given the available labour and the means to enforce it which the enemy then possessed. Bomber Command was therefore directed to destroy the dumps and depôts in which flying bombs were stored.

Caves in limestone hillsides, or chalk quarries, which were then used as storage and supply depôts were expected by the enemy to withstand the heaviest attack that we could bring to bear. Nevertheless, concentrations of 1,000-lb. bombs, suitably fuzed, and the 12,000-lb. bombs proved effective.

Proof of this is to be found on page 20 where there is a description of the supply depôt at St. Leu d'Esserent before and after these attacks, based upon a study of the damage found there when they were captured; a photograph appears as Fig. 33. Statistics are provided by Table VI.

TABLE VI
FLYING BOMB TARGETS

Target.	Date.	Aircraft.		Bomb Tonnage.		Total	Aircraft Missing.
		Despatched.	Attacked.	H.E.	In-cendiaries.		
Supply Depôts	July ..	1,846	1,759	8,082	33	8,115	49
	Aug. ..	3,556	3,228	15,061	84	15,145	23
	Sept. ..	153	143	652	17	669	—
	Total ..	5,555	5,130	23,795	134	23,929	72
Launching Sites ..	July ..	2,664	2,426	9,198	102	9,300	9
	Aug. ..	1,616	851	2,886	85	2,971	8
	Total ..	4,280	3,277	12,084	187	12,271	17
Supply Sites	July ..	1,135	1,116	4,356	25	4,381	1
	Aug. ..	—	—	—	—	—	—
	Total ..	1,135	1,116	4,356	25	4,381	1
Large Sites	July ..	571	531	2,479	18	2,497	5
	Aug. ..	398	322	1,236	21	1,257	2
	Total ..	969	853	3,715	39	3,754	7
	Grand Total	11,939	10,376	43,950	385	44,335	97 (0.8%)

(g) The Offensive Resumed against German Industrial Centres

In view of the heavy tasks allotted to Bomber Command in support of military and other operations, the German industrial cities naturally received less than the full weight of attack which they deserved, and perhaps expected. Indeed, for a period of two months which included D-Day, it proved impossible to attack any German city in strength. The enemy doubtless took every advantage of this period of respite on the home front, since his military effort largely depended upon the productive capacity of his battered industrial cities.

In the third week of July the period of respite ended. While many other demands had still to be met by day and night, depending on Allied military requirements, the Command was able to deliver 35,000 tons of bombs in 30 attacks on 18 German cities during the remaining part of the quarter. To achieve this scale of effort it was necessary to operate in poor weather as well as good, and occasionally by day, whenever opportunity offered; and sometimes two, or even three, cities were attacked simultaneously.



FIG. 21.—KONIGSBERG, capital of East Prussia and principal advanced base and communication centre for the supply of the German Armies in the north-east, as photographed after two Bomber Command attacks at the end of August. These operations, which involved double journeys of 1,900 miles, resulted in the destruction of 400 acres out of a total built-up area of 860. About 65 per cent. of the fully built-up central area of the city was destroyed.



FIG. 22.—STETTIN. Germany's largest Baltic port. The central area of the city, on the west bank of River ODER, was almost completely destroyed in the night attack of 16/17.8.44, which caused damage over 1,000 acres of the city area. A further attack on 29/30.9.44 added another 500 acres to the gross area of the city damaged in Bomber Command attacks.



FIG. 23. — The Bomber Command night attack on 11/12.9.44 devastated the centre of the city of DARMSTADT and the adjacent fully-built-up areas. Extensive damage was inflicted on military barracks, railway workshops and industrial concerns. Practically all the tremendous damage shown above was the result of a single attack.

INLAND INDUSTRIAL CENTRES

TABLE VIIA

Target.	Date.	Aircraft.		Bomb Tonnage.		Total.	Aircraft Missing.
		Despatched.	Attacked.	H.E.	In-cerdiaries.		
Stuttgart	July 24/25 ..	614	576	1,303·7	446·7	1,750·4	21
	July 25/26 ..	550	478	1,058·1	385·5	1,443·6	12
	July 28/29 ..	496	457	1,284·6	328·7	1,613·3	39
	Sept. 12/13	217	211	322·8	558·5	881·3	4
		1,877	1,722	3,969·2	1,719·4	5,688·6	75
Russelsheim Opel Work	Aug. 12/13 ..	287	274	512·3	455·5	967·8	20
	Aug. 25/26 ..	412	410	788·8	765·6	1,554·4	15
		699	684	1,301·1	1,221·1	2,522·2	35
Darmstadt	Aug. 25/26 ..	196	162	262·5	291·5	554·0	7
	Sept. 11/12	240	234	355·7	516·8	872·5	12
		436	396	618·2	808·3	1,426·5	19
Neuss	Sept. 23/24	549	492	2,657·8	3·1	2,660·9	7
Osnabrück	Sept. 13 ..	38	37	35·7	77·1	112·8	—
Osnabrück Rly. Centre..	Sept. 13 ..	80	80	357·4	5·4	362·8	—
		118	117	393·1	82·5	475·6	—
Münster	Sept. 12 ..	124	121	161·6	188·4	350·0	2
	Sept. 23/24	—	65*	387·1	—	387·1	—
		124	186	548·7	188·4	737·1	2
München-Gladbach and Rheydt.	Sept. 9/10 ..	137	128	180·4	434·6	615·0	—
	Sept. 19/20	237	233	203·6	448·4	652·0	5
		374	361	384·0	883·0	1,267·0	5
Kaiserslautern	Sept. 27/28	172	167	44·3	629·8	674·1	1
Kaiserslautern Railway Repair Shops.	Sept. 27/28	55	48	31·1	106·4	137·7	1
		227	215	75·6	736·2	811·8	2
Karlsruhe	Sept. 26/27	237	222	117·7	833·1	950·8	2
Frankfurt	Sept. 12/13	387	366	791·0	755·7	1,546·7	17
Brunswick	Aug. 12/13 ..	379	350	840·9	445·2	1,286·1	27

* Includes aircraft despatched on Handorf Airfield and the Dortmund-Ems Canal.

Results were relatively greater than in the past, owing to constant improvement in bombing concentration.

What Goebbels thinks about our raids on German industrial cities is best explained in his own words:—

"The enemy has stepped up his terror attacks against the Reich in a degree never witnessed before.... Our worst headache is the air war. The test to which the enemy is putting our people, particularly in the West, is severe and grievous."

This pronouncement was made on 13 December, 1944, in "a Western city" which had just been attacked (it was undoubtedly Essen), and the German radio added that "columns of smoke and a smell of burning drifted over as he spoke in a half-wrecked meeting hall."

There was a stage, in September, when columns of smoke rose from half a dozen German cities at the same time. (See Figs. 7-13, facing page 1.)

Stuttgart is, or was, the most important industrial city in South Germany, as well as being a centre of rail communications. The chief industries, grouped in three areas just outside

the limits of the city, include the Robert Bosch and Daimler-Benz factories, and important ball-bearing and machine-tool works.

Weather was difficult for the first three attacks on the city, which were delivered within the space of five nights at the end of July. Low cloud covered the target on the first occasion, but reconnaissance revealed fires burning in the west and south part of the area. Extremely bad weather was encountered on the route next night but, after passing through thick cloud with electrical storms and icing conditions, crews found rather better conditions over the target, and photographic plots show that an exceptionally concentrated and well-centred attack ensued. The third attack was less fortunate as thick cloud obscured both ground and sky-markers at the target. Moreover enemy fighters, aided by moonlight, opposed the bombers in strength and losses were higher than usual. Our victories were, however, more numerous than on any previous night—27:6:12 German fighters being claimed by our aircraft.

The July raids—mainly that of 25/26 July—caused an exceptionally high concentration of damage in the centre of the target area. A large

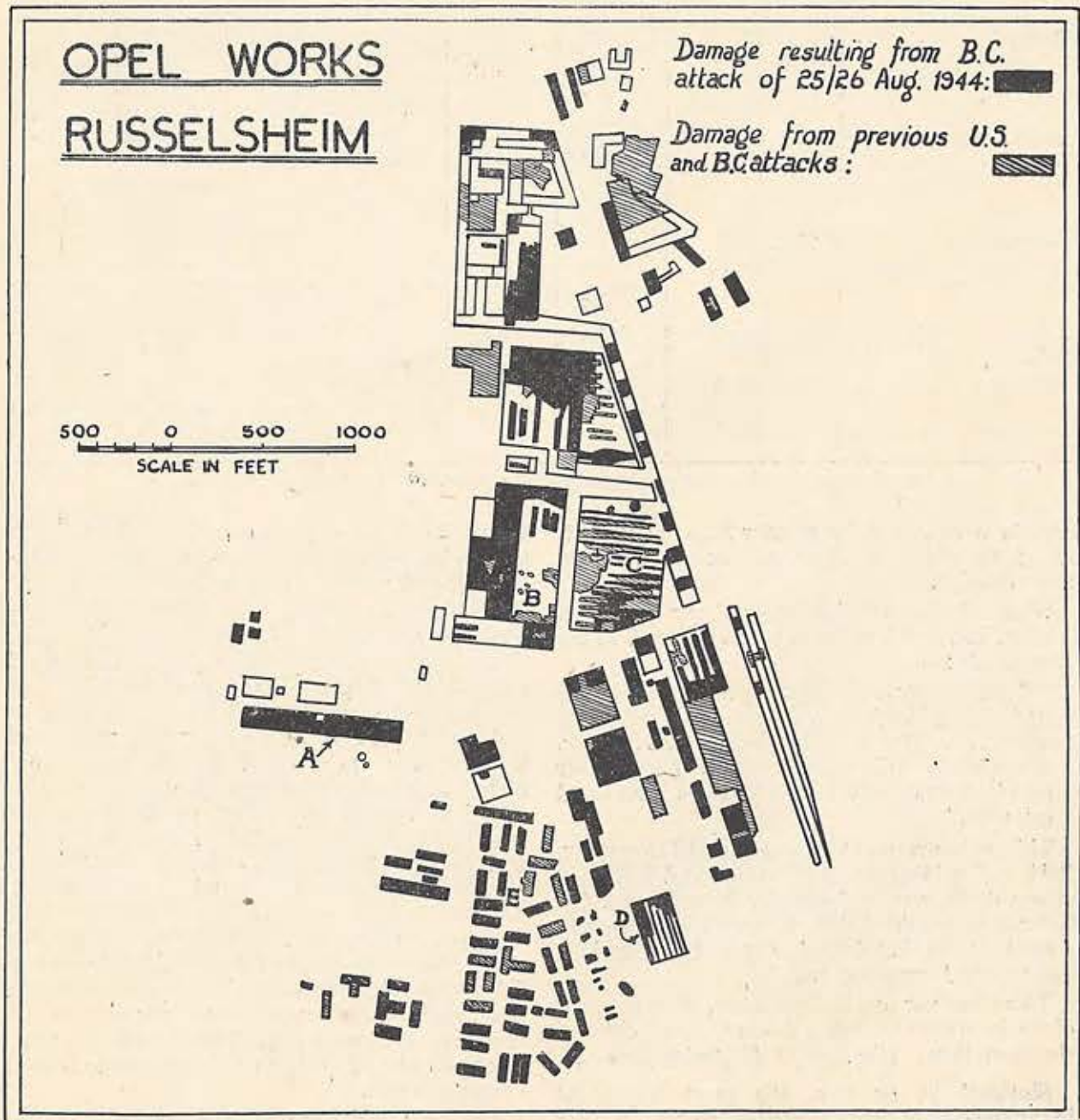
proportion of the buildings damaged were practically obliterated, no more than a few feet of the walls remaining above the ground. It is believed that more than 100,000 people were unhoused as a result of these raids. Among important buildings seriously damaged were the original Robert Bosch works in the city centre, now devoted to research and development, and the main railway station.

