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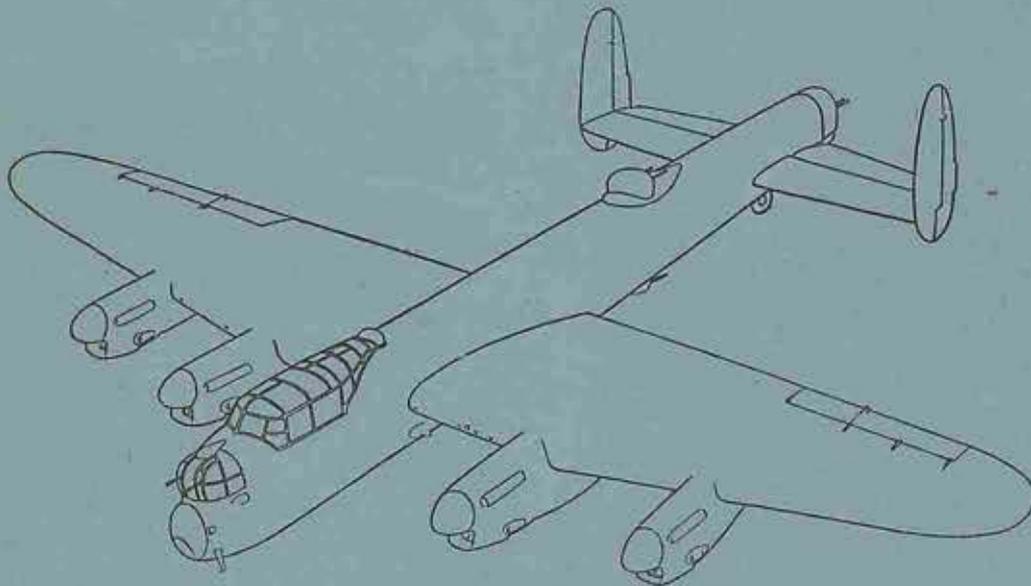
BOMBER COMMAND QUARTERLY REVIEW

16 Feb 81

17 Feb 81

January — February — March, 1943

No. 4



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CONTENTS

	<i>Page</i>
I. REVIEW OF THE BOMBER OFFENSIVE	
Introduction	1
(i) Essen Devastated	2
(ii) Attacks on other Industrial and Naval Objectives	5
(iii) The Air Offensive and the Axis Transport System	9
(iv) War against the U-Boat : a Survey of the Year ended March, 1943	12
 II. FLYING INCIDENTS	
(i) Flying a Lancaster with Two Engines on One Side	16
(ii) A Parachute Descent over Enemy Territory	16
(iii) A Successful Crash-Landing in Sweden	17
(iv) An Aircraft sees a U-Boat blown up by a Mine	18
 III. THE IMPORTANCE OF THE RUHR	
	19

ILLUSTRATIONS

<i>Figure</i>		
1	Essen : the Result of Three Night Raids	} <i>between</i> 4-5
2	The Centre of Essen Devastated	
3-4	The Northern Section of Krupp's Works	
5-6	A Transformer and a Radio Works	
7-9	Attack on Knaben Mines	} <i>between</i> 8-9
10	Eindhoven Radio Works again Damaged	
11	Naval Ammunition Depôt Obliterated	
12	Attack on Rotterdam Docks	
13-14	German Railway Centres	} <i>between</i> 10-11
15	Mosquitoes Attack Locomotive Works	
16	Low-level Raid on Railway Workshops	
17-18	Bostons Attack on Morlaix Viaduct	
19-20	Lorient and St. Nazaire	14-15

DIAGRAMS

Map Showing Distribution of Bombing Operations	1
Damaged Buildings in Krupp's Works, 5/6 March-3/4 April	2
The Installations of the Molybdenum Mines, Knaben	7
Rail Communications to Brest and Lorient	11
The Ruhr Towns	19

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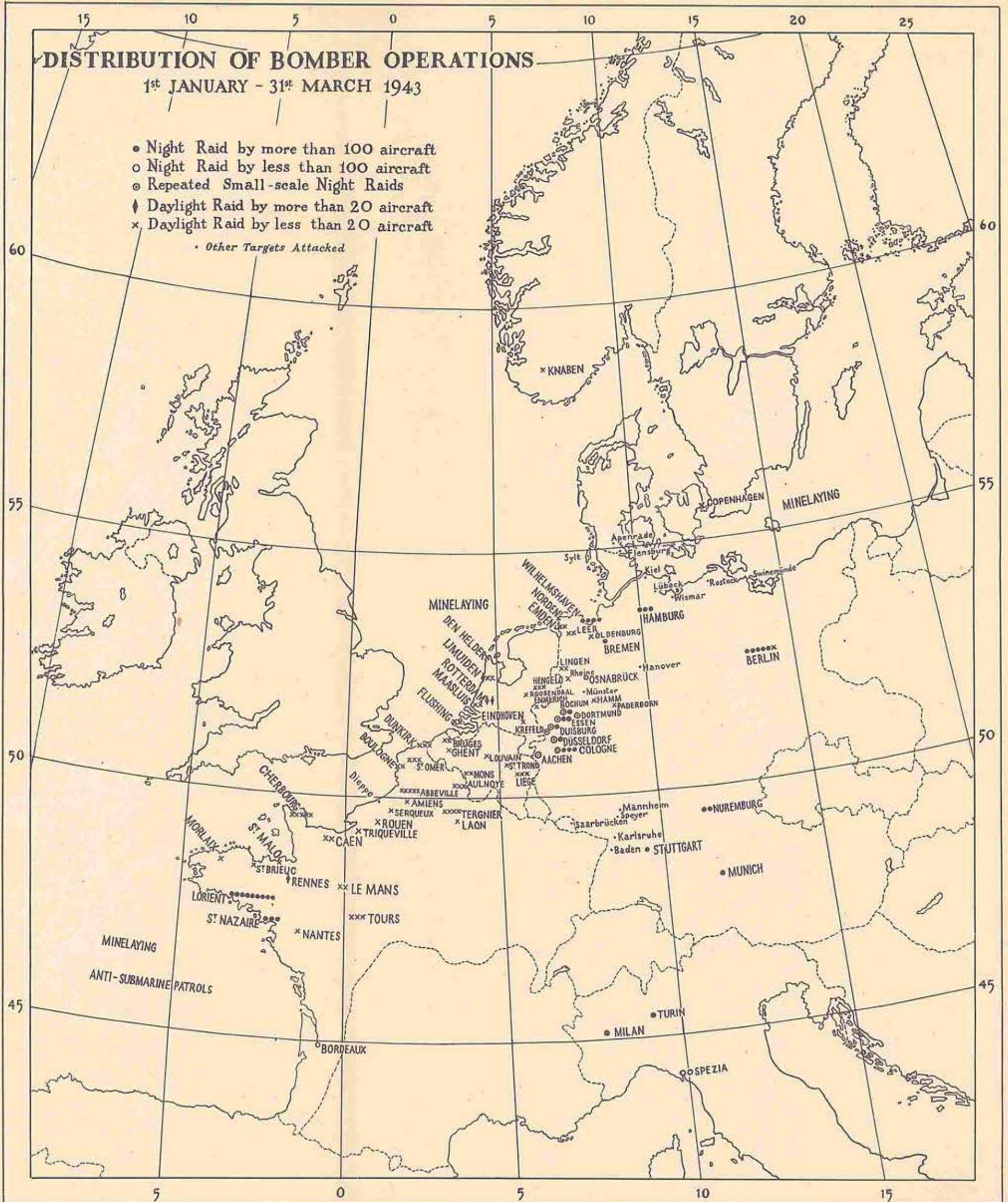
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DISTRIBUTION OF BOMBER OPERATIONS

1st JANUARY - 31st MARCH 1943

- Night Raid by more than 100 aircraft
- Night Raid by less than 100 aircraft
- ⊙ Repeated Small-scale Night Raids
- ◆ Daylight Raid by more than 20 aircraft
- × Daylight Raid by less than 20 aircraft
- Other Targets Attacked



BOMBER COMMAND QUARTERLY REVIEW

No. 4

I. REVIEW OF THE BOMBER OFFENSIVE

1st January—31st March, 1943

Introduction

In the past the first quarter of the year has generally proved the least favourable for bombing operations owing to the influence of the weather. The first three months of this year were therefore all the more remarkable for a scale of effort which surpassed all previous records since the beginning of the war—not only in quantity but also in the importance of the results achieved. A comparison with the first quarter of 1942 is very striking.

Quarter.	Total Sorties Despatched.	Weight of Bombs Dropped on Enemy Territory.	No. of Mines Laid.
January–March, 1942	6,126	5,974 tons	724
January–March, 1943	14,632	25,881 tons	3,573

While the number of sorties despatched was considerably more than twice that of the corresponding period last year, the weight of bombs was more than four times as great, far exceeding the earlier record of 16,000 tons dropped in the third quarter of 1942. This growing weight of attack illustrates the effect of the continued increase in the proportion of heavy bombers, which now form approximately 65 per cent. of all the operational aircraft in the Command. The carrying capacity of the present force is well shown by the fact that up to the end of March the Command had dropped, in the fourth year of the war, more than the combined tonnage of the first two years. Already in January, February and March nearly 3,775 heavy H.E. bombs (of 4,000 lb. or over) had been released on enemy targets, as against 4,055 in the whole of 1942. But the greater bomb capacity of our aircraft is only partly responsible for the notable advance in the scale of air offensive. The outstanding feature of 1943 has been the substantial increase in the total number of sorties. This is to some extent the result of an expansion in the first-line strength of the Command, but development in bombing technique has also enabled night-bombing squadrons to operate in weather that would have seemed impossible a year ago. In the past, conditions of poor visibility over the target area precluded the chance of a successful attack, but effective operations can now be carried out even when haze or cloud prevents visual identification of the objective. Between the New Year and the end of March, 1943, the Command operated on 67 nights, as against 58 for the same period of 1942.

The new technique has extended the scope of the offensive in several respects. While any one target can be subjected to a larger number of attacks during a given period than hitherto, the choice of objectives is also less restricted, so that the cumulative effect of our operations is considerably greater, even during a period of indifferent weather. But the best results have been obtained in good or moderate weather and in areas most favourable to the use of radio aids. The overwhelming success achieved at Essen shows what can be done in such conditions, and several other highly important but more distant industrial centres such as Berlin, Munich and Nuremburg received really damaging attacks for the first time within the period reviewed.

It would have been hardly surprising if these intensive operations had entailed a loss-rate equal with the highest experienced last year, since the enemy's defences have multiplied as the war has developed. In the event, the cost compared favourably with the average for 1942, and February's losses (2.5 per cent. of sorties despatched) were actually the lowest for any month since May, 1941. This was, no doubt, partly due to the high proportion of sorties made against targets in Western France during the month, but it should be noted that the defences of the Ruhr also proved less effective than in 1942. The average loss-rate for operations in that area stood at 3.3 per cent. for the first three months of this year as against the average of 4.4 per cent. for last year. Some of this improvement was due to the fact that our bombers were able to operate in weather conditions which hampered the enemy's fighters and prevented his searchlights from operating effectively.

The distribution of effort is set forth in the table below, and the targets attacked on bomber raids are shown on the map facing page 1.

BOMBING OPERATIONS.			OTHER OPERATIONS.		
	Sorties Despatched	Weight of Bombs.		Sorties Despatched	Results.
Germany	7,688	17,442 tons	Sea-Mining	1,647	3,573 mines laid.
Italy	338	636 tons	Leaflets	208	Approx. 49 million dropped (including those dropped on bomber raids).
Occupied Europe ..	4,094	7,803 tons	Anti-Submarine Patrols.	657	21 U-Boats sighted, 11 attacked.
Total .. .	12,120	25,881 tons	Total .. .	2,512	—

It will be noticed that more than half the total sorties and 67 per cent. of the weight of bombs was directed against targets in Germany. Of these, objectives in the Ruhr area received the most persistent battering so far experienced by any part of Germany. The results of the raids on Essen itself are of such outstanding importance that they are described separately in Section (i). The second section summarises more briefly the salient features of attacks on other centres of the enemy's war production, whether in Germany, Italy, or in the Occupied Countries.

Operations against Germany's extended and over-burdened lines of communication (Section (iii)) form an increasingly significant part of the bomber offensive.

An exceptional feature of the first quarter of 1943 was the series of heavy night raids delivered on the submarine bases on the west coast of France. These have been considered in the fourth section which takes the form of a review of the various ways in which the Command has contributed to the defensive war against the U-Boats during the year ending 31 March, 1943.

(i) Essen Devastated

For three years Essen has represented, so to speak, the bull's eye for our offensive against German war production. The enemy, knowing full well what the destruction of Essen would entail (*see* article on page 19) used every means in his power to frustrate our attacks. The struggle resolved itself into a major and long-drawn-out battle in which the initial advantages lay almost entirely with the defence.

The city of Essen is about three miles in diameter, situated in the centre of the sprawling industrial area of the Ruhr. There is no prominent landmark at Essen itself, which appears very similar to other towns in the valley. Indeed it is very difficult at night to discern where one Ruhr town ends and the next begins, owing to the scattered settlements of the workers and outlying industrial concerns which cover much of the intervening districts. Essen is a dozen miles from the nearest point on the Rhine and even the Ruhr is several miles away. Although there are features of the latter and of the canal system further north which should be recognisable under favourable weather conditions the region is notoriously subject to thick industrial haze, and at night it is generally difficult to distinguish any features whatever.

In addition to the natural difficulties of finding the city the enemy concentrated a vast quantity of guns and searchlights in the area, and expended much effort in producing effective decoys. He did his utmost to hide Essen by camouflaging distinctive landmarks, the outstanding instance of which was the draining of the great sheet of water known as the Baldeney See.

It is therefore not surprising that methods of attack which proved successful elsewhere failed to produce the same effects on Essen. Although 10 per cent. of our whole bombing effort in 1942 was directed against Essen little damage was inflicted on the main target. However, a considerable proportion of the weight of these attacks fell on other built-up areas in the Ruhr, and especially useful damage was done to the Thyssen steel works at Hamborn and to important factories at Oberhausen by crews unable to locate Krupp's. It became obvious as a result of these operations that something quite new was required to help crews to locate this target in the heart of the built-up Ruhr, and in spite of industrial haze and the concentrated flak defences.

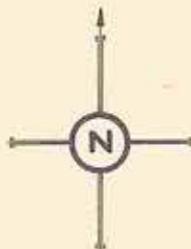
During the latter part of 1942 the development of new tactical methods, including visual target-marking devices, showed that it was possible in good weather conditions to effect a considerable improvement in the concentration of bombing.

In January and February, 1943, relatively small forces of Lancasters, led by a few P.F.F. Mosquitoes, operated over the Ruhr on many occasions, often in unfavourable weather. Among the damage later seen on reconnaissance photographs was the almost complete destruction of a large building in Krupp's that was probably an open-hearth steel-working shop, and buildings at Krupp's Helene mine were also seriously damaged by fire. In addition P.F.F. Mosquitoes alone carried out harassing raids on the Ruhr with insistent regularity so that throughout the whole of the first 12 weeks of

FRIEDRICH KRUPP A.G.

○ Damaged areas

SCALE
0 500 1000 2000 FEET



1943 the enemy alarms were sounded and the defence services called out on an average of one night in two. These raids caused considerable disturbance over a wide area, particularly in factories where night work was in progress, while our main bomber force was employed elsewhere. On 5 February the president of the Essen police felt obliged to publish a "final warning" to all "who continue irresponsibly to neglect their A.R.P. duty." He had observed during the recent raids that "a large part of the population leaves its houses for bunker shelters during air raids, without leaving fire-watchers behind." He ordered that every house was to be provided with three people to watch for incendiaries, and shelter wardens were categorically forbidden to admit able-bodied males between the ages of 16 and 65. Thus, even before Essen was seriously damaged, the feelings of the people could be expressed in an editorial in the *National Zeitung* of 3 March in these words:—

The population of the Ruhr district . . . are meeting the enemy's blows for the entire nation. They are facing the enemy nightly and working daily with undiminished diligence. . . . It is difficult to give a correct picture to someone who has not experienced a raid, and even those who have occasionally been through one cannot imagine what it means to be expecting them continually and to live in strained preparedness to defend oneself against this terror.

Two days later the city experienced the first of three really shattering blows. On 5/6 March 442 aircraft were despatched against Essen and found good weather over the target apart from the usual haze. The Pathfinder technique was unanimously reported to have been perfectly executed. The official narrative of the operation summarised it as follows:—

Red target-indicators were well positioned and the backers-up, with green target-indicators, bombed with great accuracy, focussing the attack on the centre of the target. Innumerable fires were seen well concentrated around the markers, there being an almost solid circle of fires two miles in diameter. Descriptions of these vary from "looked like an immense pot boiling over," to "the glow from 150 miles away looked like a red sunset."

Nothing in the least like this had ever happened to Essen in any previous attack and as a result of the concentration achieved only 14 aircraft were missing from this operation. Some experienced crews reported the fires "largely massed close to Krupp's works" as the biggest and most concentrated ever seen. Months and even years of grim endeavour, of experiment and of training in new methods, had at last provided the weapon and the force capable of destroying the heart of the enemy's armament industry. It was a victory comparable only with Cologne, and marked the turning point in the battle of the Ruhr.

