

R.A.F. NARRATIVE

(First Draft)

PHOTOGRAPHIC RECONNAISSANCE

VOLUME I

TO APRIL 1941

AIR HISTORICAL BRANCH (1)
AIR MINISTRY.

PHOTOGRAPHIC RECONNAISSANCE BY THE
ROYAL AIR FORCE IN THE WAR OF 1939 - 45

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PART I

TO THE OUTBREAK OF WAR

1. INTRODUCTION.

"Reconnaissance, or observation, can never be superseded; knowledge comes before power; and the air is first of all a place to see from" - Sir Walter Raleigh:

The basic theory of reconnaissance is as old as war itself, namely that the more accurately the enemy's dispositions are known the greater the opportunity of engaging him at the time and place and in the manner most calculated to secure his overthrow, an axiom which applies with equal force to both defensive and offensive warfare. It is because accurate information or intelligence about the enemy and his intentions results in so great an economy in the effective application of force, that war leaders have consistently found it to their advantage to secure it even at considerable cost. In general, intelligence has been acquired by a number of means, including reports by agents or sympathisers in enemy territory, direct visual or photographic observation, interception of enemy communications, interrogation of enemy personnel, and examination of enemy documents and war material. While their relative importance will vary according to circumstances, including the stage reached in the development of hostilities, it must always remain true that the various sources of information are complementary and that intelligence obtained by collating distinct sources is liable to be both more comprehensive and more reliable than that based on any single line of enquiry. Accordingly, if the present narrative is concerned specifically with the immense development of photographic reconnaissance as a function of air power, it is not intended to suggest that alternative sources of information have ceased to be of value; indeed, it might be argued that,

since the aeroplane and, in particular the aero-camera, have vastly increased the range and detail of reconnaissance data, the importance of sources capable of amplifying and checking visual intelligence has, if anything, been greatly enhanced; and, conversely, that the very range and flexibility of air reconnaissance has increased the value of any clues that may serve to define its most profitable objectives at any particular time.

Until comparatively recently visual reconnaissance was restricted to what a man could see on foot, on horseback or stationed on a natural eminence or an artificial observation post, and it is a sobering thought that the great captains of history fought their battles with very little direct knowledge of the forces against whom they were engaged or even of the development of the battle. Only with flight did there come the possibility of surveying the whole field of battle and of extending the range of vision beyond and behind the immediate area of hostilities, allowing the commander to base his plans upon an accurate and comprehensive knowledge of the dispositions and activities of the enemy. At the same time the development of mechanised industry, of which flying machines capable of moving under their own power were an outstanding product, extended the range of war itself from the battle-front to the entire territory of a hostile power, from professional soldiers to whole populations, so vastly increasing the area over which reconnaissance was necessary. Thus military necessity and the technical means for meeting it have worked together to further the development of air reconnaissance in modern war.

3.

When on October 15th 1783 Jean de Rozier took the air in one of Montgolfier's hot-air balloons, he vastly extended the horizon of man's vision, yet balloons played no important part in the Revolutionary and Napoleonic wars. Napoleon III made some use of balloons for reconnaissance in the Italian campaign of 1859, but their first important use for military purposes occurred in the American Civil War, which in this, as in so many other respects, revealed the shape of things to come, and it is significant that it was the industrial North which took the lead in this development. As a result of experience gained during the Civil War, balloons were adopted during the following years as part of the normal military equipment of most Powers.

Meanwhile the development of photography had greatly enhanced the possibilities of air reconnaissance, which so long as it depended entirely on the impressions of individual observers, remained strictly limited. Even if for certain tactical purposes visual reconnaissance is unlikely to be wholly superseded, it was photography that first made it possible to secure a comprehensive, detailed, impersonal and lasting record of what is visible from the air; and it is only by securing such records that accurate comparisons could be instituted with the results of previous reconnaissance, or detailed collations made with other sources of information, in the manner needed to build up an adequate strategical picture. Photography from the air was first made practical by the development of the collodion process between 1848 and 1851, and the ensuing decade saw a number of practical essays in balloon photography in France and America.

The superiority of aerial over terrestrial reconnaissance, once demonstrated, was so striking as to compel the attention of military experts; indeed, it was primarily to further reconnaissance that soldiers applied themselves to the development first of balloons, next of airships, and finally of kites and self-propelled flying machines. Balloons were actively employed in most of the foreign wars of the 19th and early 20th centuries, being used by the French in the siege of Paris (1870-1) and during their campaign in China of 1900, and by the Japanese in the Russo-Japanese War of 1904. Military experiments in Britain began at Woolwich Arsenal in 1878 and from 1883 were carried on at the balloon school, depot and factory established at Chatham. Balloon detachments served with the Bechuanaland Expedition of 1884 and the Sudan Expedition of the following year. In 1890 a balloon section was formed as a unit of the Royal Engineers. Four balloon sections took part in the South African War and it is interesting to recall that a balloon sent to help in the relief of Ladysmith was used to direct fire and to report Boer positions. Even in the war of 1914-18 balloon photography was put to occasional use, as when in the Macedonian campaign of 1917 a panorama of the country between the Vardar river and Lake Dojran was photographed by an Army balloon in preparation for the battle.