Meanwhile the U.S.A.A.F. attended to the outlying war plants—the Daimler-Benz works at Unterturkheim, for instance, suffered heavy damage from the U.S. raid of 5 September. Bomber Command returned to Stuttgart on 12/13 September and, in clear weather, inflicted much further damage. Again the original Bosch establishment suffered, as well as other priority engineering plants; and the main goods station, previously damaged, was practically destroyed. More than 25 city blocks which had previously escaped serious damage were completely devastated, only burnt-out shells remaining. About half of this large industrial city had been made uninhabitable. (See Fig 11.)

Russelsheim.—The Opel works at Russelsheim was the largest automobile factory in Germany before the war. It had since been converted to the manufacture of aircraft components and military M/T vehicles and had become one of the most important targets of this class in Germany.

Following a relatively light attack by the U.S.A.A.F. in July, Bomber Command delivered two heavy attacks in August. While the first of these did not achieve much success, the second and heavier attack on 25/26 August was outstanding. The night was cloudless and visibility was good. Hooded flares provided excellent illumination of the target, and a good concentration of markers near the aiming-point was continuously and accurately backed up.

Damage was widespread and severe. Half the total plan-area of this large factory was affected. Probably all machine tools were either damaged or made idle as a result of the attack. (See Figure 27, and diagram, below.)



DEVASTATION IN GERMANY'S SECOND LARGEST PORT

FIG. 24.—The northern half of BREMEN, a compact residential and industrial area, suffered particularly heavy damage in the night attack on 18/19.8.44. Damage visible on photographs covered a gross area of some 1,500 acres throughout the city. (This may be compared with the figure of some 600 acres damaged in the first thousand bomber raid on Cologne in 1942.)

It is considered that accommodation for more than 100,000 people was destroyed or rendered uninhabitable in this one attack. The remainder of the city was severely damaged in a subsequent attack by Bomber Command on 6/7.10.44.



BREMEN DOCKS

FIG. 25.—The completely devastated district shown here, still smouldering after the attack of 18/19.8.44, extends over an area approximately 1½ miles by 1 mile. It includes a great number of gutted transhipment sheds, and the important Atlaswerke shipyard (inset pre-raid view).

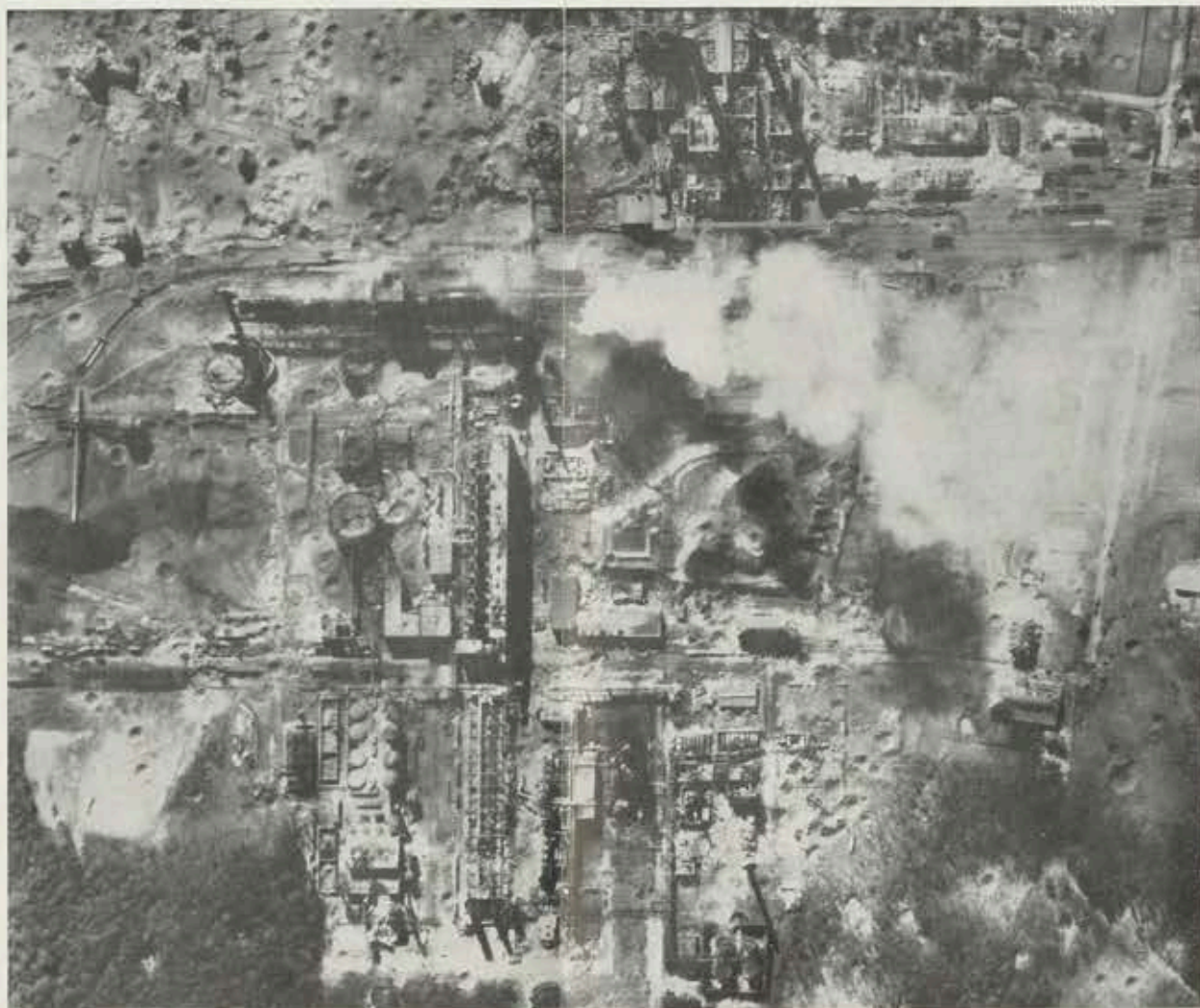


FIG. 26.—THE SYNTHETIC OIL PLANT AT KAMEN IN THE RUHR was still burning late on the day following the single and very successful attack on 11.9.44. All vital parts of the plant were destroyed or severely damaged, and production ceased for many months.



FIG. 27.—THE ADAM OPEL A.G. FACTORY, AT RUSSELSHEIM, the largest pre-war automobile factory in Germany, since converted to the manufacture of aircraft components and military M/T vehicles.

This important war factory was damaged by U.S.A.A.F. in July, 1944, and the damage was greatly increased as a result of two subsequent attacks by Bomber Command. The above photograph was taken after the second of these, on 25/26.8.4, which was particularly successful. Compare with damage plot, reproduced opposite (page 12).

Key to Annotations

A—Forge Shop
B—Press Shop and Chassis Assembly
C—Machine Shop

D—Reduction gears for Daimler-Benz aero-engines.
E—Hutments for workers

Darmstadt.—The first, and smaller, of the Darmstadt operations took place on the same night as two other attacks in strength—against Russelsheim and Brest. Owing to a series of technical accidents which prevented the accurate marking of the target, the city suffered relatively little on this occasion. But its initial luck did not last long. On the cloudless night of 11/12 September, the city centre and adjacent fully built-up areas were devastated (see Figs. 7 and 23) and the important railway facilities were affected by heavy damage to the wagon shops.

Neuss.—The strategically important railway facilities at this Rhineland port suffered in the heavy raid of 23/24 September. Thick cloud obscured the target during the attack and crews bombed the red glow of markers or fires seen through the cloud. While the railway marshalling yard and locomotive depots were damaged, the weight of the attack was concentrated upon factories in the adjacent dock area. In one part of the docks almost every important factory building was either seriously damaged or destroyed.

Osnabrück and Münster.—These towns, both attacked in daylight, were also important points in the enemy's system of rail-communications. At the former the main station and marshalling yards (where the main Berlin-Ruhr line joins the north-south Hamburg-Munich line) bore the brunt of the attack. But the old town was also attacked, and several direct hits were scored on the rolling mills of Klockner Werke A.G., which firm produces naval shells and gun mountings, as well as breech parts for tank guns.

Damage resulting from the Münster attack was heavy. The main station and the goods station buildings were severely damaged and the locomotive repair shops gutted. (See Figs. 12 and 13.)

München-Gladbach, another rail centre and a western outpost of the Ruhr industrial area, was

heavily damaged twice within ten days. Altogether more than 50 industrial works were severely damaged or destroyed, including two priority engineering and armament works; and a group of seven large factories located on the west side of the town were practically destroyed by fire. (See Fig. 8.)