A week later, on 12/13 March, another attack was made by a similar force and, in spite of increased opposition from the flak defences, this operation was no less effective. All crews reported that the Pathfinders' aiming-point markers were accurately timed and concentrated. After the first quarter of an hour the fires merged into a huge mass of red flame. In the attack which took place at the beginning of the next quarter (3/4 April)—the third within a month—we gained a further great success and Krupp's once more suffered direct and severe damage.

Excellent reconnaissance photographs proved beyond doubt the severity of the blows which Essen had suffered. Fires were still burning the second day after the raid of 5/6 March and the centre of the city was seen to be devastated, one fire-swept area alone including about 160 acres of municipal, commercial and residential buildings (Fig. 2). Twenty per cent. of the city centre was completely destroyed. At Krupp's the damage affected no less than 53 separate shops covering well over a million square feet, and representing 10 per cent. of the total area of the buildings in the works. In view of the distribution and high proportion of heavy fire damage a production loss equivalent to two weeks output of the whole of Krupp's works is the minimum expected from this one attack.

Serious industrial damage (mainly in Krupp's) was estimated to cover 66 acres and this with non-industrial damage elsewhere in the city made up an aggregate of 300 acres of seriously damaged buildings as a result of the first raid only. On the basis of damage seen on reconnaissance photographs an estimated total of 13,220 dwelling units were rendered uninhabitable. The number of people rendered homeless was estimated at 50,000 of whom over 40,000 belonged to the working class, and most of these were probably Krupp's employees. Damaged but habitable houses were estimated at 52,000, apart from minor damage such as broken glass, etc., and first-aid repairs to these over the first six months after the raid will require about six million man-hours. Well over a third of all the houses in Essen suffered some form of damage.

Although reconnaissance showed that part of the works was able to remain in operation after the first attack, this state of affairs was changed within a week. The reconnaissance report issued after the attack of 12th/13th stated:—

Whereas damage from the previous raid was seen mostly in the town centre and the Krupp works, the fresh damage is most concentrated in the works and suburban areas to the north-west. Almost as large a number of shops and administrative buildings of Krupp's have been affected as in the last raid and the damage is on a scale altogether more severe. . . . Some of the larger buildings are seen to be still on fire. Forty-eight shops and administrative buildings are affected of which 12 are main workshops where half the area has been destroyed or severely damaged. The locomotive works, the largest individual shop, has damage extending over 85,000 square yards. Altogether the area of the buildings of the Krupp works destroyed or severely damaged in this raid exceeds 196,300 square yards as compared with 136,000 square yards of damage in the previous raid.

A great number of hutted camps in the northern districts have suffered damage. In all some 120 huts have been destroyed, including the large messing huts or canteens, and it is roughly estimated that accommodation for at least 6,000 workmen is in consequence no longer available.

The damage in this raid was concentrated into the industrial zone to a remarkable extent. A detailed analysis shows that there was approximately twice as much industrial damage as non-industrial. Out of an estimated total of 71 acres of seriously affected industrial buildings by far the greater part occurred in the Krupp works itself.

As a result of the two March raids, 27 per cent. of the built-up area of Krupp's was seen to have suffered damage. This affected over half of the 300 separate buildings of the huge combine (*see* diagram). Taking into account only direct damage to the works shown by reconnaissance and ignoring the important effects of destruction of workers' houses, etc., the *minimum* total loss of production would be placed at two months equivalent loss for all departments of the works. This estimate is based on English repair rates; in fact later photographs indicate considerably greater delay in repair. Reports reaching this country via Sweden state that the damage to Krupp's was the heaviest so far inflicted by the R.A.F. on works vital to the German war effort. A week after the second raid no work was in progress at Krupp's and the whole plant was at a standstill when photographed on the day after the raid of 3/4 April.

The most heavily damaged departments as seen from photographs were situated in the northern and central sections of the works:—

Locomotive Department (Northern Section).—The main loco erection shop, covering about 19 acres, has been completely stripped of sheeting by H.E. bombs and fire. Roof-members are still in position over most of the area, but extensive damage to contents and internal structure may be assumed. Taking into account damage to engines in various stages of assembly, a loss of production equivalent to three months' full output of this absolutely vital department is considered probable.

Wagon Department (Northern Section).—The main wagon-assembly shop has been completely gutted. Allowing for the possibility of temporary dispersal, and even assuming that the production of components is not seriously delayed, a loss of two months' full output should occur. This may be reckoned as something not far short of one thousand heavy military wagons. It is, however, believed that this workshop is now mainly engaged in making tank hulls.

Motor Department (Central Section).—The motor assembly shop, believed to be producing heavy-duty lorries, received direct hits from H.E., which removed one half the area of roofing and also caused structural damage. It should be impossible to get this shop back into full production within two months of the date of damage, and a minimum production loss equal to three weeks' full output may be inferred.

Steel Processing Department (Central Section).—The main cast steel and steel processing shops suffered numerous smaller items of damage, which appear to have affected particularly the rolling mills, although a sheet metal shop, a machine shop probably employed on wheel axles, and a group of furnaces have also received severe structural damage.

The Power Station.—A power station within the site area has been heavily damaged, but plenty of power appears to be available from outside sources such as the large Essen-Karnap Steam Electric Station, and neighbouring industrial stations. It is unlikely, therefore, that the Krupp's station is a vital point, or that its damage caused a crisis in power supply. It will, however, have added considerably to the general chaos, which was described by the Ministry of Economic Warfare as "without parallel in previous experience of industrial bombing."

No other results of the two March raids can compare in importance with the damage to Krupp's itself, or the unhousing of thousands of their workers. The destruction by fire of 65 per cent. of the Goldschmidt factory, a "priority" target engaged in production of soft metals and alloys, bearing metals and welding materials, was, however, a very handsome bonus. The complete destruction by fire of the Wolff factory (including an iron foundry) is likely to cause difficulties in replacing machinery for the coal-mining industry at a time when many colliery buildings have suffered damage. This plant had doubled in size since 1937 and was probably in full production at the time of the raid. Krupp's Harbour Foundry Works, which supplies the main Essen works with more than a million tons of pig iron and steel ingots yearly, was seen to have been damaged over 100,000 square ft. This damage included a recent extension to the steel plant probably containing electric furnaces. In the Borbeck suburb a factory having the second largest production of zinc in Germany received blast damage from several H.E. bombs which fell on the site, and the important Presswerk (plastics and mouldings) factory was damaged over half its total area and in this case a minimum production loss of two months may be assumed.

From all this, which is by no means a complete summary of the industrial damage caused by these two shattering raids, it will be realised that a very considerable time must elapse before Essen's contribution to the war machine is worth the effort expended in rebuilding the place. Moreover, since the end of March, Bomber Command has delivered further deadly blows and on each occasion more of Krupp's was laid low. Details of the most recent raids will be given in the next *Review* but there are already indications of a transfer of labour eastwards—away from the shattered engineering shops of devastated Essen.

(ii) Attacks on other Industrial and Naval Objectives

A. Industrial Objectives

Western Germany.—While Essen bore the brunt of the renewed onslaught upon Western Germany the neighbouring cities of Duisburg and Bochum, and the great Rhineland cities of Düsseldorf and Cologne were also subjected to a sequence of relatively heavy night raids as well as many small ones. These had the effect of "softening up" the Ruhr, preparatory to the main weight of the spring offensive. Targets were generally located in cloudy weather by means of navigational aids. A neutral visitor who arrived in Cologne the day after one of these cloud-cover attacks (by 160 aircraft)

ESSEN: THE RESULT OF THREE NIGHT RAIDS

(See article on page 2.)



FIG. 1.—The outlined areas, amounting to nearly 600 acres, were damaged in the course of one month as a result of the night raids of 5/6 and 12/13 March and 3/4 April, 1943. About half of the 300 buildings in Krupp's works (enclosed by black line) were damaged, while in the central city, the shaded part (marked A above) was devastated over an area of 160 acres. This is illustrated on a large scale in Fig. 2, while a plan of the buildings in Krupp's will be found facing page 2. Many hutted camps for workers were destroyed in the raids and some are seen above (marked B). In March alone it is estimated that about 75,000 working-class people were unhoused, of whom the majority were Krupp's employees.



FIG. 2.—The northern half of the central city of ESSEN was wiped out on the night of 5/6 March, 1943. The 160 acres of devastation shown above extends over a mile and a quarter, from the damaged turning shops of Krupp's (right-hand bottom corner) to the Goldschmidt chemical and metal factory at (B). The outlined area, which includes the obliterated sections of the Goldschmidt factory, alone comprises 16 acres of complete destruction. At (A) are the gutted offices of the City Council, and many other public and commercial buildings are included in the ruined district.

THE NORTHERN SECTION OF KRUPP'S WORKS



FIG. 3.—All the buildings outlined were damaged on 12/13 March, or during the raid of the previous week. Many were still burning when the above photograph was taken.

- (A) The huge Locomotive and Tender Erection Shops entirely stripped of roofing, the whole area having been swept by fire. This is the largest individual building in Krupp's Works and, with a smaller workshop which was also demolished, had an output greater than any other locomotive works in Axis Europe apart from Henschel's of Kassel. The long block adjoining contains Drawing Offices, now gutted. Including these, the overall length of the Locomotive Shops is about a quarter of a mile.
- (B) Bar Rolling Mill for high speed steels, and Machine Shops producing armaments and heavy machine tools: part destroyed, the remainder showing roof damage.
- (C) Large Workshop, believed to make tank hulls, practically destroyed by fire, still burning strongly.
- (D) New Workshop believed to make flak wagons and armoured trains as well as carriages for heavy guns.
- (E) Machine Shop thought to produce gun-carriages and special rolling stock, completely unroofed.

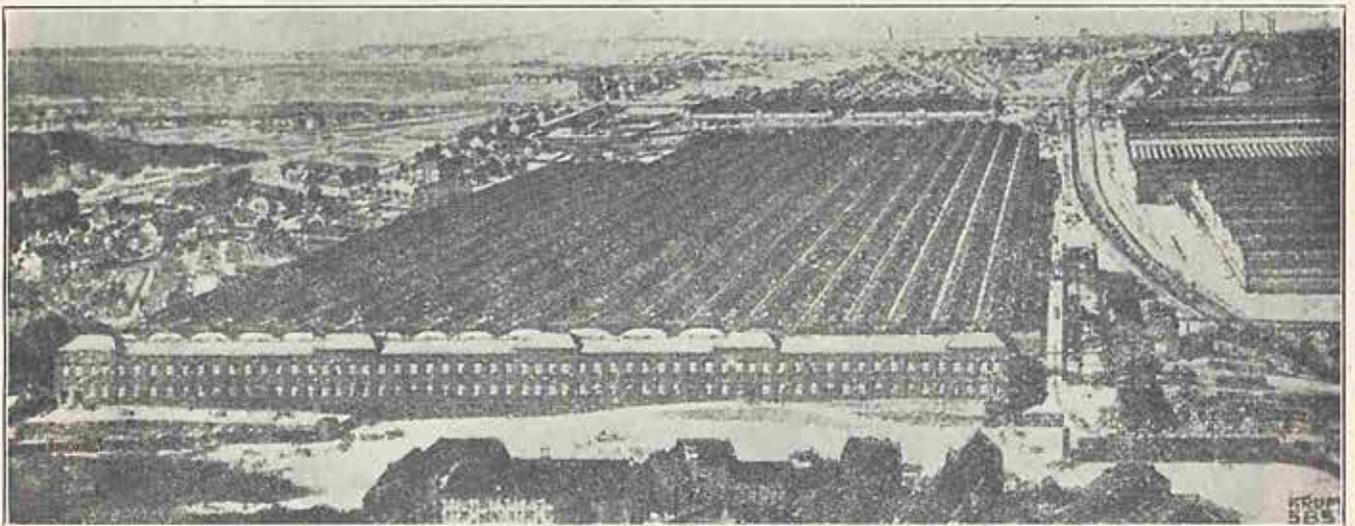


FIG. 4.—A low oblique view of the huge Locomotive Erection Shops as they stood before the raid of 12/13 March. This vital section of the works covered nearly 20 acres. Comparison with the vertical photograph above shows that from end to end the whole building was unroofed and fire undoubtedly caused heavy damage to the contents and internal structure. The importance of this blow to German locomotive construction is discussed in the section entitled "The Air Offensive and the Axis Transport System" (page 9).

A TRANSFORMER AND A RADIO WORKS

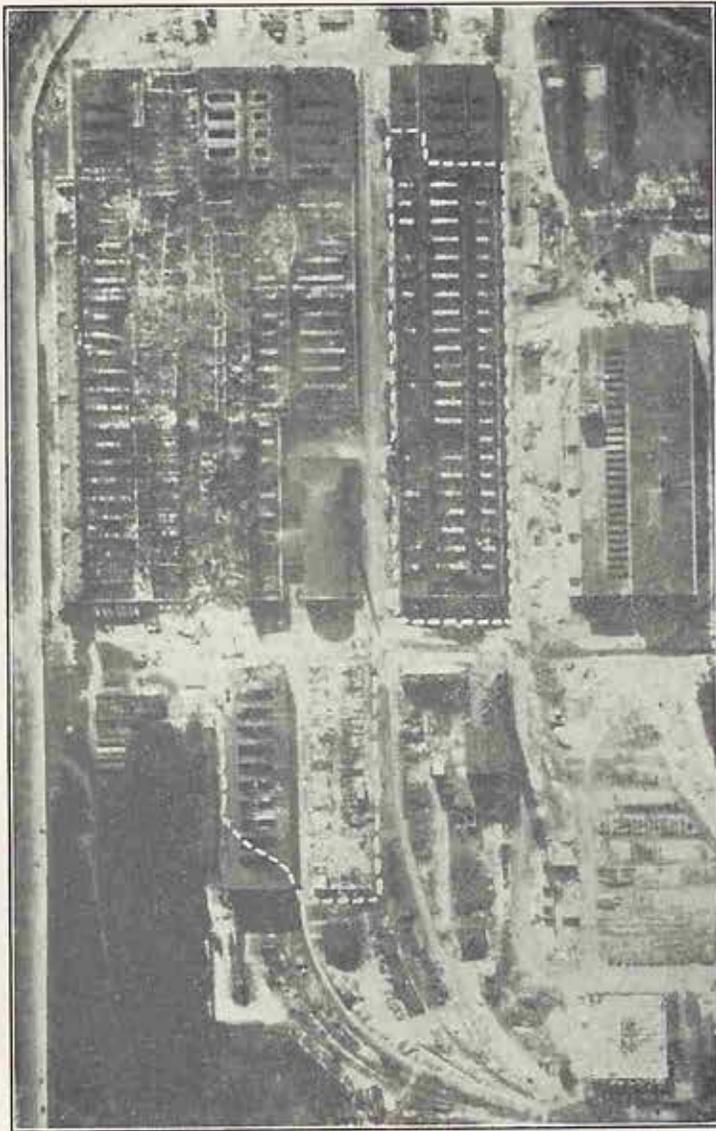


FIG. 5.—More than half of the Siemens-Schuckert transformer plant was destroyed during the attack on NUREMBURG, 8/9 March. The main workshops were two-thirds destroyed, and the wreckage of the overhead girder structure can be clearly seen in the above photograph. Three other damaged workshops are outlined. This plant was credited with 40 per cent. of the total German output of transformers. (See page 6.)