Kaiserslautern was heavily attacked for the first time on 27/28 September, when it was bombed from below dense cloud. Over half the fully built-up area was wrecked and heavy damage was inflicted on industrial plants, including the large railway workshops.

Karlsruhe.—Following the successful U.S.A.A.F. attack on the important railway repair shops here on 5 September, Bomber Command attacked the city, which is the administrative centre of the province of Baden.

The target was unexpectedly covered by cloud, but blind marking was accurate, and an hour later a reconnaissance Mosquito reported fires with smoke rising to 8,000 ft. Later reconnaissance showed that the administrative hub of the city, with its government and municipal buildings, was virtually in ruins. Munition factories suffered severe damage.

Frankfurt.—The commercial and industrial centre of the Upper Rhineland, partly devastated last March by Bomber Command, received further attention on 12/13 September. Many of the important engineering concerns damaged in previous attacks were hit again, and the condition of the west part of the city now in places—especially around the marshalling yards—equals the devastation in the centre.

Brunswick.—The single Bomber Command attack on this city in August affected a number of priority industrial targets, but these results were far surpassed by the attack which followed on 14/15 October. These will be described in the next issue of the *Review*.

TABLE VIIb
THE CITIES OF THE PLAIN : THE NORTH SEA AND BALTIC PORTS
(See Below)

Target.	Date.	Aircraft.		Bomb Tonnage.		Total.	Aircraft Missing.
		Despatched.	Attacked.	H.E.	In-cendiaries.		
Hamburg	July 28/29 ..	308	300	1,141.7	11.4	1,153.1	23
Bremen	Aug. 18/19 ..	288	273	565.1	565.8	1,130.9	1
Bremerhaven	Sept. 18/19	213	208	51.3	812.6	863.9	2
Emden	Sept. 6 ..	181	180	353.2	228.1	581.3	1
Kiel	July 23/24 ..	629	612	2,819.8	96.5	2,916.3	4
	Aug. 16/17 ..	348	336	451.3	451.5	902.8	5
	Aug. 26/27 ..	381	367	854.6	895.5	1,750.1	17
	Sept. 15/16	490	465	663.2	788.3	1,451.5	6
		1,848	1,780	4,788.9	2,231.8	7,020.7	32
Stettin	Aug. 16/17 ..	461	440	562.0	826.0	1,388.0	5
	Aug. 29/30 ..	403	384	607.4	731.0	1,338.4	23
		864	824	1,169.4	1,557.0	2,726.4	28
Königsberg	Aug. 26/27 ..	174	167	129.5	329.9	459.4	4
	Aug. 29/30 ..	189	173	133.9	347.0	480.9	15
		363	340	263.4	676.9	940.3	19

Hamburg.—In July, 1943, Germany's second city and largest port was reduced by bombing to a condition rivalling that of the Biblical Cities of the Plain. Since the destruction of the greater part of the built-up area, the U.S.A.A.F. had subjected the important oil targets and shipyards in the area to repeated attacks. The Bomber Command attack on 28/29 July, 1944, caused fresh damage to the battered city, but it was hardly surprising that this was not on a scale comparable with that of the previous year.

Bremen.—There was rather more left of Germany's second largest port before the attack of 18/19 August, 1944. There was no cloud that night and 273 heavies achieved a formidable concentration on the target. Mosquitos returning from Berlin observed the city blazing from the centre to the docks.

The gross site-area visibly damaged in this attack totalled 1,500 acres, and it is considered that accommodation for more than 100,000 people was rendered uninhabitable.

The area of almost total devastation extended over 5,000 yards from the old city as far as the west part of the docks. (See Figs. 24, 25.) Three-quarters of the Atlas-werke shipyard buildings were destroyed, nearly 40 dockside warehouses were gutted, and rail facilities suffered heavily. This was only part of the night's work, for altogether 1,037 aircraft operated against Bremen, oil refineries and other targets, for the loss of only four bombers—a rate of loss remarkably low for so large an effort.

Following this attack on Bremen, the U.S.A.A.F. bombed the various war factories around the city, and on 6/7 October Bomber Command returned to destroy the Neustadt district, formerly little damaged but now reduced to the condition of the Altstadt. This attack will be described in the next issue of the *Review*, dealing with the October–December quarter.

Bremerhafen.—The first attack on Bremerhafen by Bomber Command took place on 18/19 September. There was no cloud and visibility was good. The attack was outstanding. (See Fig. 10.) Almost all buildings in the central town area were destroyed or seriously damaged, and more than half of the inner business, residential and dock area suffered the like fate. The three priority industries of the town were damaged, no building of the first-priority Deschimag works escaped. One hundred warehouses were damaged or destroyed.

Emden.—This was bombed in daylight on 6 September, through thin cloud. Photographs taken within an hour after the attack showed almost the whole town and dock area enveloped by smoke, with the glow of many fires showing through. The old town, already much damaged in previous raids, was devastated and the submarine-building yards of the Nordsee-werke seriously damaged.

Kiel.—The chief naval dockyard and arsenal in Germany was bombed on four occasions by a total of 1,780 heavies of Bomber Command. Owing to the grouping of the industrial and built-up areas on either side of the Kieler-förde, it is inevitable that a proportion of bombs aimed at these targets fall in the waters of the inlet. The

acreage of damage caused in these attacks was relatively less than is the case with most inland cities. Nevertheless it was widespread and severe. The great shipbuilding yards of Deutsche-werke, the naval dockyard, and the naval arsenal—which formed the city's vital industries—all suffered heavily. On the west side of the inlet, an area some $2\frac{1}{2}$ miles long by $\frac{3}{4}$ mile in depth, including the old town, the modern shopping centre, and the business and residential districts of the city, was, to all intents, devastated by fire. (See Figs. 9 and 9A.)

Stettin.—Germany's largest Baltic port and important communications centre, situated on the Oder, was the target for two Bomber Command raids in August. Despite considerable cloud during the earlier of these attacks, bomb-damage was concentrated on the centre of the city and on the adjacent dock and residential areas respectively east and north of the centre. Damage visible on photographs extended over a gross site-area of 1,050 acres, and three major industrial plants were seriously damaged. One of these was the Admiralty fitting-out yard; another was the submarine-building Stettiner Oder-werke, also engaged in fitting out M-class minesweepers.

The second attack added considerably to the heavy damage in the city west of the Oder. In all, it is probable that nearly 100,000 of the population of Stettin were rendered homeless by these two operations, which fact alone must have had far-reaching effects on the activities of this important centre of communications.

Königsberg.—On the same night as the second of the Stettin operations, Königsberg, capital of East Prussia, went up in flames.

This target, with its ample dock facilities, miles of marshalling yards, and modern factories was eminently suitable for attack both as a strategic target and a tactical target, for it was of paramount importance to the German armies desperately trying to stem the Russian advance which had approached to within 100 miles. The task was not easily undertaken by Bomber Command, for it involved a journey of 1,900 miles, and was comparable to an attack by the Russian Air Force on, say, Aachen. Nevertheless, the operation was carried out on two occasions within three nights, as the first attack (though highly concentrated) fell across the eastern edge of the city.

On 29/30 August the target was at first obscured by low cloud, and bombing was delayed for 20 minutes. Then the objective was visually identified through gaps in the cloud and markers were accurately dropped. Although the force of heavies despatched was not a very large one for such a task, the result of the attack was outstanding. Damage was concentrated on the city centre, and half the buildings in the town were either gutted or seriously damaged. Well over 100,000 of the inhabitants must have been unhoused and priority goods and passenger stations were practically destroyed and at least 44 warehouses on the banks of the Pyrel were gutted. In one large military barracks containing 106 buildings no less than 59 were completely burnt out. Ruin affected every important aspect of the life of the East Prussian capital.

Attacks by Mosquitos

The increasing sting given to it by the 4,000-lb. bomb has added much to the value of the Mosquito as a bomber. Such attacks are a matter of degree for, compared with the tremendous tonnage dropped by the Lancasters and Halifaxes, a Mosquito's load may appear very small. Nevertheless, a raid in which some 50 or more 4,000-lb. bombs are dropped on an industrial city can play an important part in the general bomber offensive. When an air raid warning sounds for an attack of this magnitude the tired workers preparing for a night's rest, or in the midst of it, or the factory night-shift are

alike more than a little disturbed, and must either interrupt their rest to take shelter or else face the consequences of being involved in an incident with a "block-buster" of more than twice the effectiveness of a flying bomb. A regular succession of such raids must impose a severe tension on nerves already strained. The frequency of attack can be gauged by the effort for the three-month period which exceeded 2,500 sorties dropping more than 3,000 tons, only 10 per cent. less than the tonnage dropped on Germany by Bomber Command in the first year of the war, and only 20 per cent. less than the quarterly average in the winter of the second year.

(h) Minelaying

In terms of sorties flown and mines laid the scale of effort in July, August and September was approximately 40 per cent. of the previous quarter, which still remains a record achievement. The reduction was mainly due to the fact that many former mining areas are now occupied or about to be occupied by the Allies. The success of the mining effort in co-operation with the general Allied plan and with the Naval and Coastal Command forces in the Bay of Biscay has been outlined broadly in the paragraph above dealing with Naval warfare. In addition to this area there were others further north that had become important tactically, for when the enemy found it necessary to transfer some of his garrisons from Norway to the Western Front, his troop transports became valuable targets, and the routes between Norway, Denmark and the Baltic ports were mined to catch them.

Towards the end of the quarter, with increased hours of darkness, operations were extended to

the eastern Baltic, where canal approaches to Swinemunde and Königsberg were mined. At these two ports and also at Bremen, Bremerhaven, Hamburg and Kiel mining operations were co-ordinated with attacks by the heavy bombers, to their mutual benefit. The results of the 783 mining sorties flown and 3,042 mines laid included not only the sinking or dispersal of U-Boats, but also the sinking and disorganisation of the enemy's shipping. In addition he was forced to use valuable personnel for the purely defensive purpose of sweeping for the mines that blocked his harbours and frightened off the neutral shipmasters on whom he so largely depended for transport of vital war materials.

Particularly worthy of mention as an individual contribution to the mining is the laying of mines in the Dortmund-Ems Canal on 9/10 August by Mosquitos, a difficult operation brilliantly executed.

II. FLYING INCIDENTS

(a) The Bomber Hits Back

The determination shown by crews in carrying out their tasks in the face of intense, accurate ground fire and aggressive enemy fighters can never be too highly praised. It is made possible by the spirit of comradeship that enables each member of a crew to play his part as one of a well-drilled team, confident that the same high standard of co-operation and self-sacrifice is common to all. Added to this is the knowledge that all emergencies likely to be encountered in action have been foreseen and the most efficient means of dealing with them developed in advance on the ground.

In two of the three adventures given below the bomber was able to return fire with good effect; in the third it was the victim of flak. All three, however, have this in common: they show the value of drill sincerely practised and correctly carried out.

The Burning Lancaster that Shot down a Fighter

The moonlit night was clear above the patchy cloud which spread across the sky at 19,000 ft., and the enemy flares which lighted the way of our bombers were easily seen.

The target that night in August was Stettin; the route to it lay over that narrow strip of water dividing Sweden and Denmark at their closest approach, the Sound, which the Lancaster "B" 2 of 626 Squadron was crossing some 3,000 ft. above the cloud. Danger of interception by fighters was advertised by the flares, and a good look-out was kept to make sure that no attacker could sneak into lethal range unobserved. In the distance above the clouds other bombers could be seen, and in those, too, alert men kept watch.

It is the business of the night fighter to make his attack from as short a range as possible, taking his opponent unawares. From the moment when he sights his quarry, therefore, he must try to remain unobserved. In this, naturally, he is not always successful; although occasionally he succeeds all too well.

For all the care of her gunners, B.2 was attacked and hit by a Ju.88 which, unseen, had approached from directly below the starboard quarter to within very close range. Almost immediately another Ju.88 was reported by the mid-upper gunner to be closing in from the same direction, although without opening fire.

The first Ju.88 raked the bomber from below and set her on fire, smashed the hand crank of the rear gun turret, wrecked the mid-upper gunner's sighting bar and blasted off the perspex. In this condition the aircraft's plight was sorry enough, but a second attack developed from the starboard quarter. An explosion in the starboard wing; a fire in No. 2 tank; the cutting-out of both starboard engines; these were the immediate effects. Petrol was soon pouring from the damaged tank over the whole starboard wing, which was ablaze; but by good fortune the incendiary load in the bomb bay did not ignite.

Despite damage to the rudders and elevators, the captain managed to carry out a modified "corkscrew" in response to the gunners' commentary. The aircraft, flying at 9,000 ft., was now within two minutes of the Swedish coast and the captain warned the crew that they must bale

out; for the fire was now spreading to the fuselage.

Although one fighter had broken away and disappeared from view, the other still flew alongside the Lancaster at about 50 to 100 yards range on the port beam. Handicapped by the damage to his gun, which deprived him of a gun sight, the mid-upper gunner, manipulating his turret and guns by hand, succeeded in firing a burst of some 400 rounds. So accurate was this fire that the Ju.88, bursting into flames, rolled over, and disintegrated as it fell into cloud.

The Lancaster having thus been avenged, the gunner followed the wireless operator and rear gunner, who had already baled out through the rear door. The captain, still at the controls, saw below him the lights of a Swedish town as the aircraft broke cloud at 5,000 ft., and despite the damage, was able still to exercise sufficient control to head the blazing aircraft away from it before baling out himself. Watching as he floated down, he saw the burning wreckage crash about a mile from the town.

The entire crew landed safely in Sweden.

Down in the Drink

On 5 August, 1944, aircraft of 617 Squadron attacked the U-Boat pens at Brest at midday in brilliant weather. One aircraft, "V," did not return, but the pilot, flight engineer, and mid-upper gunner of this aircraft, who are now back in England, have given this account of what happened.

Lancaster "V" went in to bomb the target at exactly 1200 hours. Flak was intense; on the bombing run the aircraft flew through a heavy barrage, which was bursting all around it. Over the target flak was accurate and predicted, made all the more unpleasant by the evidence of the warning device which indicated that they were being tracked by German Radar throughout the run.

Just after bombing, the aircraft was hit by three flak bursts in quick succession, the last exploding directly under the bomb-bay, wounding severely both the navigator and wireless operator. The navigator was hit in the chest, arms and face, so that he was unable to speak; the wireless operator was similarly injured, but also received injuries to both his legs, which prevented him from leaving his seat. The aircraft was still under control and the pilot asked for a new course. The navigator, being unable to speak, showed him the required course on his log, while the flight-engineer gave him first aid. The bomb-aimer and mid-upper gunner meanwhile attended to the wireless operator.

It was as the pilot turned on to the new course that the starboard outer engine failed and was seen to be on fire; but prompt feathering of the engine and use of the Graviner brought the fire under control. The next immediate requirement, since the oxygen masks of both the wounded were shattered, was to lose height, but as the pilot put the nose down, fire broke out all along the starboard wing. The flight-engineer now saw that both wings, as well as the fuselage, were riddled with holes and torn in many places.

The hopeless condition of the aircraft leaving no alternative, the captain gave the order to bale out. The flight engineer, after putting the pilot's parachute ready for him, tried to open the hatch, but succeeded only with the help of the wounded navigator, who then baled out, followed by the flight-engineer himself, the bomb-aimer and the mid-upper gunner.

It was then that the pilot learned the wireless operator was unable to move and needed help to fix his parachute. Pulling the aircraft into a climb he made his way back to the wounded man, fixed his parachute harness and hauled him to the front escape hatch. To accomplish this, however, he had several times to return to the controls in order to prevent the aircraft's going into a dive. Even when he had helped the wounded man to the hatch his difficulties were not ended, for the hatch was jammed half shut. Encouraged by the knowledge that the others had struggled through, he succeeded by great endeavour in sending the wounded wireless operator clear of the aircraft, having first made sure that he was conscious and able to pull his ripcord, as indeed he was; for the pilot, watching from the hatch, saw the chute open.

When, a few moments later, the pilot baled out, he found himself floating down to the sea.

dense thunder cloud. Almost as soon as we crossed the coast, just north of Dieppe, we were engaged by accurate predicted heavy flak.

"One shell burst directly below the port inner engine, causing it to stop; a second burst close to the nose, blowing a large hole in the forward compartment and blowing out part of the navigational equipment; a third exploded near the tail, peppering the fuselage and rear turret. The mid-upper gunner was killed in his turret; the air-bomber was wounded; and the pilot had part of his foot blown away. Rapid investigation proved that neither the controls nor the hydraulics had been affected, and that although extensively damaged, the aircraft was still airworthy. As a precaution, the Captain ordered the crew to put on parachutes, and decided to carry on to the target.

"Three minutes later, as we approached the target, the port inner engine, which had been windmilling, suddenly burst into flames. The flight engineer pressed the Graviner and feathered the engine, but the fire did not go out. While we flew on, the navigator, who had been giving first aid to the injured members of the crew, lifted the wounded air bomber into position over his bomb-sight. We reached the target and bombed it.

ERRATUM

A misprint occurred on page 18 (paragraph 7, fourth line) of the last issue of B.C.Q.R. (No. 9). The Coastal Command Wellington concerned in the rescue was "K" of 415 (R.C.A.F.) Squadron—not "K" of 413 Squadron.

415 Squadron, which has since been transferred to Bomber Command, deserves full credit for its share in the rescue of the Halifax crew.

On 1 July, a force of over 300 aircraft was sent out in daylight to attack flying-bomb targets in the area north-east of Rouen. Of this force, all but one aircraft, "V" of 10 Squadron, returned safely to this country. The rear gunner of this aircraft, who is now back in England, has given this account of the flight:—

"Our Halifax was detailed to attack the flying-bomb site at St. Martin L'Hortier. We were first off and, in spite of some trouble with the starboard outer engine, which was quickly rectified by the flight-engineer, we reached the French coast ahead of schedule, flying above

burst, and the engine disappeared into the cloud below and was not seen again. According to the flight engineer, it had been hit and was smoking when last seen.

"Meanwhile, the fire on our own aircraft had increased and the shuddering had become more violent, so the captain finally decided that we should have to bale out. The aircraft had lost 6,000 ft. since the first flak engagement, and was now down to 12,000 ft. I rotated my turret and baled out. As I fell, there was an explosion, and the whole of the port wing fell off. The aircraft went down in a spin."

(b) Via Northern Russia to the "Tirpitz"

The first of the three Bomber Command attacks which culminated in the sinking of the battleship *Tirpitz* took place on 15 September 1944. It was considered that a force of Lancasters would have a good chance of sinking the battleship if they could make their bombing run before the smoke screen covered both the ship and Kaa Fjord, where she then lay within the Arctic Circle. By approaching the target overland, from the direction of Russia, it was believed that the necessary element of surprise could be achieved. In addition, it would be easier to forecast weather conditions in the target area from a base close at hand. Accordingly, aircraft were despatched to an advanced base near Archangel before the operation was carried out.

The following narrative, written by a member of the ground party who acted as adjutant to the

force commander, gives a personal impression of his visit to Northern Russia.

On 11 September 1944, 38 Lancasters of 9 and 617 Squadrons, together with two Liberators attached from Transport Command, took off for Yagodnik, an airfield near Archangel. The Liberators re-fuelled at Lossiemouth before leaving.

The weather at first was good, but about 150 miles from Archangel low cloud and rain were encountered. Aircraft flew just above tree tops over the most desolate country imaginable—lakes, forests and swamps. Map reading was impossible; weather conditions alone made this too difficult, and in addition, it was found that maps of the area were inaccurate—many villages and even railway lines being omitted.

The Archangel area was reached after about 10 hours flying and, with endurance becoming low

and with no radio aids available, it was necessary for aircraft to land without delay. Some were fortunate enough to locate airfields directly, but others had to search through low cloud and heavy rain.

Several aircraft landed at a small airfield named Keg Island. Some of the crews of these aircraft originally thought that they had landed at Yagodnik and were unable to find out the whereabouts of the other aircraft. Later, however, all aircraft were located, though in all six had crash-landed. In spite of this nobody was hurt, and in view of the weather conditions, it must be considered fortunate that no lives were lost. It was a great tribute to the skill of the pilots and navigators that so many masterly landings were made.