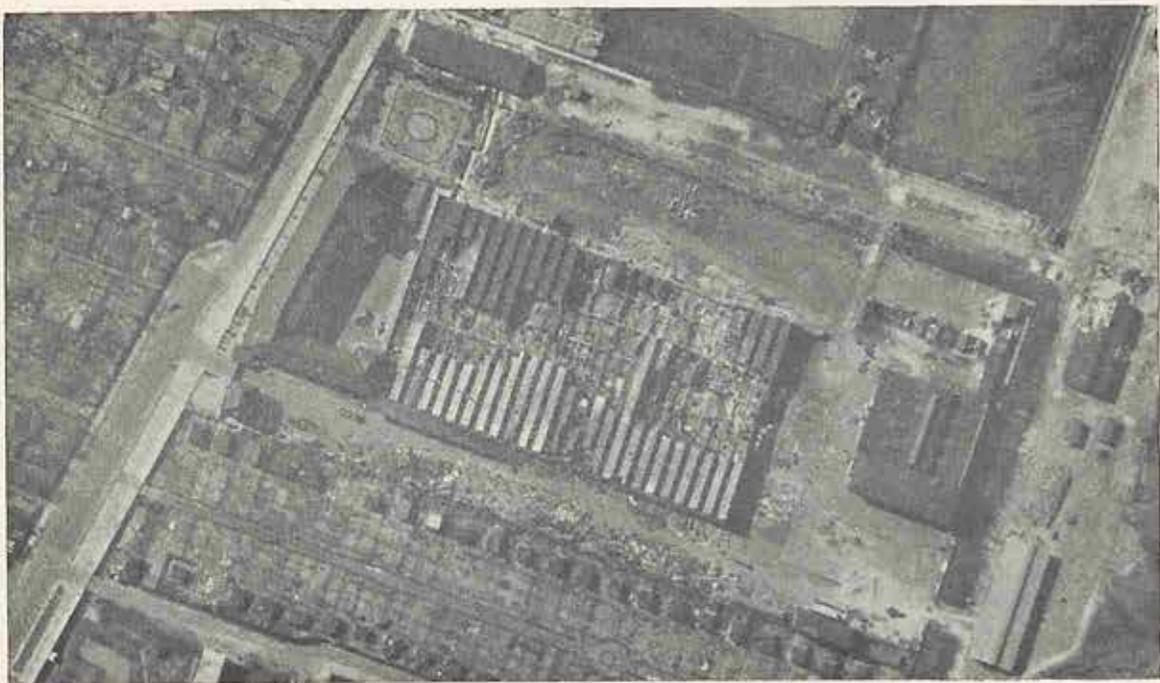


FIG. 6.—Of the many large radio factories in the BERLIN neighbourhood some of the most important suffered heavily in the January and March raids. (See page 5.) The main building of the "Blaupunkt" factory, seen above, was effectively smashed. Here portable radio sets for the army were produced.

observed a good deal of fresh damage in the city, though the devastation was naturally much less than in the famous raid of last summer. His comments on the Rhineland cities are not without interest since his visit took place in February, before the heaviest of our recent attacks. He was appalled at the devastation in Düsseldorf, one house in five appeared to have been completely destroyed, and one in three damaged. Whole blocks had disappeared, and even the hotel in which he stayed was half burned down. Yet Cologne looked more devastated because the damage was mainly in one part of the city. The inhabitants were even then engaged in controversy with the people of Duisburg as to which city had suffered most. Reconnaissance photographs showed that a number of small industries, including rubber factories and a works producing mechanical excavators, were damaged during February. Goods and rolling stock must have been destroyed when an 800 ft. transshipment shed in the Nippes district was burnt down, and damage to railway property was also appreciable. Also important was the damage revealed by photographs to several sections of the I.G. Farben Chemical Works at Leverkusen on the night of 2/3 February.

The extent of the damage to other cities was in some instances obscured by the results of later raids before it could be estimated, but hardly a town in the whole Ruhr area can have escaped some fresh damage during the quarter.

Berlin.—Like Essen, the capital of the Reich managed to survive fairly intact until 1943: both cities now have many devastated areas which prove that they are immune no longer. Of the five night attacks on Berlin that of 1/2 March was, from the industrial point of view, much the most effective, and it is said to have "shaken morale more than any other event since the beginning of the war."

In view of difficulties in maintaining an adequate military transport organisation on the Russian front it was satisfactory that five repair workshops, owned by such firms as M.A.N. and Daimler Benz, were among the industrial buildings seen to have suffered varying degrees of damage. The destruction of the State Railway workshops at Tempelhof is discussed later (page 10), in relation to the whole question of Axis rail transportation.

There is an exceptional concentration of large radio factories in the Berlin area, and some of the most important of these suffered heavily. "Telefunken" research and development laboratories, situated in the Zehlendorf district, were hit in January when six out of eight large workshops at the western end of the establishment were destroyed. In the March raid heavy damage was done to the main building itself, and to another large section. "Telefunken" were pioneers in the discovery and development of the enemy's R.D.F. and the Zehlendorf premises were built three years before the war to house their growing research department. These laboratories certainly remain one of the nerve centres of Germany's radio development work and the damage must have important repercussions. A number of other Berlin factories engaged in related activities suffered severe damage: "Blaupunkt," a subsidiary of Bosch, producing portable wireless sets for military use, the State Telephone Depot, and Mix & Genest, manufacturers of telephone and telegraph equipment.

The supply of other types of equipment to the armed forces must have been seriously affected when two branches of Askania Werke, in the Steglitz and Mariendorf districts, were extensively damaged. This firm is probably the largest maker of precision and optical instruments, especially for aircraft, and the plants concerned were engaged on the manufacture of predictors, range-finders and aircraft altimeters. A branch of Siemens engaged on similar work was also damaged and it is likely, in view of its delicate nature, that much work in process of manufacture was spoiled.

The effectiveness of the raid of 1/2 March, the Luftwaffe's anniversary, is apparent from many sources. Descriptions in the German press and also more impartial commentaries implied a high degree of perturbation among the inhabitants. It appears that a strong wind helped to spread the flames so rapidly that "many people who went to their shelters with confidence in the fire brigades came up to find their houses in ashes." The Mayor of Berlin later announced that in the allocation of vacant premises priority must be given to war industries—"especially to bombed factories." The German Air Ministry was among the buildings seriously damaged in the centre of the city, where fires were still burning the day after the raid. Thick clouds of smoke lay over the blitzed district of Wilmersdorf.

The Russians' delight at the bombing of Berlin showed itself in many ways. The intrusion of the Mosquitoes into Goering's propaganda party on 30 January inspired a cartoon in *Pravda*, while Marshal Stalin's comments on the Allied contribution to the war against the Nazis have grown steadily more appreciative.

South Germany.—As in the case of Berlin, the South German targets had not been attacked regularly or with very great effect before this year, partly owing to the long ranges involved and partly on account of weather difficulties. The range is now less of an obstacle since the proportion of heavy bombers has increased, and "pathfinding" methods assist the main force to concentrate on the target. It is certain that the operations against Nuremburg and Munich achieved more important results than any previous night attacks in the whole area.

Of two heavy raids on Nuremburg, the city of the Nazi Rallies, that of 8/9 March was the most effective. Four days later an official announcement referred to "the great damage caused by the raid which calls for the assistance of the entire population. . . . People whose premises have been damaged must repair them themselves, and neighbours should be asked to assist. All other Volksgenossen will receive instructions regarding their work, which will last from 1400 to 1800 hours on Saturday and from 0800 to 1800 hours on Sunday. Tools should be brought."

It is evident from reconnaissance photographs that these workers were not needed merely to clear up "beautiful medieval buildings," the destruction of which was so widely publicised by German propaganda. Industrial damage was very heavy, especially in the southern part of the city. In the M.A.N. Engineering Works two of the main shops and three acres of other buildings were almost entirely

destroyed. This works, already damaged at the end of August last year, is now chiefly concerned with the production of tanks, tank engines and lorries. The main buildings destroyed housed the diesel-engine test-beds and a welding shop, probably engaged in tank production. While these incidents are unlikely to have caused a total stoppage of work, output of some classes of military equipment was no doubt interrupted for many weeks after the attack.

Extremely heavy damage was inflicted on the southern branch of Siemens-Schuckert A.G., which was credited with as much as 40 per cent. of the total German output of transformers. More than half of this plant was destroyed, including two-thirds of the main workshop covering five acres (Fig. 5). This probably involved the wrecking of the overhead gantry system necessary for handling heavy transformers in course of manufacture, and rebuilding is likely to be a major operation. Owing to the urgent needs of expanding and damaged war industry the existing production capacity of transformer plants is known to be very hard pressed. The loss of output and of work in progress at this Nuremberg plant must have a widespread effect on the progress of industrial expansion all over Axis Europe.

Siemens' northern plant, engaged in servicing electric motors, searchlights, and firing-devices for mines, as well as the Aluminiumwerke-Nürnberg A.G. and a number of other engineering works, were also seriously damaged in the raid. Perhaps the most important of these incidents affected the Süddeutsche Apparate-Fabrik which was more than half destroyed. Formerly manufacturers of X-ray equipment, S.A.F. were taken over by Siemens before the war and have since been concerned in the production of specialised requirements for the radio industry. They were, for instance, the only manufacturers of selenium disc rectifiers, which even the Eindhoven Radio Works were unable to supply for themselves.

Damage to the important railway centre of Nuremberg is discussed on page 11.

On the night after the successful raid on Nuremberg a force of 260 heavies achieved a good concentration on Munich, the Bavarian capital. As in the case of Nuremberg, the very considerable effects on railway communications are listed in the third section of this *Review*. As usual Nazi propaganda bemoaned the loss of "monuments of art" which were reported to be the sole objective of the attack. One incident which they doubtless intended to cover by that elastic phrase was the partial destruction of the new Nazi Brown House. Photographs taken two days later showed considerable fire damage in the northern and western districts as well as in the centre of the city. Some of these fires were still burning at the time of the reconnaissance, which incidentally revealed that the great explosion reported during the attack was caused by a direct hit on a wet-type gasholder in the City Gas Works. Extensive fire damage occurred among military establishments, namely the Maximilian and Pioneer barracks, and at two stores for military equipment. The principal war factory affected was the well-known B.M.W. Aero-engine Works, where about one and a half acres of the main machine-shops were destroyed. Motorenwerke-Mannheim, an aluminium works, an aerodrome and a firm engaged in the production of armoured cars suffered damage in varying degrees.

The single raid on Stuttgart, on 11/12 March, was perhaps the only large-scale effort which may have failed to achieve outstanding results. Nevertheless, local papers described the "crowds looking at the damage" which impeded traffic and "would not disperse, despite warnings by loud-speakers." Workmen were ordered to leave their factories to assist in clearance and repair, and craftsmen, police and members of the armed forces were brought in from other parts of Germany for the purpose. The tramway depôt and track received damage which interfered with traffic for more than a week.

Italian Industries.—Two long-range operations of medium weight were carried out in February against the industrial centres of Milan and Turin. The latter had suffered very heavily at the close of 1942, while the larger city of Milan was shaken by the Lancasters' daylight raid.

In the raid on Turin (4/5 February), the Lingotto branch of the Fiat Aero-Engine Works received further damage, particularly to a group of multi-bay buildings beside the main block which was partially destroyed as a result of a direct hit. One of the Fiat steel works was hit, two large workshops being damaged by H.E. Four factories in the south-west part of the city were wholly or partly destroyed by fire, and other incidents occurred throughout the city.

The effect of the mid-February attack on *Milan*, the largest of Italian cities was heightened by disappointment in the performance of German Flak. The damage to industrial property greatly exceeded that in business and residential areas, over 50 factories being damaged. These included:—

- (a) The aero- and marine-engine works of Alfa-Romeo, where fire had destroyed half of a large multi-bay workshop, probably a machine-shop.
- (b) In the Caproni airframe and component factory part of the sub-assembly shop was demolished, the research department gutted, and there were several other incidents.
- (c) The Isotta Fraschini works, producing castings and forgings in aluminium and other light metals, had one five-bay shed completely gutted, and damage to another.
- (d) Heavy and extensive damage by H.E. and incendiaries was inflicted on the Brown-Boveri transformer and electric-motor works.
- (e) The Arca dye factory was destroyed by a single heavy H.E. bomb, the area of destruction extending over 1,800 square yards.

Occupied Europe.—Most of the bomber effort against German targets in western Europe was concentrated either on the railway centres or the U-Boat bases, and the results of these operations are summarised separately. One of the quarter's most important attacks on industrial objectives in Occupied Europe was carried out in daylight by Mosquitoes of No. 2 Group. This low-level attack on the installation of the molybdenum mines situated in a remote district in the Norwegian mountains at *Knaben*, was a highly successful achievement. Ten aircraft took part in this operation, on 3 March. A variety of factors makes the Knaben mines a target of peculiar importance. Molybdenum is needed principally for increasing the toughness and shock-resisting properties in alloy steels used in the manufacture of gun-barrels, drilling tools, and in high-speed steels for the aircraft and vehicle industries. The Knaben mines formerly had an output of some 900 tons of molybdenum sulphide per annum, but the Germans planned to double this output. Krupp's provided additional crushing and grinding plant, which was installed with great urgency during the winter of 1940-41, under conditions of extreme difficulty owing to the hard winter and the remote situation of the mine. Germany used to obtain 80 per cent. of her molybdenum supplies from Knaben, and most of the balance from French Morocco. With the Allied occupation of North Africa, however, Knaben has assumed yet greater significance, since it now accounts for all save five per cent. of Germany's molybdenum supplies. In this connection it is of interest that the Germans should have maintained their supply of oil to Knaben, while reducing it for other German undertakings in Norway. Though there are four molybdenum mines in the Knaben area, the whole of the ore obtained from these is treated in one flotation plant.

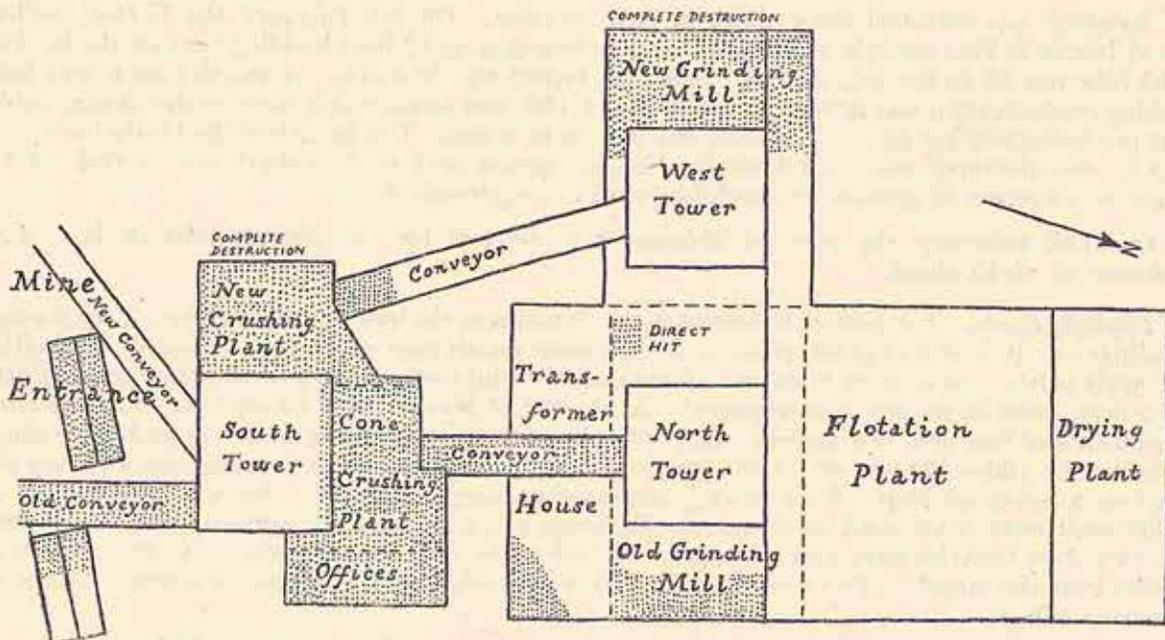


Diagram of the Installations of the Molybdenum Mines at Knaben, marking the sections damaged on 3 March, as shown by reconnaissance. The Flotation Plant was also seriously damaged by bombs which entered the building and exploded inside.

Scale approx. 1 : 500

The steel alloy position as a whole in Germany has become very critical indeed since, in the last few months, the remaining stocks of chrome were exhausted, and this has compelled the Germans to forbid the use of chrome in the manufacture of guns. There is every reason to think that the interruption of work at Knaben will have seriously exacerbated this situation, and that great difficulty may be experienced in replacing damaged machinery in the flotation plant which was supplied in the first instance from the U.S.A. Photographs show a concentration of bursts on and near the ore bins, conveyors, and the new extension of the ball mills and classifiers of the molybdenum mines. The latter was entirely destroyed, as were the cone-crushers and two other buildings. Three conveyors were seriously damaged. The raid was completely successful, the flotation plant and its machinery being put out of action, and the extreme accuracy of the bombing was greatly admired by the Norwegians. (See Figs. 7-9.)

By the end of March, the Phillips Radio works at *Eindhoven* had begun to recover from the heavy damage inflicted on 6 December. Since that event the sale of electric lamps had been banned in Germany (except to certain essential establishments), doubtless to release capacity for the manufacture of radio valves to offset the effects of the loss of output from Eindhoven. In the interval clearance and rebuilding had been pushed ahead. Some of the important machinery removed from buildings previously damaged had been placed in a part of the valve stores as that part, being reinforced, was regarded as stronger than the rest.

On 30 March ten Mosquitoes made a second low level attack on this target. Many of the bombers scored direct hits, partially destroying the main store rooms. The important lamp and valve sections of the main building, not seriously damaged in the earlier raid, and the boiler house, also received severe damage, so that a number of vital parts of the works were put out of action and production practically came to a standstill once again. This is likely to be all the more serious to the Germans as it occurred in the same month as their own radio plants in Berlin and Nuremburg suffered heavy blows. (See Fig. 10.)

A number of other attacks were carried out on industrial targets in the Low Countries and France during the quarter, and as a result the output of steel and engineering plants controlled by the Nazis has fallen still lower. At *Aulnoye*, for example, one of the largest firms of steel tube makers in France (employing 3,300 hands before the war) was very heavily damaged by three Mosquitoes on 4 March. All 12 of their bombs fell on the works, and two-thirds of the roof, which covered about 30 acres, was destroyed.

B. Naval Objectives

The heaviest raids on naval targets were directed against the U-Boat bases of Lorient and St. Nazaire, which are referred to on page 14, while the very successful daylight attacks by the U.S.A.A.F. on submarine construction yards at Vegesack and other North Sea ports lie outside the scope of this *Review*.

Nights Raids on German Ports.—Bomber Command carried out four night raids on the German North Sea base of *Wilhelmshaven* during February, and on the 11th/12th the main ammunition depot was completely wiped out. A hundred and twenty acres were instantaneously devastated and only craters marked where the store-houses had stood (Fig. 11). Severe blast damage was done to the Deutsche Werke plant, north of the Tirpitz Dock, which firm is engaged in re-fitting E-Boats and light naval craft. Thirty of the buildings were damaged, including the smithery, engineers' workshop and shipbuilding shop, and work in hand must have been greatly impeded.

Hamburg was attacked three times in poor weather. On 3/4 February the U-Boat building slips of Blohm & Voss are believed to have been damaged, a speed-boat building yard on the left bank of the Elbe was set on fire and one end of the Elbe tunnel was damaged. A month later a very heavy bombing concentration was achieved, and although this was considerably west of the aiming point a plant producing lubricating oil, at Wedel, was put out of action. This branch of the Deutsche-Vacuum Oil A.G. manufactured nearly all Deutsche-Vacuum grease, and much research was carried out here for the development of greases for special lubrication requirements.

On 21/22 February the port of *Bremen* was attacked by 143 aircraft without loss, under conditions of 10/10 cloud.

Daylight Raids.—The port of *Rotterdam* is the terminus of the iron-ore convoy route from Northern Scandinavia. It is also of great value to the Germans on account of its very extensive shipbuilding and repair yards. As a result of our minelaying and Coastal Command's anti-shipping strikes Rotterdam's dock facilities are never unemployed. At the end of March, No. 2 Group sent relatively strong detachments of Venturas to attack the docks and shipping on consecutive days. Considerable success was achieved: a direct hit was scored on a *sperrbrecher* undergoing repair in a floating dock, and very close misses on a merchant ship "Westerdam," and another merchant vessel. Several minesweepers and smaller craft were either sunk or damaged. Buildings in the engineering works at Wilton's Shipyard and other dock facilities were also hit and, on 29 March, the fires started in the docks were still visible 30 miles from the target. (Two days later the U.S.A.A.F. added to the damage and scored hits on the submarine slips.)

On 19 February more than two-thirds of the torpedo workshops at *Den Helder* were destroyed and a large building demolished in the torpedo-boat establishment. As a result of two daylight attacks on the Schelde shipyard at *Flushing*, the shipbuilding shed, west of the marine dock, received a direct hit which caused a gap of 1,000 sq. ft. in its roof, and another shed was severely damaged. Hits were scored on dock and airfield installations in the vicinity.

Reconnaissance showed that considerable damage resulted from daylight attacks on *Dunkirk Docks* by aircraft of No. 2 Group and of the U.S.A.A.F. Three storage tanks in the oil refinery were destroyed and three more damaged. Railway installations in the dock area were seriously affected, and on 26 February Venturas scored a direct hit on the railway swing bridge.

The much bombed Stork diesel engine works at *Hengelo*, one of the most important Dutch concerns now forced to supply the German navy, received three further small-scale daylight attacks during the quarter. On 27 March low oblique photographs showed at least four bursts on or near the boiler shops, the pipe-bending shops, and on the adjoining fitting-out shops of the Dijkers plant. The latter firm works in close conjunction with Stork and produces casings and windings for electric motors as well as torpedoes. Both these plants and the Haxemeyer (electrical and mechanical re-equipment) factory were damaged in the two earlier raids.

The Mosquitoes' raid on the Burmeister and Wain diesel engine works at *Copenhagen* was even more successful. Before the war this firm was one of the most important manufacturers in the world of marine diesel engines, and also produced their own design of submarine engines. Since 1940 the works have been compelled to accept many German orders. They are an important source of certain U-Boat components, as well as many other essential items of war equipment. The engineering shops were fully active at the time of the attack although in the previous month 2,500 of the employees had struck work successfully as a protest against the introduction of German security police.

The works are situated on the island of Christianshavn, adjoining the shipyards of the Danish capital. The raid took place at dusk on 27 January—six days before Burmeister and Wain were due to celebrate their centenary. Eight out of nine Mosquitoes which attacked the target dropped delayed action bombs from a low level. The most important incident shown by reconnaissance was a direct hit on the heat treatment shop, the loss of which probably brought the whole plant to a standstill. Unlike a machine shop, a heat treatment shop is highly susceptible to bomb damage, the light steel furnaces fired by gas or oil offering little resistance to blast or fragmentation. A large area of roof was stripped



ATTACK ON KNABEN MINES

(See page 7.)

FIG. 7.—One of the ten Mosquitoes which put out of action the installations of the vital molybdenum mines on 3 March. This small target, remotely situated in the mountains of Southern Norway, was bombed with extreme accuracy.

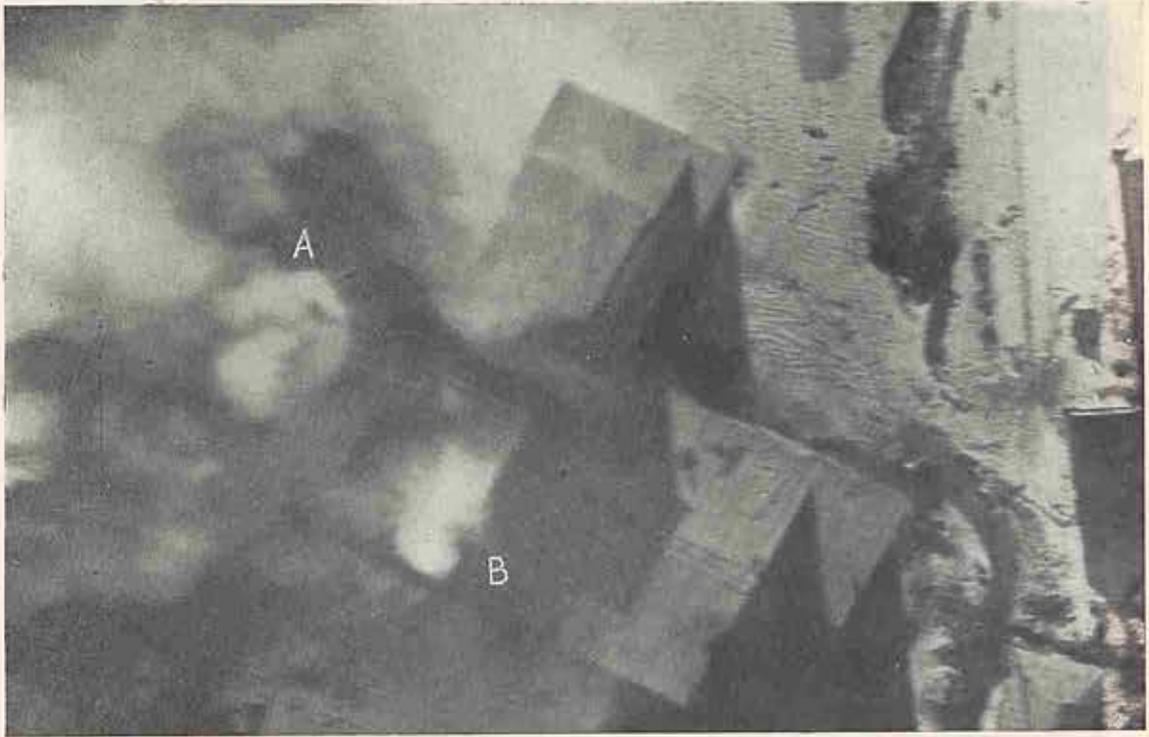


FIG. 8.—Over the mine installations: bursts enveloping the southern section and conveyors (A), and another on the old grinding plant (B) adjoining the north tower. Four bombs are falling towards the new grinding mill which was completely destroyed. Other bombs exploded in the flotation plant, the roof of which is seen to the right of (B).

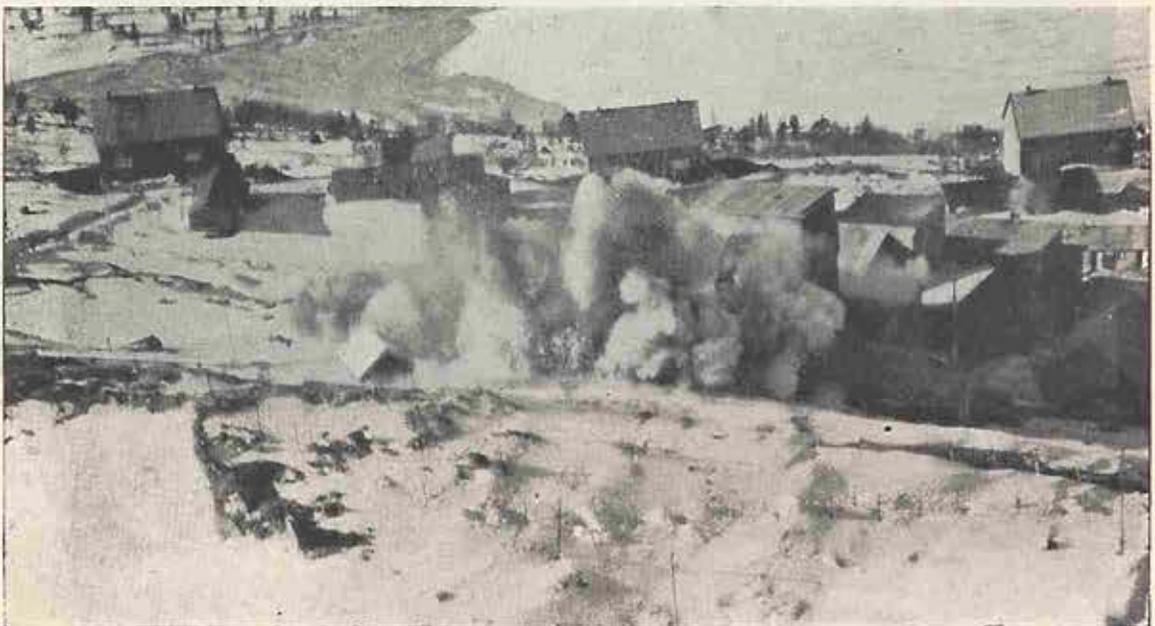


FIG. 9.—Leaving the target: several bursts on the buildings at the southern end of the plant and near the entrance to the molybdenum mine. In the background is a small lake, frozen over, one of the few landmarks in this difficult terrain.

EINDHOVEN RADIO WORKS AGAIN DAMAGED

(See page 7.)

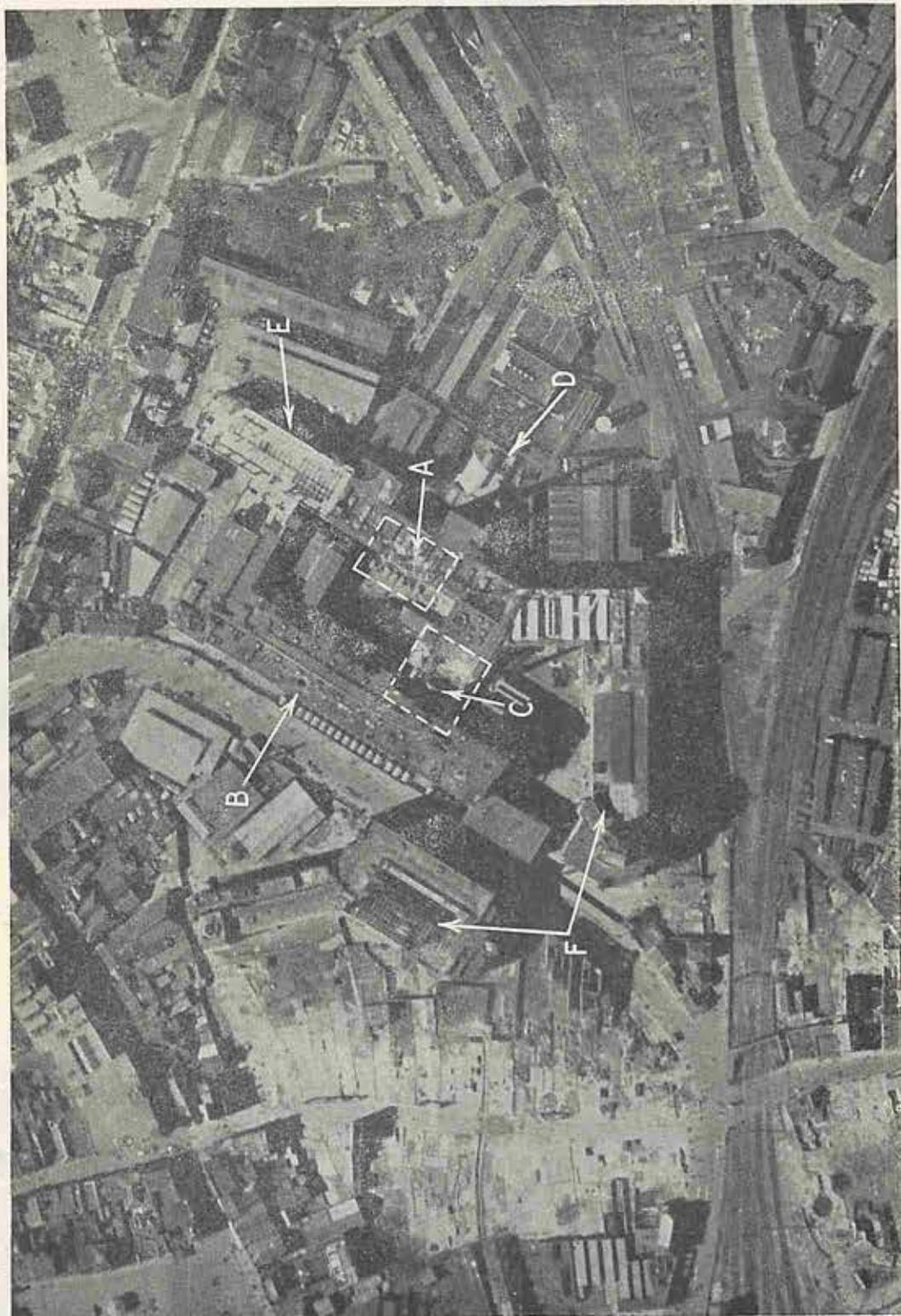


FIG. 10.—Three months after the heavy destruction caused to the Phillips Works (6 December, 1942) rebuilding had made considerable headway and some important machinery salvaged from the ruins had been removed to an undamaged part of the Valve Storage Section. On 30 March ten Mosquitoes successfully hit this section demolishing three storeys (C, above). The important Lamp Manufacturing Section (A) was severely damaged, as was the Valve Section (B), by a bomb which passed through the roof and exploded inside this vital building. A direct hit was also scored on the Boiler House (D). Rebuilding operations are seen in progress at E and F.

NAVAL AMMUNITION DEPOT OBLITERATED

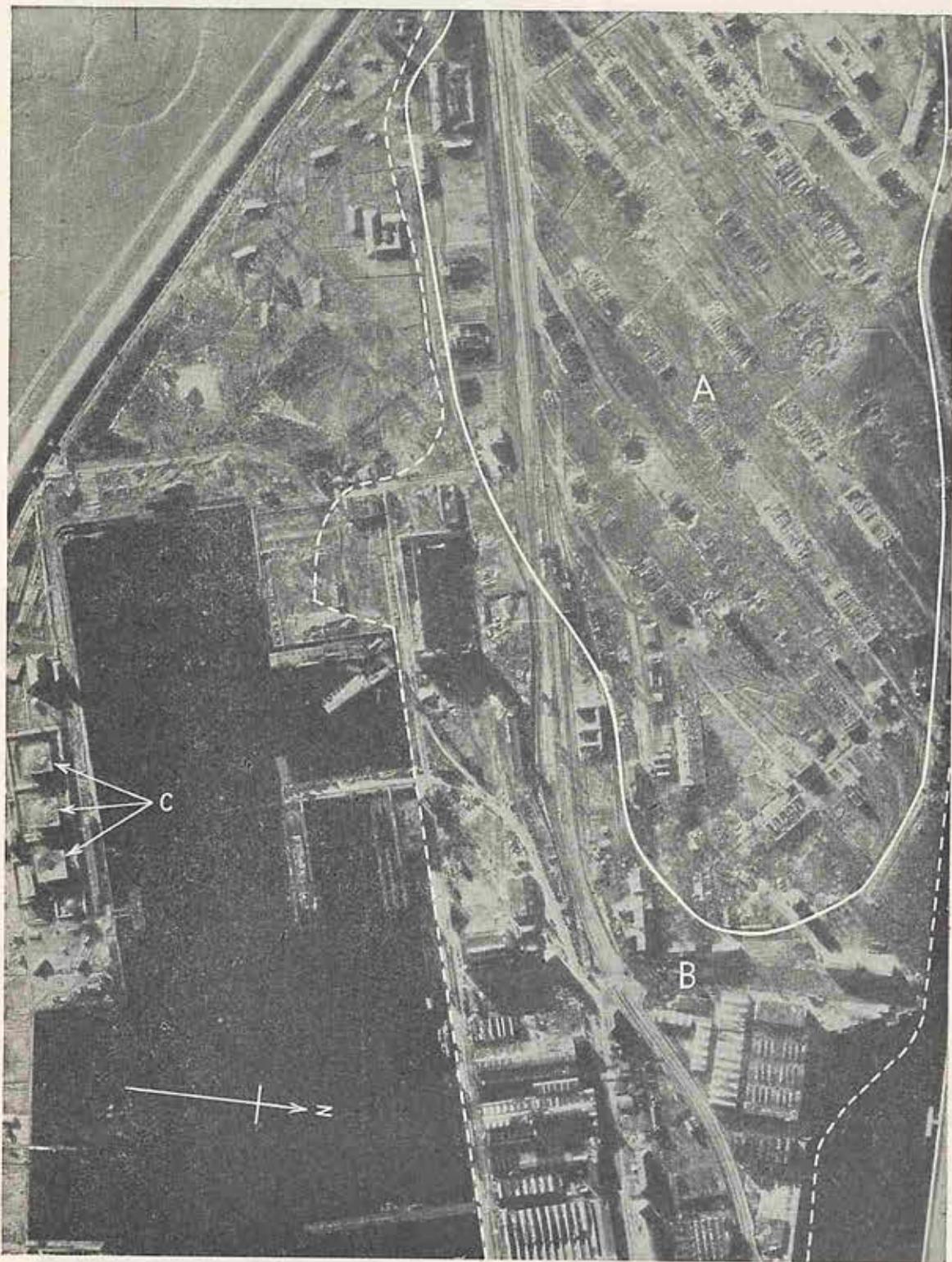


FIG. 11.—A huge explosion was reported by many aircraft which took part in the raid on Wilhelmshaven, the North Sea naval base, on 11/12 February. Daylight reconnaissance revealed that the main ammunition depot (A) immediately west of the docks had been completely erased over an area of 150 acres. Forty storage huts had disappeared, and an area of blast damage (B) affected 30 buildings in the Deutsche Werke shipyards, engaged in refitting E-Boats and other naval craft. On the other side of the Tirpitz Dock three oil storage tanks (C) were also damaged.