The Russians had originally expected some 250 guests but last minute alterations had increased the number to 325. In addition, the crews of the crashed aircraft had to be located and collected from outlying districts. In the circumstances the Russians performed wonders in giving all available help. The Russians placed transport aircraft at the disposal of the Commanding Officer and even dropped a parachutist to direct the crew of one aircraft which had crash-landed in a morass. In this particular case the blind led the blind for a while, as the guide lost his way!

Eventually all crews and serviceable aircraft collected at Yagodnik where accommodation and re-fuelling facilities existed. Yagodnik is an island in the middle of the river Dvina, about 20 miles from Archangel. It can only be reached from that city by air or river. The accommodation consisted of a paddle steamer which was moored to the river bank, and several underground huts. These huts provide warmth in winter but the absence of any kind of ventilation and the fact that a large brick fireplace forms a major part of the accommodation leads to a degree of stuffiness difficult to bear.

Entertainment was provided by the Russians in the form of cinema shows, dances, etc., and on one occasion a lecture on a Russian composer which started 55 minutes late, lasted for 75 minutes, and was a complete mystery from start to finish to the British members of the audience.

The much-publicised football match also took place and proved a huge success. A football match in Russia demands much ceremony, including the exchange of bouquets by the opposing captains before the start of a game, and a tune somewhat similar to *See the Conquering Hero Comes* had to be played each time the home team scored a goal. Apparently it is also possible for the weary player to be replaced by a reserve—for two members retired from the game and were replaced by the Commanding Officer and the local Station Commander. The latter was so fed with passes by his triumphant team that a glancing blow off his knee which scored a goal must have caused him considerable relief as it enabled the game to be continued under more normal conditions. Nevertheless, our Allies showed that they thoroughly understood the game and were, indeed, very capable players.

The major job of servicing and re-fuelling the aircraft for the operation was tackled by the

maintenance crews in a wholehearted manner—they worked for 48 hours almost without a break, and their keenness and cheerfulness was what one would expect of such a grand team. It was refreshing to see all trades helping where help was most needed. The following instances will give some idea of what difficulties were overcome. With the bowzers available it took exactly 18 hours to re-fuel the aircraft alone. A spare engine was carried in one of the Liberators and as no crane was available to remove this from the aircraft, a ramp of trees with blankets on top had to be built so that the engine could be slid down.

Meanwhile a Mosquito had arrived at Yagodnik for P.R.U. duties and, after a favourable met. report from the pilot, the operation took place on 15 September. Both take-off and landing on return from the operation were accomplished smoothly, 28 aircraft taking off in 23 minutes, and 27 landing in 30 minutes—one aircraft having flown direct to the United Kingdom. This was a film unit aircraft of No. 463 Squadron which, apart from doing a fine job of work in producing a record of the attack, put up what is believed to be a record operational flight for a Lancaster, making the homeward journey from Yagodnik to Waddington via Kaa Fjord in 14 hours 33 minutes.

As aircraft became re-fuelled and serviceable they returned to the U.K., until finally the two Liberators remained and they were held up for about a week. While waiting for their aircraft to be re-fuelled some of the crews went into Archangel by minesweeper and were entertained by the R.A.F. Mission there. The final return to the United Kingdom was made under variable but much better conditions than the outward journey.

A few impressions of this northern outpost of the U.S.S.R. as seen in a fleeting visit may be of interest. It is, of course, quite impossible to form balanced judgments, or to provide a real comparison between social and economic conditions in Russia and those to which we are accustomed in Great Britain. After all, Archangel is in the very far north of the vast land mass which constitutes the U.S.S.R., and was for some period cut off from the rest of Russia by the Finnish-German advances. Bearing all this in mind, however, it can hardly be described as a health resort. There was not a great deal of food, the clothing of the civilians was of poor quality, as were the roads and houses; while sanitation and drainage, where they existed, were far below anything generally to be seen in this country. However, we found that the organisation to provide the essentials of war was good, and all the technicians we encountered were capable and willing workers. The system of privilege is apparent; extra food and clothing are the reward of rank in the armed forces and of position in civil works. At Archangel we found among the Russians an intense patriotism, and belief in the future prosperity of Russia after the war. All Russian energies seem directed towards the future.

Our hosts, with the limited facilities at their disposal, did everything they could for our comfort, and for this we were all very grateful.

PHOTOGRAPHS TAKEN BY MET. FLIGHT MOSQUITOS ON WEATHER
RECONNAISSANCE (See article on page 19.)



FIG. 28.—Cumulo-nimbus cloud developing in the Bremen area, base 4,000 ft., top 31,000 ft. This picture gives a good idea of the great uprush of air associated with this type of cloud. The observer reports that the cloud developed the characteristic "anvil" formation shortly after the photograph was taken. Icing in this type of cloud is normally very severe, and extensive development of this nature would constitute a very serious threat to heavy bombers.



FIG. 29.—A "Pampa's eye view" of a sheet of low stratus cloud over the North Sea in the Dogger Bank area. The lateral and transverse corrugations are of considerable interest.

CLOUD CONDITIONS OVER NORTHERN FRANCE : A PHOTOGRAPH BY A MET. FLIGHT MOSQUITO



FIG. 30.—The complexity of a well-developed system of shower clouds is well shown here, and also the way in which they tend to build up over the land, leaving the sea and the coastal strip clear. The strips of layer cloud are all off-shoots of the main cloud mass in the rear, which went up to 26,000 ft. The Channel coast, including Cap Gris Nez and the Calais area (*left*) are seen in the foreground.

III. MISCELLANEOUS ITEMS

(a) Weather Investigation over Enemy Territory

The problem of forecasting weather is difficult even in one's own country where the organisation necessary to obtain and collate data can be laid on as required. Yet how immeasurably more difficult it is when the weather to be forecast is the enemy's. Nevertheless, detailed and accurate information regarding the weather to be expected en route or at the target is an integral part of operational planning, which is handicapped seriously if it cannot be supplied. As a reliable means of forecast, the data ordinarily available, namely, ground reports from areas in this country (and, since the invasion, from liberated countries too) and a relatively small number of vertical soundings, giving temperature and humidity, made by aircraft or by radio methods proved inadequate, and did not enable confident and precise assessment to be made of cloud height and other essential details required in planning bomber operations.

These difficulties, although they were increased and became intensified as Bomber Command expanded, were sufficiently acute as far back as 1941 when the need for special meteorological flights over enemy territory became apparent. Towards the end of that year, in September, the first meteorological reconnaissance flight was made over enemy territory by an aircraft of the Met. Flight at Mildenhall. As this unit was then armed with Gladiators, the flight in question was made in a borrowed P.R. Spitfire more suitable for the task.

Following the success of this experiment, the Met. Flight continued to operate over enemy territory under the control of Coastal Command at Bircham Newton until April, 1943, when it was transferred to Bomber Command. As repeated interceptions of the Mosquito IVs by F.W.190s. and M.E.109s. implied the need for a faster aircraft, the flight was re-equipped in consequence with Mosquito XVI.

Scale of Effort

The official requirement is for four flights a day at half an hour's notice to anywhere in Europe within a maximum range of 1,600 miles; but during the past summer, when large scale operations were being planned, five or more flights have frequently been flown in the day, and the monthly total of sorties has exceeded a hundred. The use of the flight is not restricted to Bomber Command alone but is available for all Commands; although practically all the work has in fact been done for the Command and, until recently, for the U.S.A.A.F. Now, with the formation by the U.S.A.A.F. of a separate meteorological flight of Mosquitos, the work undertaken is exclusively for Bomber Command, with the exception of an occasional long flight for Transport Command.

Operational Procedure

As soon as the target and route have been laid down, Met. sorties are arranged by Bomber Command Met. Office through Pathfinder Air

Staff, the security aspect of the sorties being checked by Bomber Command Air Staff. Routes and requirements are then passed direct by telephone to the standby crew who are required to be airborne within 20 minutes of getting instructions by day, and within 60 minutes by night. Speed is of great importance, for it has become the rule rather than the exception that the final decision regarding a Bomber Command operation is based on this information, the sorties being planned normally to land about an hour-and-a-half before the heavies are due off. Orthodox briefing has therefore to be dispensed with, and as fast and accurate calculating of flight-plans is essential, it is the responsibility of the first standby crew to have available all the information they require to make a sortie in any direction.

Most of the sorties flown consist of straight reconnaissance of the weather conditions on a route planned in consultation with the Met. officers at Group and Command. The majority of the flying is done at high level, but on many trips various descents, often to ground level, are made to measure cloud layers, and to make temperature soundings.

Unless detailed to obtain specific information, such as the position of fronts, cloud base at final points, amount of medium cloud on the route, coverage of various cloud layers, icing levels, condensation trail levels, upper winds, temperatures and the like, the observer attempts to gather as much weather information as possible over the whole route. Usually experienced crews find that they are able to estimate cloud heights to within a thousand feet, but when they are not fully confident of their estimate, they are instructed to make actual measurements. During night sorties, flares of various kinds are sometimes carried, to illuminate cloud layers and to measure cloud tops, while on dark nights when making low descents, where the forecast surface pressure in the area has not been reliable, ground flares have also been used.

Interrogation

At one time, crews sent back W/T reports on the weather conditions encountered; and now, in some cases, coded reports are sent by V.H.F., when a report after landing would be too late for the operation in question. In the case of patrols flown in the Pas de Calais and Normandy areas during the period of the invasion and the attacks on the V.I launching sites, a series of V.H.F. reports were sent from pre-arranged points on the patrol. However, the greater part of the reporting and interrogation is done by telephone immediately the crew has landed at base, which gives a much more complete picture of the weather situation.

The observers are encouraged to bring back a comprehensive picture of the weather over the whole route, rather than a series of disconnected observations, and this difficult technique they have developed to a high degree. Deviations are often made from the pre-arranged track to plot

accurately the edge of cloud layers, the positions of cumulo-nimbus clouds or the positions of fronts. The information collected is noted and drawn on an ordinary Mercator plotting chart, which enables quick reference to be made to the whole situation during the telephone interrogation.

As a rule, the crews selected for the work have already completed an operational tour in Bomber Command or in a Coastal Met. Squadron. In the former case, they are trained to Met. observation at the unit, the navigator-observers being attached to Coastal Command Met. squadrons for short periods to gain additional experience of Met. work.

Of Service to All

Oblique sky photographs of the weather conditions encountered are taken with a handheld camera, and these are processed immediately and sent to Group and Command Met. offices. Copies are also kept for reference, resulting in an enormous and informative collection of photographs of weather and Met. phenomena of every sort, some of which have considerable value, not only in relation to the operation for which the sorties were laid on, but as contributions to scientific knowledge. Examples are shown at Figs. 28, 29 and 30.

In addition to cameras of this type, vertical cameras are also carried on all Met. flights, and photographs of interest to Intelligence are taken when they do not interfere with the Met. reconnaissance. A great deal of photography of ports, shipping, cities, airfields and factories has been done, and on various occasions Met. flights have happened to be routed near targets immediately after or during attacks, enabling interesting cover to be obtained. By night, a slow-operating-shutter camera is carried, in case burning targets are encountered and photos can be taken which may prove useful to the damage assessment experts. Opportunity is also taken at the end of long descents to obtain low oblique photographs, in the hope that they may also be of some use to Intelligence.

Many occasions could be quoted when information obtained by these flights has led to a re-adjustment of timing increasing the success of an attack; and on other occasions a serious loss has been avoided when conditions prohibitive for heavy aircraft on the planned route have been discovered in time. It can therefore be said that the Met. Flight has proved itself to be an integral part of Bomber Command, and an indispensable aid to the carrying out of our bomber operations over Germany.

(b) Bombers versus Architects

When a cannon ball first smashed a breach in a castle wall, it was not only the stonework that fell; with it there fell, too, the powerful isolationist barons and the whole feudal system. The castle until that moment had been impregnable, but it is a simple truth that there is no defence so strong that a means of attack cannot eventually be found to overcome it. Such a means can always be found, but before it comes along, a strong defensive system may enjoy the benefits of temporary immunity. The enemy, in building V-weapon stores, and his U-Boat and E/R-Boat pens, hoped that he was conferring on them an imperviousness to bombing which even the rapidly improving bombing technology would not reduce. The designers had looked ahead, but in the light of present knowledge, they did not look ahead far enough; they used a spy-glass when they needed a telescope.

Nevertheless, it would be unfair not to give credit to the considerable ability of the architects who set their knowledge and wits, and all the resources of engineering against the heavy bomber. The pens are fine engineering feats, judged by any standard.

Below are eye witness accounts of the submarine pens at Brest; of St. Leu d'Esserent, a flying-bomb storage dépôt constructed in a limestone cave; and of Wizernes, a large and heavily protected V-weapon site.

The illustrations (Figs. 31 to 37) convey an impression of the effect on these constructions of deep-penetration 12,000-lb. bombs, capable of displacing 1,000,000 cub. ft. of earth and making a crater requiring 5,000 tons of earth to fill.

Submarine Pens at Brest

The immensity of the pens and their solid structure exceeded any impressions which may have been previously gained by looking at plans or reconnaissance photographs. At first glance, it appeared that such a massive structure must be almost impervious to bombing. The entrance to the pens consists of a huge doorway with a heavily armoured door and with sufficient space for two large lorries to pass each other with ease. The roadway through this door traverses the entire length of the structure; on one side are three tiers of accommodation and on the other side are the pens. The first five pens are of the large wet type fitted with armoured guillotine doors on the seaward side, and the remaining 10 were of the dry type and were fitted with dock gates in addition to the doors. All the pens possessed overhead gantries, high-pressure air pipes and other equipment suitable for servicing submarines.

When they realised that surrender was near, the Germans threw every object they could lay their hands on into the pens, with the result that the surface of the water was covered with litter and oil fuel. Two large holes and a crack made by heavy bombs in the great concrete roof of the pens let in daylight to this gloomy scene. The reinforced concrete had been driven inwards, and hundreds of steel bars were dangling vertically from the roof. At the points of impact, the roof was approximately 16 ft. thick.

Access to the top of the pens was possible by means of inside steel ladders close to the main entrance. The most interesting feature on the

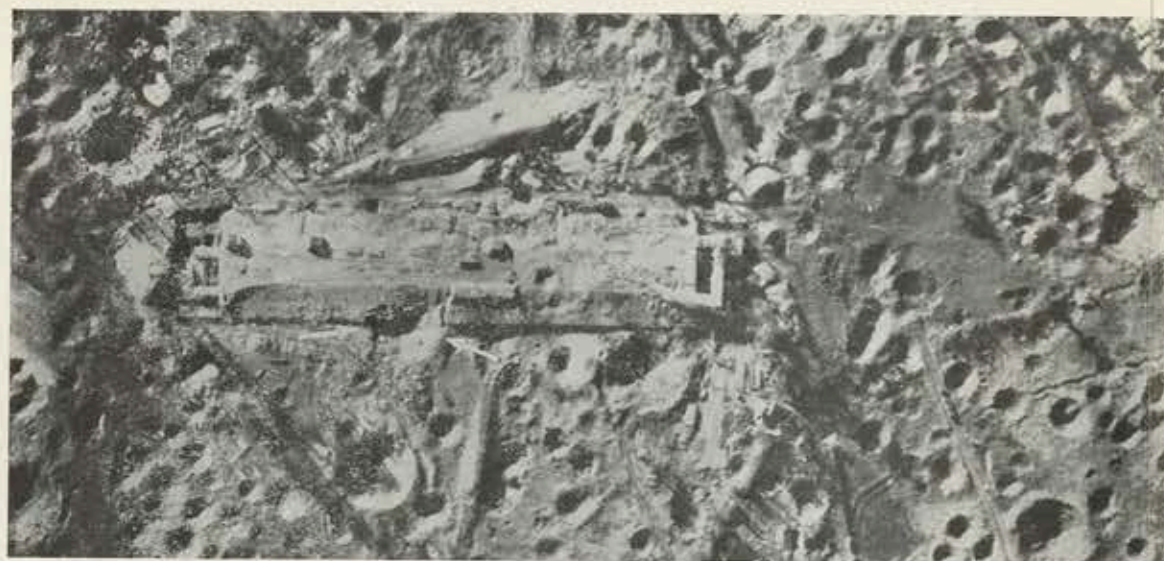


FIG. 31.—SIRACOURT. Vertical photograph of the supposedly "bomb-proof" concrete structure after a direct hit by a 12,000-lb. bomb (arrows).



FIG. 32.—SIRACOURT. Ground photographs of the effect on the concrete structure of a direct hit by a 12,000-lb. bomb (compare Fig. 28 above).

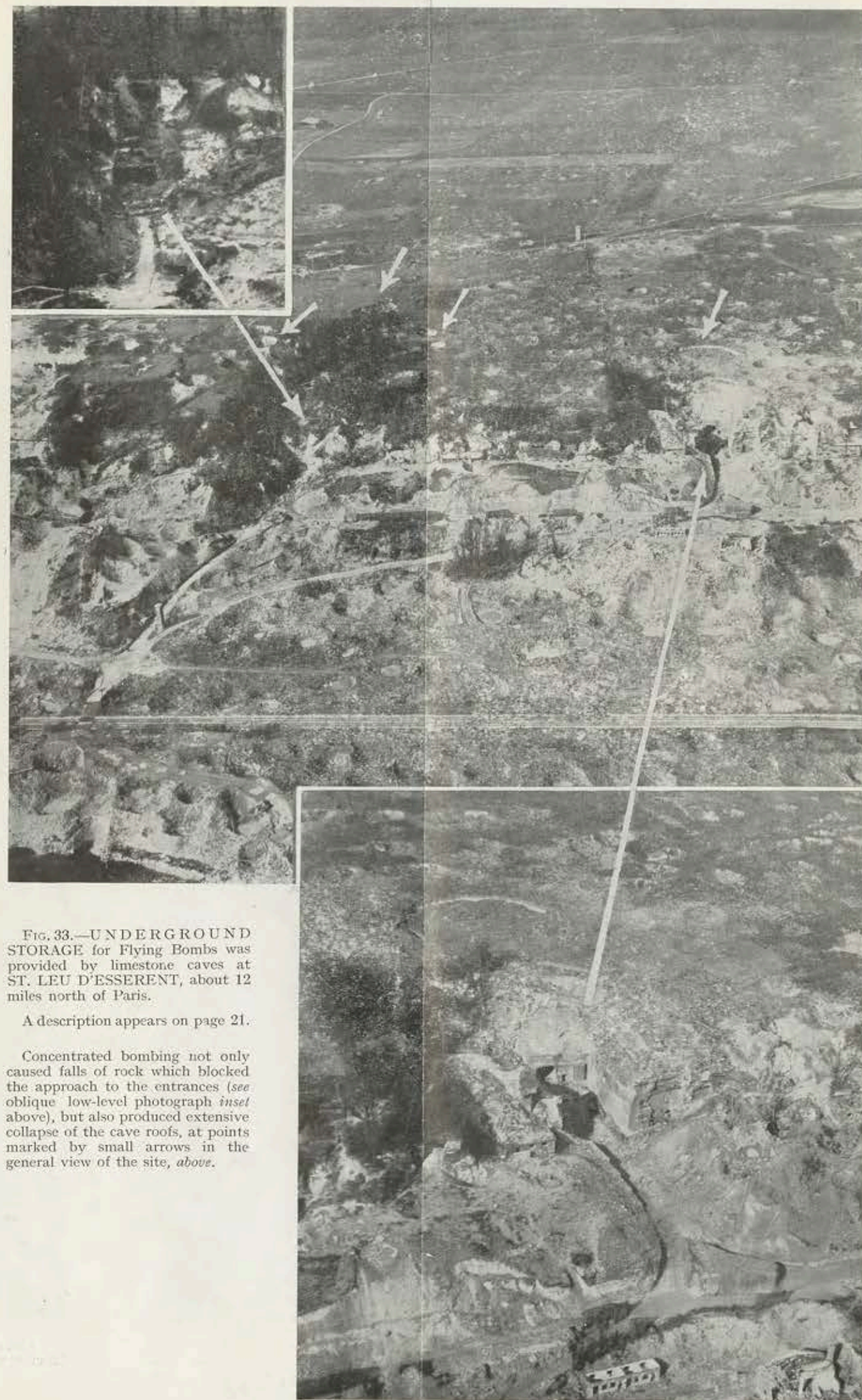


FIG. 33.—UNDERGROUND STORAGE for Flying Bombs was provided by limestone caves at ST. LEU D'ESSERENT, about 12 miles north of Paris.