ATTACK ON ROTTERDAM DOCKS

(See page 8.)



FIG. 12.—When *Venturas* of No. 2 Group attacked shipping and dock facilities in Rotterdam in daylight on 28 March, a direct hit was scored on a large *Sperbrecher* undergoing repair in floating dock (see arrow). In this raid and on the following day several minesweepers and smaller craft were either sunk or damaged; and very near misses were scored on two merchant vessels in Wilton's Yard, both included in the above photograph.

from the test shops, probably owing to fire, and the adjoining service department and several other workshops and office buildings were also damaged. One large building was practically destroyed. Swedish sources indicate that the presence of long-delay bombs caused serious confusion in the neighbourhood and the harbour was not re-opened until 3 February. Despite German propaganda to the contrary the Danes showed their appreciation of the attack in a number of unmistakable ways: by sending an enormous number of wreaths to the funeral of the crew of the single aircraft which crashed after striking overhead cables in the failing light; and, secondly, by sabotage and strikes such as occurred at the Aalborg shipyards, where 1,100 workers struck the week after the raid.

Minelaying.—The very large scale of minelaying operations which was one of the outstanding features of 1942 was well maintained during the first quarter of the new year. More mines were laid than in any previous quarter since the start of the war, and the enemy's fast dwindling shipping resources suffered numerous losses.

It is known that over 300 enemy ships have been either sunk or damaged by mines laid from aircraft of Bomber Command since the offensive began in 1940. Noteworthy successes included in these casualties are the sinkings of the large tanker *Eurosee* (11,000 tons), the transport *Wuri* (7,000 tons), the *Consul Horn* (8,400 tons), and the train ferries *Starke* and *Malmo* (2,500 and 1,600 tons respectively). In addition the German battle cruisers *Scharnhorst* and *Gneisenau* were both mined and damaged during their escape from Brest to Germany.

The full results of the minelaying campaign cannot be realised until the termination of hostilities. That they must exceed results which become known from time to time is obvious. The enemy's concern and the immense importance he is now attaching to his ever-growing minesweeping efforts indicate that these results may well exceed most optimistic estimates.

C. Miscellaneous Operations

Airfields.—On 13 January at least 70 bombs burst within the northern dispersal area at *Abbeville Drucal*. Several aircraft shelters received direct hits, and many bombs fell among the airfield buildings. At *St. Omer*, the Fort Rouge airfield was attacked on the same day, direct hits on four or five aircraft shelters resulting in fires. A week later *Caen/Carpiquet* and the fighter airfield at Cherbourg were attacked, and at the latter several more aircraft shelters were destroyed.

Leaflets.—Two hundred sorties despatched by the Operational Training Units dropped some 25 million leaflets over occupied territory. An approximately equal number were dropped over Germany and occupied territory in the course of night operations by bomb-carrying aircraft. Leaflets are known to spread alarm and despondency among the enemy, particularly in Italy, while such documents as enlarged views of the ruins of Krupp's works have a tremendous effect on the resisting peoples of occupied Europe. It is reported that some of the Paris police collect our leaflets on their early morning rounds, carefully distributing a good proportion to trustworthy people before handing in the rest to the Germans.

(iii) The Air Offensive and the Axis Transport System

"Transport has become the key to victory, and the effective organisation of transport will determine the duration of the war." The truth of this public pronouncement by our Minister of Labour is so obvious, from the point of view of Allied strategy, that one is inclined to forget that it applies with equal force to our enemies.

Before the war a very large proportion of the heavy goods traffic between the different European countries passed by sea routes now partly or entirely closed. This applies above all to traffic to or from Italy and the Balkans on the one hand and Germany, France and the Low Countries on the other. For instance, German coal from the Ruhr was shipped via Rotterdam to a large number of Italian ports. Bauxite was shipped from Yugoslavia, oil from Rumania, and grain from various parts of southern Europe by way of the Straits of Gibraltar and the English Channel to Hamburg, Bremen and other North Sea ports.

Now that these sea routes are closed most of the goods have to be carried by rail, or a combination of rail and inland waterways. The despatch of a million tons of coal per month to Italy across the Alps gives some idea of the scale of the additional burden thrown on the Axis railways, already increased as a result of the shortage of fuel and tyres for road transport. The railways have thus become the backbone of the enemy's transport system and are said to carry no less than 80 per cent. of all goods traffic in the Reich. On the other hand, the part which the Reichsbahn now plays in the German military machine was already foreseen to some extent as far back as the time of Bismarck, who originally planned its great strategic lines. During the last war it performed its military functions with consummate success, and even during the disintegration of the western front in November, 1918, succeeded in carrying back to the Rhine and beyond the vast bulk of the army and its equipment. The Nazis in their turn did much to prepare the railways for their fundamental part in the present struggle: the entire east-to-west main lines were renewed, the depth of ballast increased on all important lines, and long mileages were realigned to increase speed, reduce flange- and rail-wear, and to lower the man-power cost of maintenance.

But there are two factors which Hitler does not seem to have taken into account. The failure to achieve victory in the west before embarking on the costly Russian campaign stretched the railway organisation far beyond its normal limits: from Northern Norway to Sicily, from the Pyrenees and the Biscay U-Boat bases to the Russian fronts and the Black and Ægean Seas. Some of the railways in

occupied territories (such as the Polish) are actually incorporated in the German system, while the remainder are under German control, with German train-crews appearing as far south as the Spanish border. In occupied Russia some 18,000 route-miles have been taken over—a 10 per cent. increase in the track previously operated in Axis Europe, resulting in a sharp fall in the proportion of locomotives and rolling stock to track mileage (since the Russians withdrew all their locomotives from this territory).

The second factor is the R.A.F. offensive, which has in recent months inflicted a series of highly damaging blows against key points in the Nazi rail-transport mechanism. There is every reason to believe that these blows will do much to impair the efficiency of the system at a time when the Germans are doing everything possible to make good losses on the Eastern front due to air and ground attack, and to winter conditions.

The grave view which the Nazis take of this position was revealed for the first time a year ago, in April, 1942. Then the Führer admitted that the supply of locomotives had proved inadequate to meet the immense demands made upon their transport system during the terrible Russian winter of 1941. The army and even the Luftwaffe had had to go short. Göring and others promised solemnly that this would not be allowed to happen again. They aimed to increase output of locomotives from 3,000 to 7,500 per annum; and the production of locomotives and wagons was accorded a priority equal to that of aircraft, tanks and submarines. Eight months later, at New Year, 1943, the Secretary of State for the Reichsbahn still seemed to be feeling anxious when he declared: "Railway transport has become the innermost part of our strategy. We have learnt by bitter experience, and are taking all the many necessary precautionary measures to ensure the transport which will bring the success we expect."

Meanwhile Bomber Command is doing its utmost to ensure that the German transport system will, on the contrary, remain inadequate for the many burdens which the Nazis have thrown upon it. Almost every time an important German town suffers from our attacks, railway installations are hit and repair and storage plant is damaged. Last year damage was done to the Henschel Works at Kassel, the largest locomotive producers in German Europe; the sheds and repair facilities of the Nippes railway workshops were almost entirely destroyed in the "thousand raid" on Cologne; at Bremen, Mainz and Karlsruhe repair shops were damaged, and the locomotive shops at Saarbrücken were attacked with particular success. Le Creusot, one of the biggest locomotive works in Occupied Europe, was damaged in the Lancasters' daylight raid last October.

The war on German locomotive production has been greatly intensified in 1943, and in March more damage was inflicted on the railway system of Axis Europe than in any previous month. The outstanding success was the destruction by fire of the great locomotive-building works of Krupp at Essen on 12/13 March (Figs. 3-4). Krupp's were reckoned the largest locomotive producers in Europe after Henschel of Kassel. Taking into account the loss of work in progress and the impossibility of resuming production for at least three months, it is probable that an output of between 100 and 150 locomotives has been lost, as well as much other railway equipment. This is certainly the most serious damage of the kind inflicted so far, but three other important locomotive building works were also damaged. In a brilliant daylight attack on 23 March fifteen Mosquitoes of No. 2 Group partially destroyed the "Batignolles" (St. Joseph) works at Nantes, which was working on a contract for the Germans (Fig. 15). It is probable that a loss of output amounting to some 15 locomotives will have resulted from this attack. The other two locomotive works, Cockerill at Liège and Krauss Maffei at Munich were less heavily damaged, but here also some loss of output is certain to result. The total interruption to the Germans' building programme caused by these four incidents would be equivalent to the loss of not less than 150 new locomotives—a month's output from all the factories in Axis Europe at the rate of production current a year ago.

The output of railway wagons was also affected by severe fire damage to twelve buildings (covering 16 acres) of Rathgeber at Munich, one of the leading wagon and tractor works in Germany.

Besides the blows at Axis locomotive construction, excellent results were obtained from attacks on important locomotive repair-shops both in Germany and in France. The outstanding incident occurred on 1/2 March at Berlin, where over 22 acres of the Tempelhof railway repair works were completely devastated by fire. All the locomotives and rolling stock under repair at the time in this second largest of Germany's repair works are presumed to be a total loss, together with all equipment. In the same raid over 7,000 square yards of the Underground Railway depôt in the Schöneberg district was burnt out and, as the depôt is normally full at night, heavy destruction to electric locomotives and rolling stock must have resulted. Photographs of Munich show that the shed for servicing electric locomotives, at Laim, was completely destroyed and 21 locomotives are visible in the ruins (Fig. 14). Owing to failure of the electric-traction system none of these could be removed until several days after the raid. A large part of the steam locomotive round-house was also demolished and most of its 26 engines would be in need of extensive repairs, while some would be a total loss. Both at Paderborn and Nuremberg important repair workshops were heavily damaged and locomotive sheds at each place were also hit. It is believed that about 150 locomotives were destroyed or seriously damaged in the repair shops at the four German towns considered.

Meanwhile, in daylight operations against French repair shops, aircraft of No. 2 Group and of the U.S.A.A.F. may have immobilised at least an equal number of locomotives in the course of attacks at Tours (Fig. 16), Aulnoye, Le Mans, Hellemmes (Lille), Rouen and Rennes. While the load on repair facilities has been increased as a result of the attacks, the facilities themselves have been diminished. The queue of damaged locomotives awaiting repair has been further swollen by operations carried out by Fighter and Army Co-operation Commands. Disorganisation is increased owing to shortage of skilled labour, since the best workers (like the best engines) have been transferred to Germany.

The capacity of the Axis railways to meet war demands is limited not only by the units of rolling stock available, but also by their average speed of movement. The bombing of key traffic centres and marshalling yards may cause congestion which will react throughout the whole system, slowing down the rate of movement. Such congestion reduces the availability of wagons for loading and involves long

GERMAN RAILWAY CENTRES

(See page 10.)

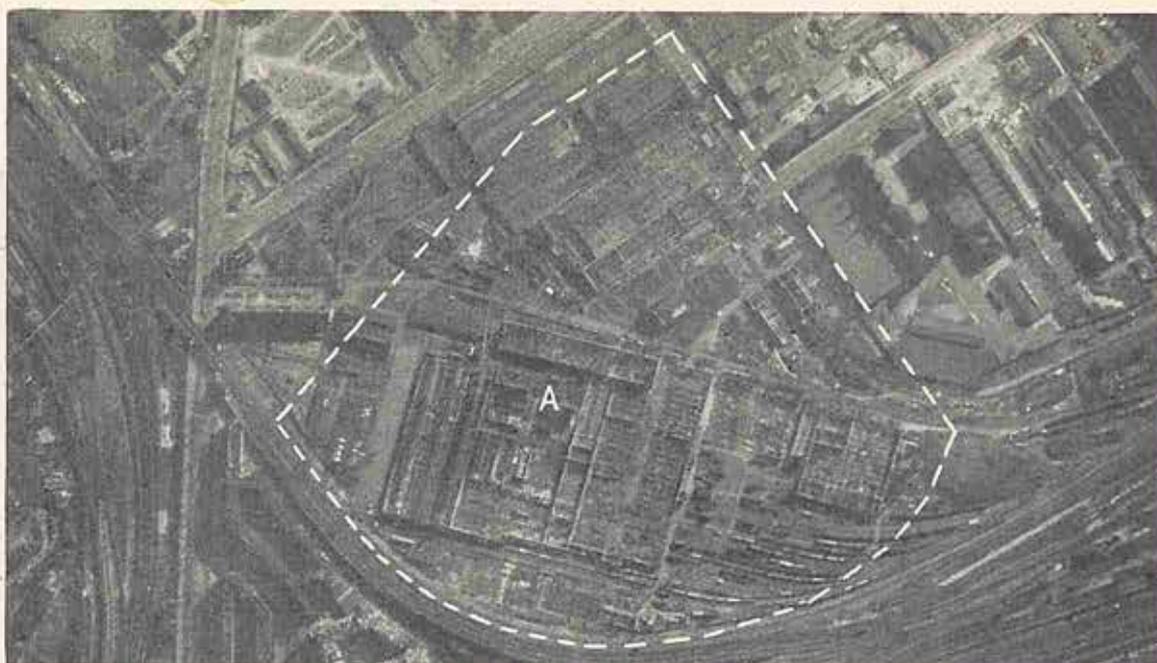


FIG. 13.—Over 22 acres of the State Railway Workshops (A) at Templehof, BERLIN, were completely devastated by fire during the attack on 1/2 March. This is the second largest of Germany's railway repair works. Practically all the locomotives and rolling stock under repair at the time, together with all equipment, must have been a total loss.



FIG. 14.—At MUNICH the sheds for servicing electric locomotives (A) were completely destroyed by fire and H.E. during the night raid of 9/10 March. The above photograph shows 21 locomotives, damaged by fire, remaining in the ruins. In the steam locomotive depot (B) one of the round-houses was demolished. Most of its 26 engines would require extensive repairs and some were no doubt a total loss.

MOSQUITOES ATTACK LOCOMOTIVE WORKS

(See page 10.)