A description appears on page 21.

Concentrated bombing not only caused falls of rock which blocked the approach to the entrances (see oblique low-level photograph *inset* above), but also produced extensive collapse of the cave roofs, at points marked by small arrows in the general view of the site, *above*.



FIG. 34.—(Above and right) LA PALLICE submarine pens during and after accurate daylight attack with 12,000-lb. bombs, 9.8.44. (To aid comparison, annotations, *a*, *b*, and *c*, have been inserted on both photographs.)

Arrows indicate the chief point of damage to the heavy concrete roof, which was destroyed over an area measuring 240 ft. by 120 ft.

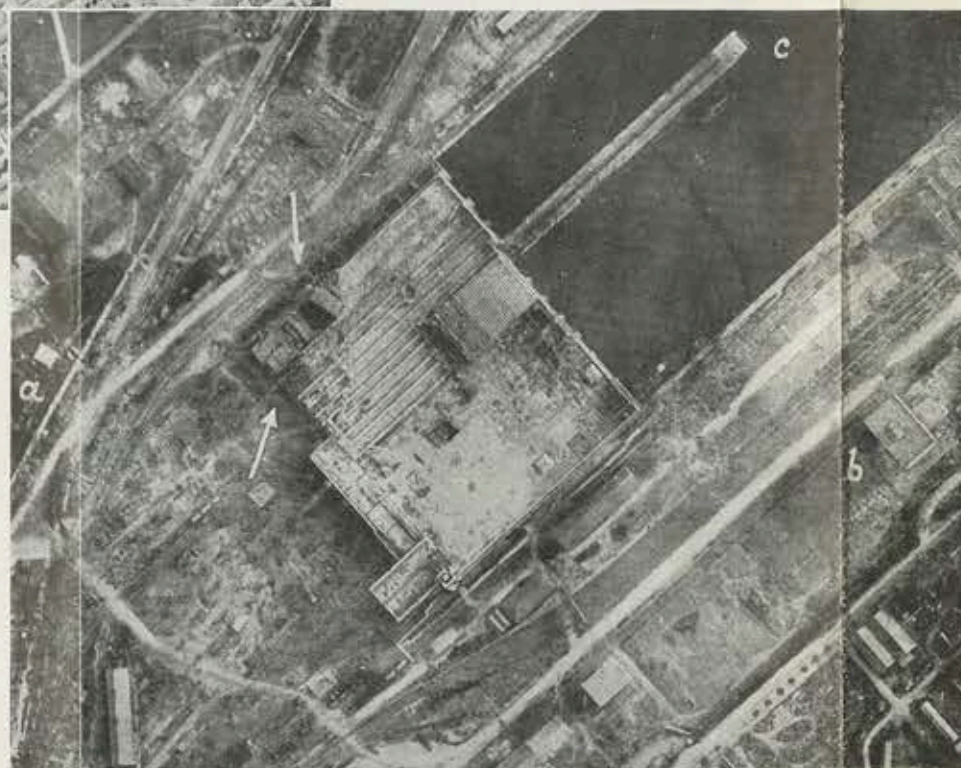


FIG. 35.—(Right) BREAST submarine pens during attack by only five aircraft carrying 12,000-lb. bombs, on 13.8.44.

The pens, measuring more than 300 yards in length, are hidden by a concentration of bomb-bursts.

(See Fig. 37, below.)

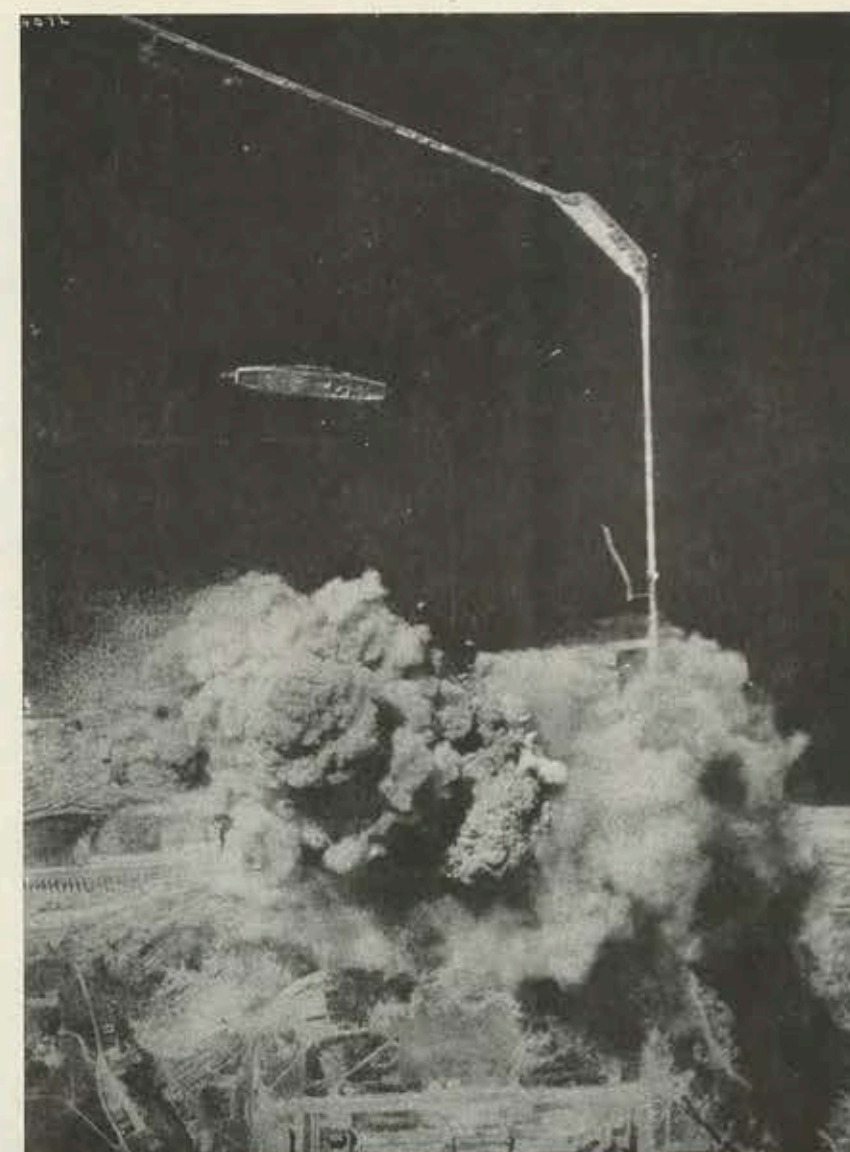


FIG. 36.—IJMUIDEN "E" and "R"-Boat pen, after the daylight attack on 24.8.44. This vertical photograph shows:

- A — A 15 ft. hole through the concrete roof.
- B — Large portion (94 x 30 ft.) of the back of the pen destroyed.
- C — Debris in the dock caused by blast from inside the pen, and from a near miss in front of the entrance.
- D — Two very near misses by 12,000 lb. bombs, one crater measuring over 100 ft. across.



FIG. 37.—BREAST submarine pens. This photograph, taken on the roof of the pens, shows a hole in the 16-ft. reinforced concrete roof resulting from a direct hit by a 12,000-lb. bomb.

roof was new construction to add on extra thicknesses of concrete, and a system of bursting spaces for the entire area. About one-third had been completed, and measurements showed that it had been the intention of the Germans to construct finally a roof which in some places, together with the bursting spaces, would have been no less than 29 ft. thick.

On the roof it was possible to see the craters formed by the heavy and other smaller bombs. In all, nine of the 12,000-pounders hit the roof, making two penetrations and one crack.

After visiting the pens we made a difficult journey towards the dockyard to visit the two large graving docks which contained sperrbrechers, and to ascertain the effect of Bomber Command's recent bombing of these targets. After clambering in and out of craters and climbing round girders, overturned railway trucks and other obstructions, it was possible to get near the dock side, where an excellent view could be obtained. Both sperrbrechers had been severely damaged and both were resting on the bottom of the flooded docks. The damage in this vicinity caused by Bomber Command's attacks was exceptional.

St. Leu d'Esserent

This site consists of a cave area tunnelled some years ago into the limestone hillside overlooking the River Oise. The Germans had cleaned up the inside of the area and were using it for the storage of flying-bombs.

The aim of the attack was to collapse the roof of the cave, which, as far as could be ascertained, had an average thickness of about 25 ft. of limestone and clay. A subsidiary aim of the attack was to devastate the road and rail communications running between the entrance to the caves and the river, in order seriously to impede communications. Unfortunately, full examination of the area over the caves could not be made, owing to the presence of mines, but all but one of the known 12,000-lb. hits were, in fact, examined from the outside; the effects of this one incident were, however, seen from the inside of the caves where the roof had been brought down and completely blocked the tunnels.

During the examination of the ground above the caves, two instances were noted where multiple hits from 1,000-lb. bombs had caused a subsidence of the roof. Another large area of subsidence had occurred from a 12,000-lb. hit, on which 1,000-lb. bombs had also fallen. There were, therefore, a total of three areas of subsidence, of which two were examined externally. Over the soft limestone, of about 12 to 15 ft. in thickness, was a covering of soft clay 6 to 10 ft. thick.

The Germans, before departure, demolished one of the main entrances, presumably with a view to sealing up equipment within. One other entrance was open and showed signs of considerable spalling from the roof, one enormous block of stone having crushed two flying-bombs, and a little further on the tunnel was completely sealed by subsidences caused by a 12,000-lb. hit.

The whole area between the caves and the river was utterly devastated by concentrated H.E. bombing. The railway had been re-laid by the Herculean efforts of 5,000 U.S. engineers, and the roadway was in the process of being cleared

by French labour. This aspect of the attack was undoubtedly effective, and must have seriously impeded the Germans' communications.