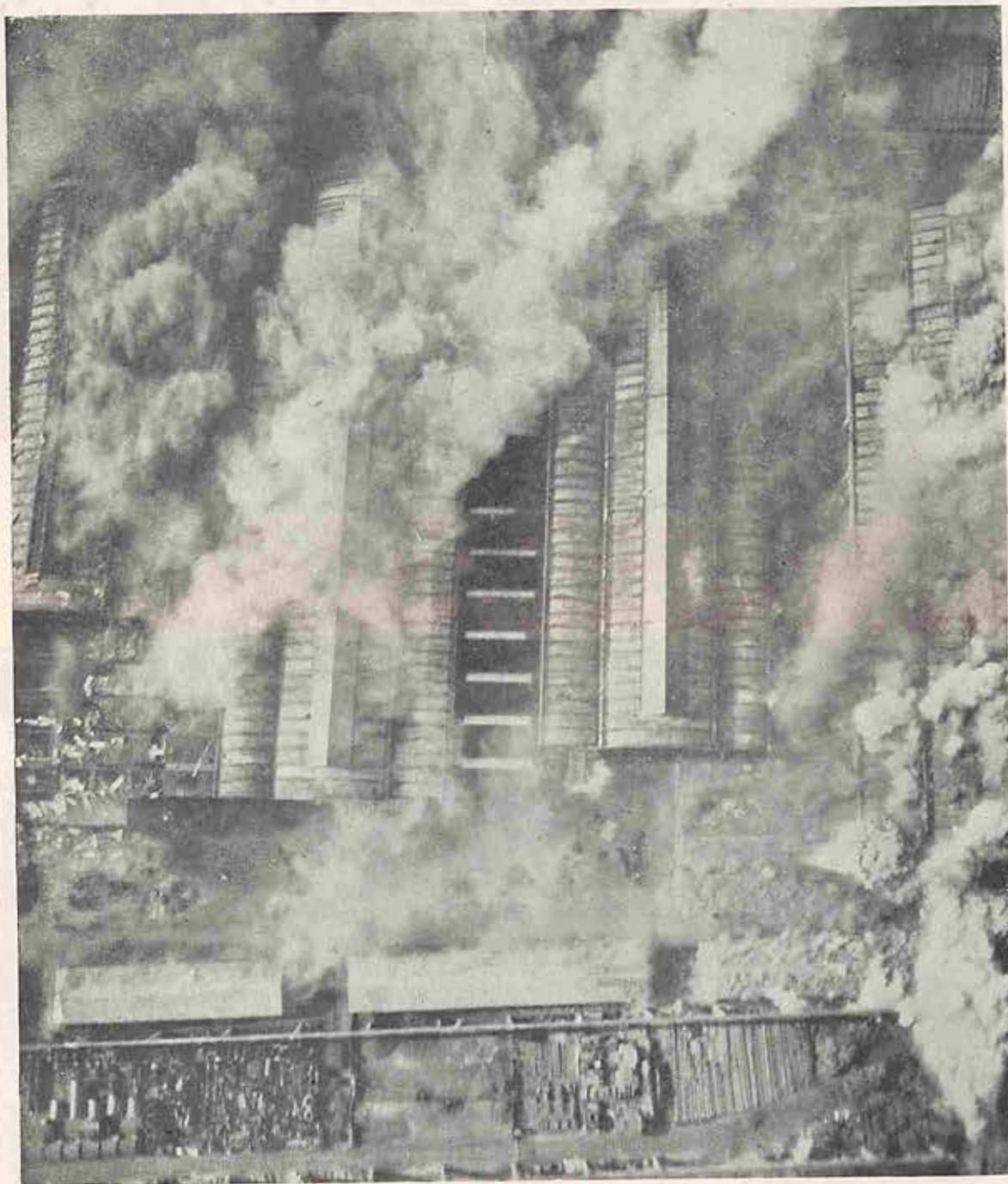


FIG. 15.—On 23 March fifteen Mosquitoes of No. 2 Group partially destroyed the "Batignolles" Locomotive Works, three miles north of NANTES, which was working under contract for the Germans. This photograph shows smoke from many direct hits, and roof-covering scattered by the effect of blast.

LOW-LEVEL RAID ON RAILWAY WORKSHOPS



FIG. 16.—Many direct hits were scored on the important workshops at the railway centre of TOURS, on 18 February. This remarkable "close-up" shows a section of the works already damaged in previous Mosquito raids, and a number of fresh bursts developing.

BOSTONS' ATTACK ON MORLAIX VIADUCT



FIG. 17.—On 29 January twelve Bostons attacked the Morlaix Viaduct in Brittany. This rises to a height of 200 feet above the tidal river which it spans, to carry the main line used to supply the naval base at Brest. Thirty-six bombs fell in a close group at the eastern end of the viaduct. (See below.)



FIG. 18.—Three weeks later both tracks were removed over two-thirds of the length of the viaduct. At least two craters (arrows) can be seen on the viaduct itself and it is believed that the base of one of the piers was damaged. Traffic to Brest had to be diverted by way of the unsatisfactory route through Lorient. (See diagram opposite.)

hours and strain for railway crews. The marshalling yards of the Ruhr-Rhine area form the nerve-centre of the German transport system. (For instance the yard at "much-bombed Hamm," at the eastern entrance to and exit from the Ruhr, is the largest in Germany, with a maximum capacity of 10,000 wagons per 24 hours.) Since the beginning of 1943, Bomber Command's repeated visits to the Ruhr have caused considerable damage at several of these important railway centres. It is possible that even more serious slowing-down has resulted from repeated air-raid alarms, particularly when these occur at night, as lighting must then be totally extinguished in the marshalling yards. Even with normal restricted lighting our own experience shows a sharp fall in the number of wagons which can be handled during the hours of darkness at the large marshalling yards.

The most serious dislocation so far this year was achieved at Munich where the electric-traction system was so heavily damaged that only two out of eight lines at the main station were working three days after the raid. Traffic on the chief supply-route to Italy (via the Brenner Pass) appears to have been completely interrupted for that period, and normal working was not restored until 16 days after the attack. Full restoration of the electric-traction system took much longer and necessitated the calling in of railway workers from a wide area.

At Nuremberg, in addition to the severe damage already mentioned at the carriage and wagon repair workshops, about 16 acres in the new traffic centre, comprising yards, transit warehouses, coal and timber dumps were burnt out; four acres in the Scheiling goods yard were gutted; the goods station west of the Hauptbahnhof, the railway offices and the customs house were also largely destroyed. The capacity of Nuremberg as a goods handling centre was probably reduced for a considerable period, and a large volume of goods in transit and railway stores must have been written off.

Although no major railway facilities were involved at Essen, numerous incidents of track damage and smashed-up rolling stock on important lines were alone sufficient to interrupt working for several days. During March, 2,000 men, including soldiers, had to be employed on clearance and relaying. It is probable that in such a network of railways, points and crossings would be affected, and replacement stocks of these are known to be limited owing to exceptional demands on the Eastern Front. Hamm, the chief rail exit from the Ruhr, was bombed by the U.S.A.A.F. on 4 March, and considerable damage was done to the passenger station and to rolling stock on the sidings.

In France the chief feature of the quarter was the dislocation of the supply route to the Atlantic U-Boat bases. The breaching of the Morlaix viaduct by Bostons at the end of January closed the main line used for naval supplies to Brest for about two months. The alternative route by Lorient, involving an additional run of 100 km., was repeatedly interrupted in the course of the quarter's raids by night and day. For instance, on 6 March, Fortresses scored two hits on the western approach to the viaduct which carries the line over the River Scorff at Lorient. The rear of a goods train was destroyed and the embankment collapsed, necessitating complete stoppage of traffic for two days.

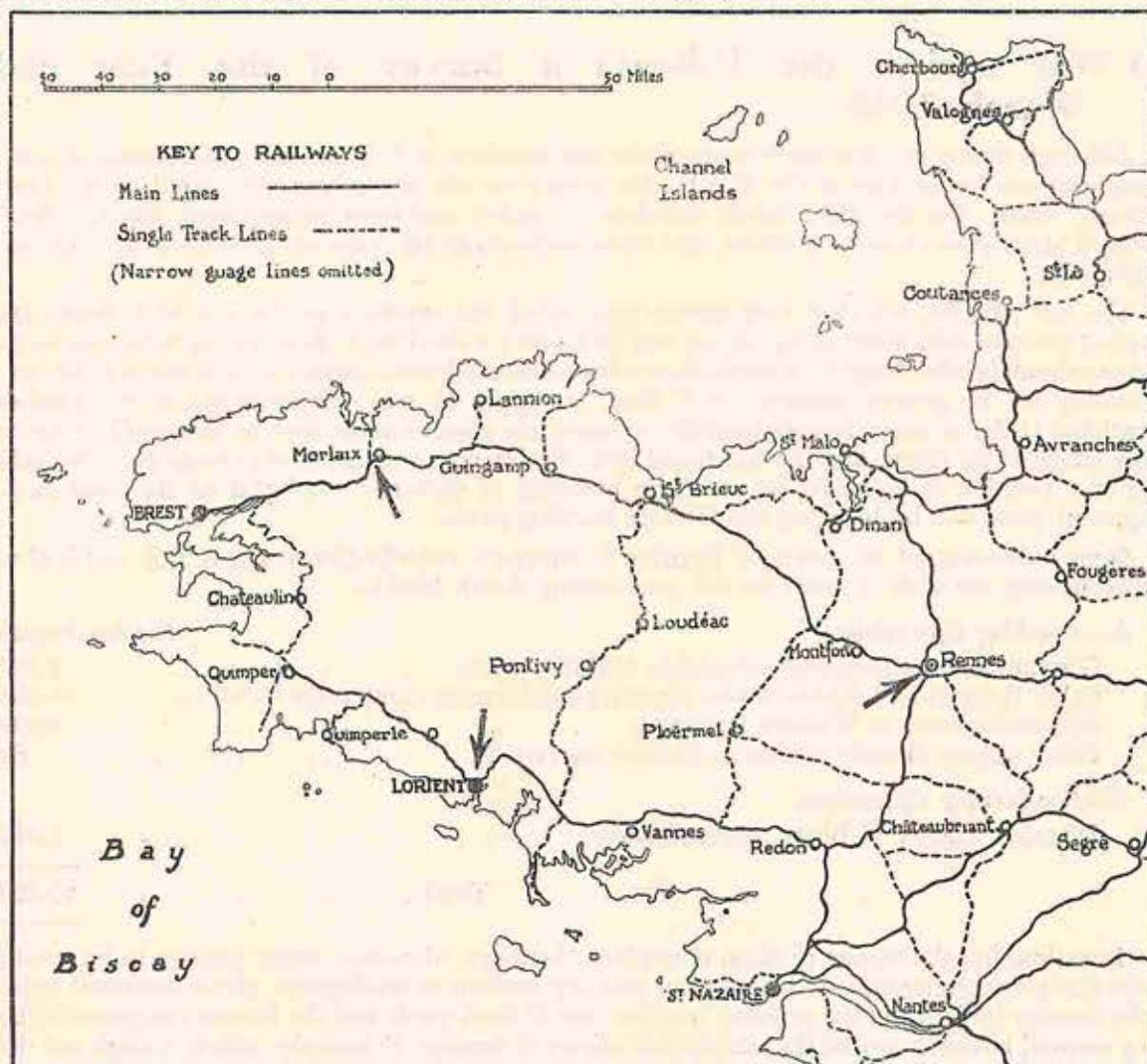


Diagram of the supply-routes to the naval base at BREST, showing the points at which they were interrupted by bombing.

Of the attacks on French, Belgian and German marshalling yards, that made by 12 Venturas on Caen on 10 February was a typical example. At least two direct hits were scored on the engine sheds and the station; the goods depôt and tracks in the marshalling yards were all affected. At Le Mans, Mosquitoes damaged railway tracks and rolling stock as well as the repair shops which were the main target. On 24 March, three Mosquitoes intercepted goods trains in N.W. Germany despite much ground opposition. One had a particularly successful day: of the three trains it attacked on the Hamm-Gütersloh line one had a dozen of its trucks derailed, some of them rolling down an embankment; another train was brought to a standstill with steam belching from the engine, while the double track was torn up in front of the third. A single incident which occurred on 14 February indicates what disorganisation may result from such attacks. One of the Mosquitoes despatched to Tours lost formation and bombed a goods train on the main Paris-Brest line instead. Of the four 500 lb. bombs released, one fell on the locomotive and exploded in the cab. Both up and down lines were blocked for some hours during which four special troop trains, one leave train and two goods trains had to be diverted to other routes.

The U.S.A.A.F. attacks in March greatly added to the disorganisation of railway communications with the Atlantic bases. On 8 March 48 direct hits were scored on the marshalling yards at Rennes, the most important railway centre in Brittany. Traffic was brought to a standstill owing to many craters at both ends of the yard and there was no substantial through traffic for a week. In the same month the great Rouen-Sotteville yards were twice extensively damaged by the Eighth Air Force, and at Amiens, Lorient and St. Nazaire, the railways suffered considerably from their attentions. The situation in N.W. France has now deteriorated to such an extent that the Nazis have actually been forced to return some of the best French locomotives which they had previously requisitioned to relieve the burden on the Reichsbahn.

All this makes it plain that the German transport system is at the present moment strained to the uttermost. Some time ago it was decreed that all goods trucks must be loaded two tons above their maximum capacity. There are strict limits to the amount of traffic which can be diverted to the canal and river systems, and our mining campaign has gravely depleted the shipping needed for coastwise traffic. These routes are in any case subject to frequent interruptions, and to attacks by Coastal Command and Naval forces. In spite of all the enemy's efforts the German transport system as a whole is deteriorating: the efficiency of the fighting services and the war industries is directly threatened by delays and loss of supplies. While it is unlikely that the system will break down suddenly in a spectacular way, our air offensive is producing conditions favourable for continued Russian resistance in the East and at the same time adding immensely to the difficulties of organising the war production of Germany and Occupied Europe.

(iv) War against the U-Boat: a Survey of the Year ended March, 1943

Although during the first three years of the war numbers of U-Boats were either sunk or seriously damaged at sea by aircraft of the R.A.F., the return for the flying hours expended on the task was relatively small. On the other hand, ceaseless air patrol and even unsuccessful attacks affect the morale of submarine crews as a whole, and have unquestionably reduced the scale of activity against our shipping.

The fact remains, however, that within this period the enemy's production of U-Boats greatly exceeded the casualties inflicted by our sea and air forces; indeed the U-Boat strength became increased by approximately 400. Improved methods of attack and additional surface vessels and aircraft are now accounting for far greater numbers of U-Boat casualties at sea. Nevertheless, if the numbers of operational U-Boats are to be substantially reduced, the menace must also be powerfully attacked at earlier stages of its career and the continued flow of reinforcements decisively checked. The achievement of a decision is hastened by strategic bombing of factories employed on the construction of component parts and by bombing the U-Boat building yards.

Some indication of the scale of Bomber Command's contribution towards this end is given by figures showing the scale of effort for the year ending March 1943:—

<i>A—Bombing Operations.</i>	<i>Sorties Despatched.</i>
German towns containing submarine building yards	8,590
Other German and Italian towns containing submarine component factories ..	14,480
Submarine bases in Western Europe	3,000
Other targets directly related to U-Boat warfare	80
 <i>B—Sea-Mining Operations.</i>	
Directed against U-Boats, <i>approximately</i>	1,350
Total	27,500

In estimating the results of these operations there are, of course, many aspects to be considered. In the first place photographs, which are our primary medium of intelligence, give a minimum indication of the damage inflicted on the primary targets—the U-Boat yards and the known component factories. They cannot, however, reveal the widespread effects of damage to factories which, though not directly identified with submarine construction, are nevertheless producing basic materials (such as steel) and

parts eventually destined for U-Boats. In many of our raids small unidentified works are destroyed, some of which are certainly operating on local sub-contracts for components. Nor do photographs indicate such important factors as the loss of skilled workers killed or injured in "area" attacks; or the loss of time during periods of air-raid alarms and post-raid disorganisation, the disruption of transport facilities serving factories and building yards, aggravated by the adverse impressions made on the employees' morale.

Such intangible results as these are likely to decrease the output and activities of submarines to an even greater extent than direct damage to vessels building on the slips, or to factory buildings engaged in the construction of parts.

Submarine Building Yards

At the close of the period reviewed it was estimated that there were over 250 U-Boats building or fitting-out. This work is carried out at 18 yards situated in 12 German ports, but 80 per cent. of it is concentrated at Hamburg, Kiel, Danzig, Bremen and Vegesack. All 12 ports, with the exception of Stettin which has since been heavily bombed, were attacked during the 12-month period. Six of the yards themselves have received direct damage (excluding the very successful U.S.A.A.F. raid on Vegesack). The most notable results have been:—

- (i) *Emden*.—Very severe damage was inflicted on the Nordsee Werke which seriously affected the rate of U-Boat construction.
- (ii) *Wilhelmshaven*.—Delays of from 10–12 months in the construction of U-Boats.
- (iii) *Kiel*.—From three to four months delays in the construction of U-Boats at the Kriegsmarine Werft.
- (iv) *Hamburg*.—Several boats were delayed launching.
- (v) *Flensburg, Lübeck, Bremerhaven*.—Delays also occurred at these three ports.

The output of U-Boats showed a steady increase each month up to the middle of last year; it then became stabilised at about 20 boats a month. There have been signs that great efforts were made to increase this output.

It is, therefore, reasonable to conclude that the stabilisation of the output was largely attributable to the success of Bomber Command attacks on towns containing the building yards and component factories. Had the mass-production programme been allowed to expand unmolested the output of U-Boats would now have reached a greater figure.

Submarine Component Factories

There are about 110 works in Axis Europe and in neutral countries known to be manufacturing U-Boat components of various kinds. Of these only 47 factories are in towns which have not been attacked—35 because they are either out of range or situated in localities unsuitable for night area attacks; and two more are in neutral territory.

The remaining 63 works are situated in 21 towns all of which have been attacked during the twelve months reviewed. Just over a third of the factories (35 per cent.) have received direct damage visible on photographs. This represents nearly 20 per cent. of all the known component factories available to the enemy. The results may be classified as follows:—

	(a)	(b)	(c)	(d)
Type of Product.	Number of Factories in Towns attacked.*	Number Visibly Damaged.*	Percentage (b) — (a).	Percentage of total known factories.
Torpedoes, components and equipment.	16	4	Per cent. 25	Per cent. 13
U-Boat Diesel engines ..	14	9	64	36
Electric motors	4	—	—	—
Accumulators	5	1	20	8
Air compressors	2	—	—	—
Miscellaneous	34	9	26	18

* Some large factories produce more than one type of component and thus appear under more than one heading. There are indications that two further factories were damaged, but these are omitted in the absence of photographic confirmation.

It will be seen that more than a third of the U-Boat engine factories have been directly damaged and this, combined with the damage to the building yards, represents an appreciable contribution towards the eventual defeat of the Axis submarines. But this is by no means the whole story. As already pointed out (page 12) the indirect and incalculable results of area attacks on industrial centres are likely to reduce the output and activities of U-Boats to an even greater extent than the known results of direct damage to the primary targets in those centres.

So much for this brief outline of our blows against U-Boats in their pre-natal stages of development. There remain to be considered a series of attacks directed at submarines in their training grounds or actually engaged on operations.

Operational U-Boats

During the twelve-month period considered Bomber Command has contributed something in the region of a further 5,000 sorties with the object of reducing directly the operational activity of enemy submarines in the Atlantic battle.

Apart from a total of 1,750 sorties diverted to assist Coastal Command's A/S patrols (as described in the last issue of this *Review*, No. 3, p. 14) the remaining two-thirds of the effort was expended in devastating two of the towns in which the submarines' advanced bases on the coast of Western Europe are situated, and minelaying in the approaches to their bases and in training waters.

Lorient.—The largest of these base towns—was subjected to night area attacks on nine occasions between 14 January and 16 February of this year, and it was also raided in daylight by the U.S.A.A.F. Three of our February raids were made by forces between 300 and 500 strong, attacking in bright moonlight and excellent visibility.

As a result the town has been completely devastated, hardly a roof remains, and there are few buildings in the dockyard undamaged. The shipbuilding workshops, the naval slips, the accumulator stores, torpedo store, welding shop, foundry and ships stores are among the more important dockside buildings destroyed or severely damaged. Two hulks used as sheds for U-Boats have been sunk, and electricity, gas and water supplies cut off. At least four direct hits were obtained on the pens, but without of course penetrating the concrete roofs.

St. Nazaire.—Following the demolition of Lorient the U-Boat base at St. Nazaire had its turn.

Over 400 aircraft opened the series of heavy attacks on the last night in February, when one hundred and sixty-two 4,000-lb. bombs were dropped on the port area. The general secretary of the *Séours National* stated that the raid was far more concentrated than even the worst on Lorient, and that a plan of evacuation for all the towns on the Channel and Atlantic coasts was under consideration. More than 1,000 houses (he continued) were destroyed and fires were still burning a week after the raid. The greatest difficulty which had to be contended with was transport, as hundreds of the inhabitants refused to leave the town without their possessions. "They could not be blamed for this, as neither the authorities nor the *Séours National* nor yet the shops in the evacuation districts could provide them with new homes."

After two subsequent and nearly as heavy attacks by our forces, and further accurate daylight raids by the U.S.A.A.F., there was little of importance left to disintegrate apart from what was protected by the heaviest concrete shelters. Heavy damage was caused to workshops at both ship-building yards, a power station was hit, as were stores, railway tracks and rolling stock. It is not, however, considered that the destruction of Lorient and St. Nazaire had any ponderable effect on the operation of enemy submarines.

Supply Lines to the U-Boat Bases

In addition to direct assaults on the operational bases themselves, continual raids are being made on the enemy's transportation system as a whole, and in particular on the vulnerable supply lines extending from the Low Countries to the Atlantic coast. The destruction of locomotives and rolling stock, and the disorganisation of time-tables must play a by no means negligible part in delaying the output of building yards and component factories, as well as interrupting supplies to advanced bases.

The Naval Storage Depôt at Rennes suffered a highly successful raid by twenty Mosquitoes on 26 February. Heavy explosions occurred, probably from stores of ammunition, and about thirty sheds were destroyed. This is the central distributing depôt for naval stores for the French west coast ports. (Rennes was again visited on 8 March, by the U.S.A.A.F., and there was no substantial through traffic on the railways during the following week.)

The Effect of Sea Mining

In view of the heavy casualties suffered by enemy merchant shipping (including anti-mining vessels) in waters mined by Bomber Command, it is not unreasonable to assume that the loss of a substantial number of operational U-Boats can also be credited to this powerful and unseen weapon. One remarkable instance of this was actually witnessed by the crew of a No. 1 Group Wellington, and details will be found at page 18 under the heading of "Flying Incidents." How many others have been mined will, of course, never be known for only in exceptional circumstances could there be survivors or other evidence to tell the tale.

The presence of mines in the approaches to submarine bases has in itself a disturbing effect upon the strained nerves of crews on their return from lengthy Atlantic patrols. Moreover, submarine activities are likely to be hampered and even temporarily suspended while minesweepers are at work

ST. NAZAIRE NAVAL BASE AFTER A NIGHT RAID

(See page 14.)



FIG. 19.—An exceptional feature of the first quarter of 1943 was the effort expended in devastating two of the French ports in which the U-Boats' advanced bases are situated. After three heavy night attacks by Bomber Command and daylight raids by the U.S.A.A.F. there was little of importance left to disintegrate apart from what was protected by the heaviest concrete shelters. The above photograph shows fires burning around the U-Boat shelters after more than 400 bombers had attacked St. Nazaire on the last night of February.

THE DEVASTATED PORT OF LORIENT



FIG. 20.—The largest of the U-Boat bases in Western Europe is situated at Lorient. This town suffered nine heavy night raids between mid-January and mid-February of this year, and was also attacked in daylight by the U.S.A.A.F. Hardly a roof remained in the town, and dockyard and railway damage was extremely heavy. The above photograph taken after the raid of 13/14 February shows the old town and the barrack buildings completely devastated.

attempting to clear channels. Mines laid in U-Boat training areas must also exercise an effect on the morale of young and inexperienced crews who receive a taste of the hazards to be expected in their future operational theatres. Reconnaissance has often shown the attention paid by the enemy to sweeping out U-Boats from their bases. It is known that a fleet of valuable ships has been converted into *sperrbrechers* for this purpose and it is seldom that a U-Boat leaves or enters any operational base without being escorted by one or two of this type of sweeper.

The evidence, although admittedly incomplete, is sufficient to prove that the efforts of Bomber Command have substantially restricted the output of submarines from the building yards and, by the disorganisation of industries and transport, must have curtailed the activities of operational U-Boats. And this has been achieved while carrying out the Command's main role in the offensive against Germany.

II. FLYING INCIDENTS

(i) Flying a Lancaster with Two Engines on One Side

It is well known that four-engined bombers can be flown on three engines without difficulty, and many pilots have flown home from enemy territory with two engines, one on either side, put out of action. This is a relatively simple matter, but when the two engines affected happen to be on the same side more skill is required.

Returning from the Stuttgart raid on 14/15 April, Lancaster "P" of 467 Squadron was fired on when crossing the French coast at about 500 ft. A single bullet fired from the ground entered the leading edge of the mainplane inboard of the starboard inner engine. For so insignificant a missile (the hole in the wing was only half an inch across) an unusual amount of trouble resulted from what was probably a chance in a million.

The first indication that things were amiss was the failure of the gyro instruments: the supply-line from the vacuum pump had been severed. The pilot switched over to the port vacuum pump and while doing so noticed sparks coming from the exhaust of the starboard inner engine. The flight-engineer reported that the coolant temperature was rising very rapidly, indicating loss of coolant from this motor. The propeller was feathered and the supply of petrol switched off. Then the pilot attempted to open up the starboard-outer engine, but unfortunately the bullet had partially severed the throttle control: with the additional load the control fractured completely. As no power could be obtained from this engine its propeller had to be feathered also, and the Lancaster swung off course.

At first the pilot tried to fly with the aircraft banked but lost height rapidly—an uncomfortable experience at 500 ft. Then, by applying full aileron and rudder trim, he held the aircraft level and used as much rudder as was necessary to fly straight. Having regained control in this way the pilot ordered the crew to jettison ammunition, flares, flame-floats and other impedimenta but not the guns, and then climbed to between 1,000 and 1,200 ft. for the journey home. It took 45 minutes to reach the Sussex coast. From that point the pilot flew along the coast at 150 ft. and made for the nearest landing ground, ready to put his aircraft down on the beach if necessary. In the vicinity of the airfield it was found that the undercarriage hydraulics were inoperative and, as the emergency airline to the starboard wheel was also out of action, only the port wheel came down. In spite of this the Lancaster made a successful landing with only the port and tail wheel, a minimum amount of injury being caused to the starboard side of the aircraft. The engineer's log shows that the boost and revs. during the last part of the journey were +7 lbs. and 2,700 per minute, respectively, which could have been maintained a long time without straining or overheating the engines. Full boost and revs. were only used when coming in to land, the approach being quite normal otherwise. The aircraft was perfectly manageable at speeds above 135 I.A.S.

As the same pilot had cause to repeat the performance only four weeks later, returning from Duisburg with his aircraft in a similar condition, he speaks with authority on this matter. He considers that it is useless to attempt to fly with the aircraft banked: it must be kept level. Moreover he is confident that the Lancaster will fly for a long period like this as the rudder pressure required is not great and, should the pilot become tired, the flight-engineer can hold the rudder-bar from below.

(ii) A Parachute Descent over Enemy Territory

The pilot of a Lancaster of 207 Squadron had a remarkable escape when operating against the Ruhr early this year. This aircraft took off at dusk and, after climbing in the vicinity of the airfield to 15,000 ft., set course for enemy territory. Height was later increased to 20,000 ft. and the target area was reached without incident. Over the target there was shifting cloud with tops at about 10,000 ft., very much as forecast.

Approaching the target the pilot reduced height to about 18,000 feet and on sighting the aiming point released his bombs in spite of exceptionally heavy flak which was accurate for height. A number of searchlights were seen through the shifting cloud, including one or two cones of about fifteen. The aircraft was twice illuminated but managed to evade the beams.

Shortly after leaving the target the Lancaster was attacked by a night fighter. This was a surprise attack from astern which set the starboard petrol tanks ablaze and put the intercommunication out of action. The pilot did a circular dive down to 15,000 ft. but the night fighter attacked a second time, again from astern. As a result of this attack the port inner engine cut and the pilot, pulling off his helmet and mask, told the flight-engineer to order the crew to bale out. The flight-engineer handed the pilot his parachute and four of the crew tried to open the front lower escape hatch but did not succeed. They therefore made their way to the rear exit.

The next thing the pilot remembers is that he was in a steep dive at 8,000 ft., suffering from lack of oxygen due to earlier removal of his mask. He managed to level out the aircraft at 5,000 ft. and was just getting back on course again when he was attacked for the third time by a night fighter coming up from astern. The fuselage near the pilot was hit and the aircraft began to fill with smoke. The crew had baled out, and as both starboard engines seemed to have failed and the aircraft started to roll over to starboard, the pilot thought it was time to get out. He tried to push his way through the window on his port side, but found this extremely difficult. It was only after he had pulled his rip-cord that he was able to escape, the force of the parachute opening pulled him out.

On the way down he noticed two parachutes below him at about 1,000 ft. and saw the aircraft burning on the ground some distance away. He also noticed a large hole in his own parachute owing to its having caught on some part of the aircraft but (apart from a sprained ankle) he came down safely on firm ground. After burying his parachute and Mae West in a ditch he got away from the scene as rapidly as possible.

(iii) A Successful Crash-Landing in Sweden

The crew of a Wellington of 301 (Polish) Squadron narrowly escaped the enemy's clutches when returning from one of the most successful of the four night raids on the Baltic port of Rostock last year. After take-off the pilot climbed immediately to 10,000 ft. and after about an hour climbed to 18,000 ft. before crossing the Danish coast. Here a few searchlights were encountered, but these were ineffective owing to the bright moonlight.

Flying on across Denmark and climbing to 22,000 ft., they continued to Rostock, passing first of all to the north of the town and coming in to the target from the north-east. A silent glide approach was made, the pilot having cut his engines, and the bomb load consisting entirely of incendiaries was released on the town of Rostock from a height of 17,000 ft. Rostock was positively identified and the built-up area clearly seen, the crew having had the advantage of a visit to the target on the previous night.

During the approach no flak had been encountered and only a few searchlights were visible north of the town. But immediately after they had dropped their incendiaries, and while the camera was being operated, the crew experienced concentrated heavy flak, extremely accurate for height. The smoke puffs could be clearly seen in large numbers all around the aircraft.

At the exact moment at which the red light appeared on the pilot's panel, indicating that the camera film had wound over, the aircraft was hit in front and a shell fragment passed right between the two pilots. The captain sent the aircraft into a dive, at the same time banking to the right; but at this moment the starboard engine was also hit, oil pressure and boost dropped and the aircraft started to vibrate. The pilot immediately cut out the starboard engine and, as the aircraft started to go into a right-hand spin, he also cut out the port engine for a while, continuing to dive. During this dive the wireless operator reported that the aircraft had also been hit in the rear of the fuselage, and that there was a lot of smoke in the aircraft. Fortunately, however, no fire developed.

The pilot pulled out of his dive at 12,000 ft. and turned north, heading for Denmark, although the aircraft was very unstable and had a considerable tendency to "pull" to starboard. They continued to lose height, with speed down to 95/100 m.p.h. (I.A.S.). The pilot now found that the starboard wing tanks were losing petrol rapidly. He realised that there was little chance of reaching base safely, and asked the wireless operator to send out a message reading "Engine petrol Sweden," to which they received the reply "O.K. give position." A message giving position near the south coast of Laaland and height at 6,000 ft., was then sent, and a reply was received telling them to give positions as they flew on. Unfortunately the electrical system gave out and they were unable to send further messages.

Course was laid for Sweden, and on the way they threw out everything that was not required, including the front gunner's ammunition. In order to assist in stabilizing the aircraft they shut off the port tanks and used the remaining petrol in the starboard tanks. When this was finished they switched back to the port tanks. The Wellington continued to lose height, and before reaching the coast of Sweden had come down to 2,000 ft., although more under control.

The pilot first thought of coming down in the sea near the coast, using flotation gear, but as the coast was exceedingly rocky it was decided to make for land. On reaching the neighbourhood of Ystad the crew experienced A.A. fire from Swedish coastal batteries, but the aircraft was not hit. The pilot made a turning dive to port, and came down to 1,000 ft. and, although he had previously decided to order the crew to bale out whilst he remained in the aircraft in order to bring it down, they were now too low to jump successfully. A search was therefore made for a suitable landing place. The pilot was strapped in, and all members of the crew went to their crash stations.

Some apparently flat fields were seen near a wood and they decided to crash land. Flying into the wind, using 20° of flap, the pilot came down at about 140 I.A.S. and cut out the port engine at about 60 ft., but as he was gliding in to land he saw some high tension wires ahead. He therefore promptly opened up the port engine again and only just passed over the wires. The pilot climbed to some 100 ft., cut out the engine and made a second attempt to land, only to encounter high-tension wires again. This time there was no chance of climbing and the Wellington successfully passed under the wires. They finally reached a third set of wires, which could not be passed as there was a large wooden pole immediately in front of the aircraft. The pilot tried to swing the aircraft to port but, as there was no reaction, he pulled back the stick violently and the aircraft crash-landed tail first and stopped some five yards short of the pole. Apart from a few bruises, nobody was injured.

By this landing on neutral territory successfully carried out under very difficult conditions, the pilot saved his whole crew from the Nazis and prevented his aircraft and its equipment from falling into enemy hands.

All secret documents were destroyed during the flight to Sweden and thrown into the sea. The camera was damaged on landing and left to burn in the aircraft. The I.F.F. set was detonated, but the three incendiary bombs available for destroying the aircraft were unsuccessful in spite of repeated attempts by the crew. The pilot, therefore, took his axe and smashed open the overload tank on the port side bomb bay, and let out some of the remaining two or three gallons of petrol. This was ignited and the aircraft completely burnt out. The only things the Swedish authorities recovered after the fire were the front and rear turret guns, but these were certainly well damaged.

The crew were taken into custody after an hour by the Swedish equivalent of the Home Guard, and later handed over to the police who searched them all, with the exception of the pilot whom they overlooked. The police officers interrogated the crew, asking them where they had come from, where they had been, why they had landed in Sweden, their squadron number, type of aircraft, bomb load, and a few general questions, to which no answers were given by the crew. During their transfer from Ystad the crew were accompanied by a very pleasant Swedish air force officer who spoke very good English. He also asked them a lot of questions about the R.A.F., including the I.F.F., tactics, etc., and wanted to know the extent of our knowledge of Germany in so far as the Luftwaffe and German defences were concerned.

(iv) An Aircraft sees a U-Boat blown up by a Mine

Actually to witness the results of one of our sea-mining operations is an experience given to very few. Aircrews engaged on such operations generally have to be content with a bald announcement (usually long after the event) of some of the vessels sunk or damaged as the outcome of their labours.