Wizernes

This site is situated in a chalk quarry, the steep side of which faces towards London. Work was started on it in July, 1943, and 3,000 prisoners assisted by Italian labourers were reported to be employed on it. Surmounting a slight depression in the contours at the top of the quarry is a shallow concrete dome approximately 300 ft. diameter and of a thickness which cannot be measured, except at the periphery, where it was found to be 9 ft. thick; it was estimated that the centre of the dome was probably not less than 20 ft. thick, plus some 12 ft. of earth which was in the process of being dumped on the top of it. Round the perimeter of the dome is a reinforced concrete collar, supported on radial concrete arms; this collar is 24 ft. wide, and about 12 ft. thick. Direct entrance to the dome can be made through a small opening, through which spoil was being evacuated, but it was apparently intended that this entrance should eventually be sealed up as reinforcing bars had been left in place, and bent back to enable the passage of light railway trucks. The soil under the dome had been excavated to a depth of approximately 30 ft. Further and deeper excavation was in progress at a point immediately in line with the firing tunnel. It is thought that a shaft was to be driven vertically downwards at this point in order to bring the flying bombs up to the firing chamber. Just outside this entrance on the hillside, was a rectangular concrete structure with vertical and twin horizontal loopholes.

Just below the dome, and pointing in the direction of London, is a concrete structure which appears to be the end of a flying bomb launching ramp; grooves on the inside of the vertical walls were similar to those provided for mounting the rails on other sites previously examined.

The main entrance to the workings, all of which had been excavated by the Germans, was along the railway track below, and slightly to one side of, the launching tunnel. The workings consisted of a series of tunnels driven through the chalk and extending south-west for approximately 500 yards. At this point a vertical shaft, 110 ft. deep, extended to the surface; this shaft was 16 ft. square and was permanently timbered, possibly a lift shaft or rocket launching site. Near this point a hit with a 12,000-lb. penetration bomb had been obtained, on the edge of the quarry face, and this had brought down the roof and entombed some 300 workers and also closed an entrance to the workings. Another hit had been obtained in the face of the quarry just under the collar, and this, supported by two near misses, had brought down much of the quarry face, exposing two of the collar supporting arms and undermining the launching tunnel, which had canted over to one side. A large crane which had been used for hoisting constructional materials to complete the collar and firing tunnel was completely destroyed and partially buried. In addition, these 12,000-lb. hits sealed up a further entrance to the workings. The whole area covered by the constructional machinery, rail tracks and rail head, was very heavily damaged by bombing with medium-sized bombs.

(c) Flying Control in War

The need for a Flying Control Organisation was clearly shown by the experience of the first months of the war when for the first time numbers of aircraft were operated over long distances in bad weather conditions. An organisation known as Regional Control was evolved before the war, the aim being to give help to aircraft lost in distress. It was not sufficiently comprehensive to deal with more than a comparatively small number of aircraft, and the procedure was far too complicated for a tired crew to carry out at a critical moment.

In order to meet the increasing needs of the Royal Air Force, it was decided at the end of 1940 to institute a universal system of Flying Control. At first the aim was limited to the provision of means for the safety of operational aircraft returning to their bases. Plans were produced for the training of a large number of Flying Control Officers in their specialised duties and means were gradually devised for giving as much help as possible to operational aircraft within the terms of reference of the new organisation.

hence the bomb load. Some procedure for the control of large numbers of aircraft returning to base at the same time was therefore essential if aircraft were to be landed safely in the minimum time after completing a long operational sortie.

Many different aids and landing procedures were evolved for helping and controlling these large numbers of aircraft returning to congested airfields at the same time. Drem lighting was installed and was gradually improved by the introduction of sodium lights, lead in lights, funnel lights, angle of glide indicators, and identification letters. The use of searchlights as aids to homing was introduced. Small powered searchlights, known as Sandra's, were installed to cone an airfield so that a returning aircraft could find it in poor weather. Beacons flashing two letter Red characteristics and aerial light-houses flashing one letter White characteristics are in use as navigation aids and to mark "stand off" areas for aircraft waiting their turn to land. In addition, different landing procedures for the control of aircraft during the actual landing were

SUMMARY OF DIVERSIONS, ACTUAL AND PROVISIONAL

Date.	B.C. Operational Diversions.		B.C. O.T.U.s Diversions.		U.S.A.A.F. Diversions.		Other Commands Diversions.	
	Pro- visional.	Actual.	Pro- visional.	Actual.	Pro- visional.	Actual.	Pro- visional.	Actual.
Day of 6th May 1944	515	152	—	—	633	21	10	5
Month of July 1944	4,619	1,019	832	130	1,514	181	1,719	196
1st Nov. 1943-31st Oct. 1944.	36,694	7,885	3,860	847	15,978	2,215	6,400	1,309

As time went on and the amount of "round the clock" flying increased, the need for a system of control of all types of aircraft, regardless of function, became apparent. In particular, the introduction of runways on the majority of airfields in the United Kingdom and the operation of aircraft under blackout conditions emphasised the need for the control of aircraft on the ground as well as in the air. Thus the duty of the Flying Control Organisation as a whole may now be defined as "the responsibility for the safety of all aircraft from the time of their leaving dispersal until their return to it." In addition to this increase in duties the scope of the organisation has been extended to the Overseas Commands. Flying Control operates throughout the whole of the day and night, and has saved large numbers of aircraft and their crews.

As the air forces expanded, more and more airfields had to be built. The new airfields could not be evenly distributed over the whole of the country, and the result was that there was great congestion in some parts of England. At the same time the new types of aircraft needed a larger runway than the old so that some of the airfield circuits overlapped, and they were frequently separated by less than a mile.

This congestion of airfields created an operational problem of the first magnitude. The time taken in landing aircraft after an operation was a serious factor affecting the petrol load and

continually being tried out with proved success. Throughout the period under review much experimental work has been carried out in the use of Radar equipment for the control of aircraft. The GEE equipment is already extensively used to enable aircraft to break cloud safely and approach airfields in bad weather.

There were many different procedures for landing, and aircraft might often use several of them at the same time. There was then a serious danger of aircraft colliding when large scale diversions were necessary. To reduce that risk, two alternatives were open: (1) Pilots and Flying Control Officers must understand all the different procedures in use, or (2) one standard procedure must be evolved. The advantage of one standard procedure can be readily appreciated.

After many difficulties had been overcome, a standard procedure was in fact adopted throughout Bomber Command and introduced in other Commands for all diversionary purposes. It is too early to say whether this, or some modification of it, could be made a universal system throughout the service. This standard procedure enables large numbers of heavy aircraft to land safely in all sorts of weather at an average interval of less than 2 minutes for every aircraft. To get a smooth, fast flow of aircraft from the landing circuit to the runway and finally to dispersal, it is essential to have good flying discipline in the air combined with a quick clearance of the

runways and an efficient flying organisation on the ground. This two minutes average is a remarkable achievement compared with 6-8 minutes in days gone by, particularly when it is remembered that Bomber Command aircraft usually operate at night and in all types of weather.

In the event of diversion of aircraft because of bad weather, or distress, an organisation known as Central Flying Control has been set up at Headquarters, Bomber Command. This organisation serves all Commands and is responsible for advising and collating the diversion of aircraft from areas where airfields have become unfit due to weather or other causes to areas where airfields are still in use. An up-to-date record of all airfields in this country is maintained showing the facilities at each and annotating those most suitable for the diversion of heavy aircraft. A meteorological staff work in co-operation with

installations clearly defining the lanes by day. The standard landing procedure is in use at the emergency runways for all normal landings in addition to an emergency procedure for aircraft in distress. To know that he can land on a specially wide and long runway has a great psychological effect on a pilot in distress, and it is true to say that these Emergency Runways have paid handsome dividends in the saving of lives and aircraft. The Emergency Runways Monthly Bulletin gives details of a few of the incidents, and great credit is due to the ground staffs who are continuously "on their toes" day and night.

The increase in the Bomber offensive focussed attention on the large number of potential flying hours lost as the result of fog or the possibility of fog. The possibility of dispersing fog over airfields to assist aircraft landing was considered some time ago and some of the first experiments took place in fog conditions in November, 1942.

SUMMARY OF LANDINGS ON EMERGENCY RUNWAYS IN SEPTEMBER

Emergency Runway.	Technical Failure.	Damaged by Enemy Action.	Shortage of Petrol.	Diversion.	Without Under-carriage (on Runway).	Without Under-carriage (on Over-shoot).	Total for Sept.	Total Landings to Date.
CARNABY								
Opening date 20.4.44	61	7	8	35	—	—	111	351
WOODBIDGE								
Opening date 15.11.43	43	129	41	46	2	5	266	1,410
MANSTON								
Opening date 20.4.44	42	59	174	335	2	—	612	2,197

Central Flying Control and the state of the weather at every airfield is recorded hourly. The following figures of aircraft diverted in bad weather conditions will readily show the scope and responsibility of this organisation, which maintains a continuous watch.

There is always a risk of an aircraft crashing on landing after an operation because flak or fighters have damaged the hydraulics and this may make a runway unserviceable and put the airfield out of action. The diversions of other aircraft may not then be possible if they are short of petrol. To take care of such aircraft three emergency runways were constructed at Carnaby, Woodbridge and Manston and are now fully operational and available for all types of aircraft of all Commands. Each of these runways is 3,000 yards long and 250 yards wide with an undershoot area of 500 yards and an overshoot area of 500 yards which is being extended to 1,000 yards. The runways are divided laterally into three landing lanes. The South lane is coloured Green by night and marked by White painted lines by day; this is the emergency line on which aircraft in distress can land without contacting Flying Control. The centre lane is coloured White and the North lane Yellow by night, the line of light

The method used was to evaporate the fog water droplets by direct heating of the air, the heat required being supplied by burning super heated petrol under pressure. A number of enquiries and experiments have also been made in other directions and in other countries. Very briefly the arrangements of the apparatus known as F.I.D.O. is as follows. The main burner lines run parallel with the main runway which is equipped with a blind approach apparatus, by using which an incoming pilot may make the initial part of his approach to the runway in fog or low cloud. Upon entering the fog-cleared zone at an altitude of approximately 100 ft. or more, the final glide and touch down can be effected visually. The main burner lines begin some 250 yards before the touch down end of the runway and this end is sealed against fog intrusion by a cross line of burners. Fifteen F.I.D.O. airfields are now in operation in this country, including the Emergency Runways, and they have proved to be of the greatest value to bombers returning from operations. The landing operations on 19 November, 1943, when four Halifax bombers were successfully landed by F.I.D.O. were reported to the Prime Minister, who signalled his congratulations to all concerned.