But a Wellington crew of No. 305 (Polish) Squadron have the evidence of their own eyes as visual confirmation of the extremely important successes achieved by laying mines at sea.

At about 2100 on 16 February, 1943, this aircraft was laying mines in the Bay of Biscay. The night was extremely clear, there was bright moonlight and the sea was calm. The aircraft was making a run-up at a height of 500 ft. when she saw a U-Boat crash-dive ahead. It took her less than a minute to reach the position and she had just passed over it when there was a violent explosion which shook her considerably. The bomb-aimer and the rear-gunner both saw a big column of spray and the latter also saw what he took to be the tail of the U-Boat standing almost vertically out of the water. It disappeared after a short time and nothing more was seen. The aircraft continued its operation which it successfully completed.

Mines had been laid on previous sorties in this area, where the depth of the water is about 15 fathoms.

III. THE IMPORTANCE OF THE RUHR

From the beginning of the bombing war in the latter half of 1940, Essen and the industrial establishments in the area of the Ruhr Valley have been main objectives for Bomber Command.

As the so-called "Weapon-smithy of the Reich" lies within easy reach of our bombers—the Ruhr is, in fact, nearer to Britain than almost any other part of Germany—it is not surprising that Göring provided it with immensely strong searchlight and flak defences. In spite of them, however, the outlook for the "Black Country" of the Ruhr is now black indeed.

It may be well asked why did the Nazis not forestall the peril which now threatens to destroy their great armaments factories in the west by organising new industrial centres beyond the range of our aircraft?

There are a number of obvious reasons why the Ruhr still remains the most vital centre of war production in Germany. At the outset the Nazis certainly believed—not without some degree of reason—that their material superiority over the French and British was sufficient to ensure that the "lightning war" would be over before we could inflict any appreciable damage on the Ruhr. Even when their "lightning war" had failed to bring complete victory in the west, there still appeared to be good prospects of eliminating first Russia, and then Britain, before our air offensive had acquired enough weight to be effective against their powerfully-defended munitions centres. By the time the enemy realised the war was going to be a long one it was already years too late to think seriously of "moving the Ruhr." Throughout 1942, as our blows became increasingly severe, the German High Command could do nothing but apportion a still greater number of much-needed guns and, above all, fighter aircraft to the defence of their western front. Meanwhile their press and radio referred to a great "industrial migration," giving the impression that a wholesale transfer of industries mainly to the Eastern Reich and to the incorporated districts beyond, was actually in progress. This was not only wishful thinking, it was deliberately misleading, as so stupendous an undertaking could never have been contemplated seriously. Some individual factories certainly were transferred eastwards, and the other industrial areas, *e.g.*, Silesia, Austria and Saxony, had inevitably expanded during the war. But geography had pre-determined that the Ruhr would remain indispensable to the German war machine, and there is no evidence that any major Ruhr or Rhineland plant has been transferred elsewhere either for fear of bomb damage or as a result of it.

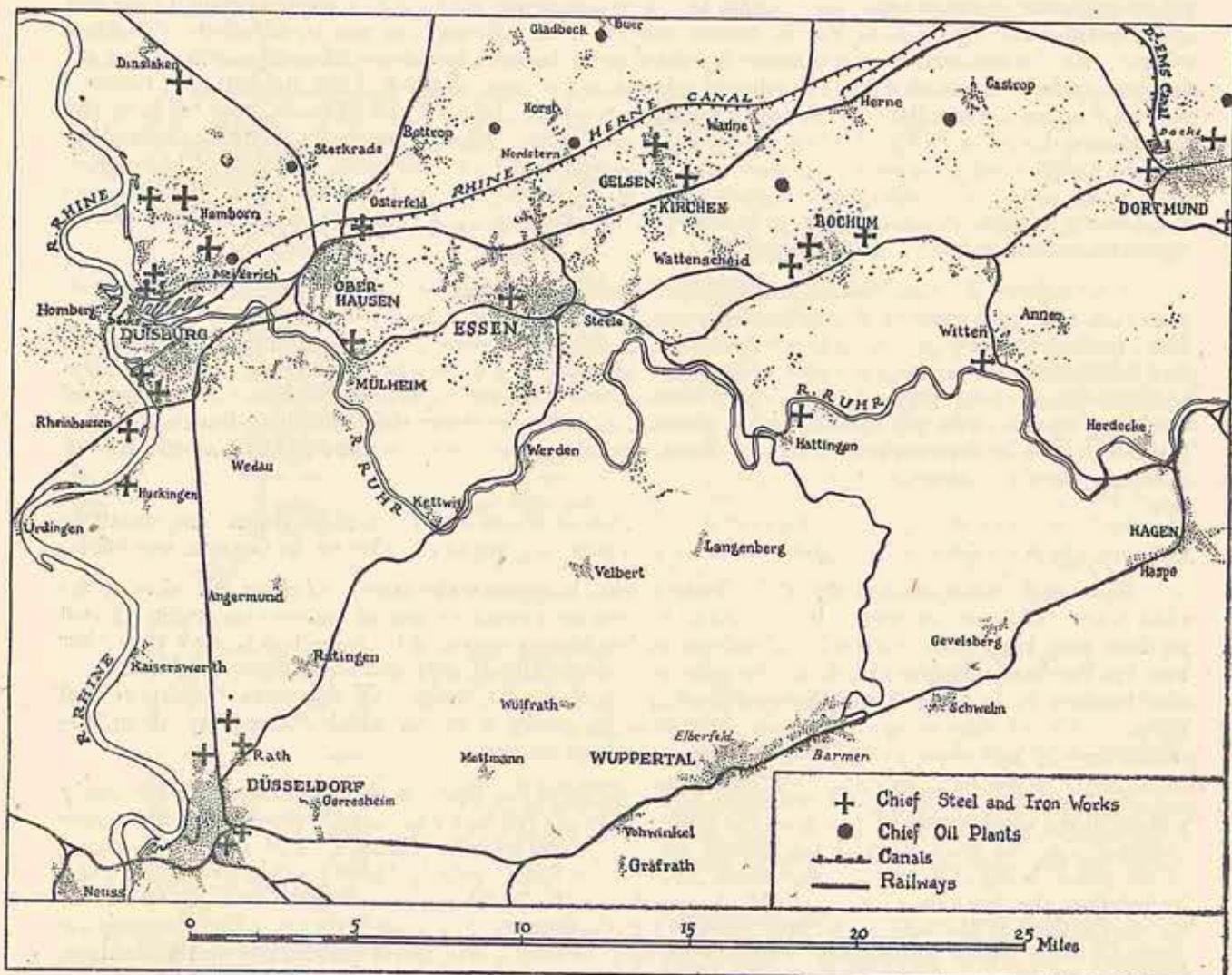


Diagram showing the relative positions of the chief towns of the Ruhr area, and the distribution of some of the basic industries.

The fundamental reason for the supremacy of the Ruhr over all other industrial regions of Axis Europe is abundance of bituminous coal. At the start of the war the Ruhr output of hard coal amounted to well over 120 million tons a year—about three-quarters of the total from all German coalfields, excluding Austria; and in addition it produced a similar proportion of the total output of furnace coke essential for metallurgical industry. Moreover, the Ruhr is ideally situated at the meeting point of trans-continental trunk routes by land and water—a fact of critical importance in the German war-transport system. Millions of tons of rich iron-ore have to be imported annually from Scandinavia and from Spain. The Swedish ore is able to reach the Ruhr by ship and river-barge (via the Rhine to the docks at Duisburg-Ruhrort, or by the Dortmund-Ems canal) without adding to the burden of the railways; while the Spanish ore comes by rail from Bordeaux. This route has at least the merit that it is shorter than it would be to any other industrial part of Germany. Indeed, the Ruhr coalfields lie midway between the only available sources of high grade iron-ore. To attempt to disperse the complex network of interdependent industries, transport facilities and utility services (to say nothing of hundreds of thousands of workers) assembled at this strategic point would be disastrously uneconomic to say the least. In the fourth year of the war, when raw materials, man-power and communications must be utilised with rigorous economy to maintain the flow of production at top speed, the effect would be catastrophic. If Bomber Command could at this stage force the enemy to attempt even a partial transference of heavy industries from western Germany, the cumulative loss in output and the added strain on the railways would bring the end of the war very much nearer. Yet if the industries remain where they are they will inevitably meet the fate of Sodom and Gomorrah.

As the destruction of the Ruhr plants is already well in hand this is an appropriate moment to consider what their loss will mean to the German war machine. A precise estimate is hardly possible, but a general idea can be obtained from the following summary of the main targets.

The main industrial belt of the Ruhr measures little over 30 miles from east to west and includes eleven large towns, of which the chief are Essen, Duisburg, Dortmund, Bochum and Gelsenkirchen.

The reputation of Essen as Germany's greatest armaments arsenal was confirmed during the first world war, when the Friedrich Krupp Works expanded on an unprecedented scale. Despite the reorganisation of the works which followed the collapse of Germany's war machine in 1918, Krupp's is still the largest individual armaments and heavy engineering plant in the Reich. In addition to the manufacture of naval, coastal and other heavy guns, of which it is the chief if not the sole producer in Germany, Krupp's is also one of the two great manufacturing centres for railway locomotives. It is, indeed, really a combination of factories producing a wide range of materials and equipment of the utmost importance to the enemy's war effort. The output of the Krupp arms and engineering factories includes heavy flak guns, torpedo tubes and bombs, armour-plate, tanks and tank engines, armoured cars and artillery tractors. Apart from the important role played by Krupp's in the manufacture of finished weapons for the armaments programme they turn out a large range of special components and semi-finished products on which a great number of other manufacturers depend. Thus, the output of Krupp's is of vital importance to the enemy's war industry as a whole. They are, for instance, believed to be the largest manufacturers in Axis Europe of aero-engine and diesel-engine crankshafts, as well as important manufacturers of air vessels for torpedoes, and probably the largest individual suppliers of locomotive wheels and axles; they also make a great range of heavy castings and forgings for special purposes in a variety of uses. A serious hold-up in deliveries of such materials is capable of almost incalculable repercussions throughout German industry.

Other industrial establishments in Essen are dwarfed by the huge Krupp group. They are, however, numerous and important in themselves—for example, the chemical and metal works of Goldschmidt A.G. Outside the city proper, suburbs sprawl in all directions, linking up with Mülheim, Oberhausen and Gelsenkirchen: a black country of foundries and engineering works, coal mines, coking and by-products plants, interspersed with workers' settlements. Among important factories on the fringe of the Essen area are two tar hydrogenation plants near Gelsenkirchen: the Gelsenberg-Benzin works at Nordstern, and Hydrierwerke-Scholven at Buer, which together produce some 575,000 metric tons of aviation petrol per annum.

Such, are possibly, the most important industries in Essen and the middle Ruhr. Important as they are, the remainder of the region, both east and west, is quite as valuable to the German war effort.

Dortmund, the most easterly of the Ruhr towns, is actually the largest of them all. One of the chief centres of heavy industries in the Reich, it contains a great variety of engineering works as well as three very large iron and steel establishments, the biggest operated by Hoesch A.G. and the other two by Vereinigte Stahlwerke A.G. Besides huge quantities of iron and steel, these establishments also produce shells and armour-plate forgings, particularly for tanks. Of the many important coal mines in the Dortmund area, and the coke-oven by-products plants which accompany them, the Minister-Stein pits alone yield 2,000,000 tons of coal per annum.

Midway between Dortmund and Essen lie the mines of the Bochum area which account for nearly a third of the total output of coal from the Ruhr. Here are the usual accompaniments of the coke-oven industry, *i.e.*, the production of gas, benzol, ammonia, synthetic oil, chemicals and explosives—many of the plants being of first-rate importance. Some of the Ruhr's principal high-grade steel works are also included in the Bochum region, notably four units of the Vereinigte Stahlwerke A.G. Of these, the Gusstahlfabrik, in Bochum itself, is of the greatest significance to the enemy's war effort, turning out amongst other things gun-barrels, complete artillery, armour-plate, naval gun-turrets and mountings, and high-grade steel for aircraft and aero-engines.

Of the industrial towns of the Ruhr proper Duisburg occupies the key position at the junction of the Rivers Rhine and Ruhr, and its inland harbour is the greatest in Europe, if not in the world. The presence of hard coal in large quantities in the immediate vicinity accounts for the development of numerous and highly important industrial plants. The coal, iron and steel industry of the surrounding district is almost entirely in the hands of the Vereinigte Stahlwerke A.G. and its subsidiary companies. Of these the August Thyssen Hütte A.G. operates four great blast-furnace plants, that in the Hamborn-Alsum district alone producing annually 2,000,000 tons of pig iron and 2,500,000 tons of steel ingots. The Krupp furnaces at Rheinhausen, on the opposite bank of the Rhine, have an output nearly as great; while in addition to a considerable steel output the Huckingen plant of the Mannesman Steel-tube Company turns out gun-barrels, mine bodies, and steel tubes for aircraft construction. Among engineering and armament works Demag-Werk I constructs hydraulically-operated mechanisms for heavy naval and coastal guns; at Eisenwerk-Wanheim, shells, bomb bodies, crankshafts and hand-grenades are produced; while parts for variable-pitch airscrews are made at Ürdingen, ships' boilers at Oberhausen, and torpedo nets and cables at Kabelwerk-Duisburg. Out of a great many other important establishments may be mentioned that of Deutsche-Solvay, at Rheinberg, on the west bank of the Rhine which was, before it was bombed last year, one of the two largest alkali works in the Reich; and the Meiderich plant which distills and processes nearly half the coal tar of Germany.

Düsseldorf also must be considered as forming an essential part of the same industrial region as the Ruhr towns, although it is actually on the Rhine some 15 miles south of the junction with the River Ruhr. It is the leading commercial city of Western Germany and the seat of the general administrative departments of practically all the important iron and steel, heavy engineering and armaments concerns of the Ruhr as well as of the Rhine districts. Its armaments and engineering factories are as important as those of Duisburg and Essen.

The Rheinmetall-Borsig works were Germany's second largest munitions works in the last war; now they are quite as important as Krupp's for all types of armaments and heavy engineering products. Their Derendorf section (in the northern district of the city) has a very large output of flak, anti-tank, and naval guns, including all but the heaviest types, which are Krupp's speciality. Their 35,000 workers also produce gun-carriages, naval gun-turrets, shells, bombs, mine bodies and components for aircraft, transport vehicles and industrial plant.

The other Rheinmetall-Borsig plant is also north of the city, at Rath, on the line to Essen. Here tanks are built at an estimated rate of 30 per month and armour plate for fortifications and for naval use forms part of the varied output from this factory. The neighbouring Mannesman Steel-Tube Works employs 24,000 workers in the production of such war materials as air cylinders for U-Boats as well as shell-, bomb- and mine-cases.

In addition to these three works of outstanding significance (they would alone make Düsseldorf a first priority target) there is to the south-east of the city the Oberbilk district severely damaged in last year's raids. Here large heavy-engineering works form a most impressive concentration. The Schiess-Defriess factory, for instance, was the leading producer of heavy machine-tools in the country, besides making magnetic mines and big bombs and shells up to 38 cm. The Klöckner Werke, one of the principal wire-drawing plants in Germany, and many other factories such as Deutsche Rohrenwerke, and the Gütehoffnungshütte Werk, which is believed to have a considerable output of heavy bombs, are all situated in the same part of the city.

While this outline of the war production centres of the Ruhr is far from complete it is sufficient to demonstrate the crucial importance of the five towns which have been considered. Reconnaissance photographs actually give the lie to the enemy's propaganda about the munitions industry having been transferred to territory beyond our reach. The Düsseldorf Schiess-Defriess Works, already mentioned, is a typical instance of what is really happening. Completely wrecked by a well-placed heavy bomb at the end of July last year, labour and materials were at once allotted to clear up the mess and rebuild the Schiess works on the same site. Six weeks later, when the ruins were just beginning to take shape, we repeated the dose and part of the establishment not flattened in July was gutted in September. Realising the impossibility of "migration," reconstruction was once more put in hand. One result of the damage here was a serious delay in the completion of a new programme for heavy flak. Thyssen's and other Ruhr factories which suffered in a similar way were laboriously rebuilt. This may look like incurable optimism, but it is nothing of the sort. The Nazis, knowing full well the risks involved, are confronted by the hard fact that the union between the Ruhr and German armaments production is indissoluble. Despite our bombing, and the losses and delays it has caused, they still believed they could get enough production out of this their richest industrial territory to keep the three branches of the Wehrmacht in the field. Up to last year they succeeded at great expense of life and labour. But the real Battle of the Ruhr started in the New Year, 1943, with the introduction of new navigational aids which have to a large extent stripped this region of its main meteorological defence. Repeated small-scale raids on all the main towns (often carried out in spite of thick cloud-cover) were swiftly followed by the tremendous blows at Essen. Now the battle is joined in earnest, and victory on this front will deny to the Nazis a large proportion of the guns, tanks and aircraft, the U-Boats and locomotives essential to the defence of their European "fortress."