While the importance of balloons in the early development of air photography ought not to be neglected, the application of the new method of reconnaissance to military activities on a really wide scale had to wait on

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War in the
Air, I,
147-154

War in the
Air, V,
350-1.

the development of aircraft capable of carrying the camera to whatever area it was desired to investigate and of bringing the films safely back to base. So long as aeroplanes were still serving an apprenticeship, the intrepid aviator was too preoccupied in keeping his machine air-borne to consider cameras. Nevertheless, as early as 1909 the Aero Club de France was able to exhibit the first air-photographs taken from an aeroplane, while in the French manoeuvres of 1911, Capt. T. Sacconey, a disciple of Colonel A. Laussedat, the pioneer of balloon photography, carried out the first photographic reconnaissance by aeroplane. Experiments undertaken with the scantiest equipment during the earliest days of the Royal Air Force resulted, in 1912-3, in the first successful photographs taken from aeroplanes in this country. But it was not until the new method of reconnaissance had proved itself in war that its military applications were appreciated by more than a handful of enthusiasts.

2. EXPERIENCES IN THE WAR OF 1914-1918.

Developments in the field of photographic reconnaissance during the war of 1914-18 merit study for two separate and complementary reasons. On the one hand they provided the only body of experience on which the Air Staff was able to draw when framing policy in the period between the two wars, and so form an essential element in any appreciation of the provision for photographic reconnaissance in the Royal Air Force at the time of the outbreak of war in 1939; on the other, they constitute a standard against which to measure the differences between the two wars and so to estimate the scale of the readjustments necessary to bring the machinery of photographic reconnaissance into line with radically new conditions.

J.C. Slessor,
Air Power &
Armies.
p.126

The basic fact to remember about the war of 1914-18 is that it was "from the air point of view, above all an 'Army Co-operation War'." The soldiers had fostered the beginnings of flight with the twin aims of improving their means of reconnaissance and of providing themselves with a method of rapid survey; the ultimate origins of the Royal Air Force trace back to a balloon detachment of the Royal Engineers; the first officers of the Military Wing of the Royal Flying Corps were drawn from regiments of the British Army; and the aircraft themselves were designed primarily for reconnaissance. The position has been admirably summed up by the Official Historian in the statement that "the single use in war for which the machines of the Military Wing of the Royal Flying Corps were designed and the men trained was reconnaissance". Moreover, /historically

War in the
Air, I.
p.260

Vol.I,
p.455

Vol.I,
p.9f

Vol.I,
p.440

historically the later uses of the air arm grew out of reconnaissance "as the branches grow out of the stem of a tree" and serious air fighting in the opening years of the 1914-18 War "was, in its essence, an attempt to put out the eyes of the other side".

At first, interference was confined to fire from the ground and a pilot had only to fly his unarmed aircraft at a height of approximately 4000 ft. to obtain immunity, but it was not more than a few weeks before aircraft attempted to deprive each other of their freedom to reconnoitre. Instructions on "Fighting in the Air", issued by the General Staff in March 1917, illustrate the extent to which reconnaissance activities had already been overlaid by fighting: two-seater reconnaissance machines were to keep compact formation flying in two rows of three, the machine with the camera being in the middle of the front row with flankers slightly higher, the second row being slightly higher again; single-seater scouts, if used for escort, were to keep separate formation and fly above the two-seaters. It was from attacks on such formations as these, centering on the reconnaissance activities of a single machine, that the majority of the great air battles of the last war arose. It is no part of our present purpose to trace the development of air-fighting, but it is important to stress that fact that, after an idyllic and all too brief period of unrestricted freedom, reconnaissance aircraft in the war of 1914-18 had to fight for their information.

The methods adopted for air reconnaissance depended partly on the tactics inherent in the contemporary stage of the air war, and partly on the requirements of the war

/situation

situation in general, which in the case of the Royal Flying Corps meant those of army co-operation. If during the opening weeks reconnaissance was almost entirely visual, this was due in part to the rudimentary character of the air war at this time. So long as aircraft remained capable only of low speeds and until attention was seriously absorbed by the necessity of combatting enemy machines, the aviator was able to make a relatively leisured study of the terrain over which he flew. Before the development of anti-aircraft artillery, moreover, reconnaissance aircraft were free to cruise at heights which allowed detailed observation of what was happening on the ground. It was the increasing speed of aircraft, the growing preoccupation with air fighting, and the necessity of flying above the ceiling of effective visual reconnaissance that gave a direct impulse to air-photography as an adjunct to, and in some measure a substitute for, visual reconnaissance. Another important factor was the shortage of observers sufficiently well trained to make accurate observations. Although the first observers were generally army officers, fully capable of appreciating the military significance of what they saw, this ceased to apply to the same extent to the increasing numbers required to meet a rapidly expanding establishment, and it was found a simpler matter to train photographers than observers skilled in the art of military interpretation. Moreover, the camera had much in its favour even when compared with the most perfect observer. As the Official Historian put it, "the camera pictures only what is there, omits nothing, provides a record which can easily be duplicated, and supplies a means for recording, with relentless precision, the multitudinous changes that have

War in the
Air, Vol.I
p.44Of.

Vol.I,p.304

War in the
Air, Vol.II
p.87

Vol.I.p.304

taken place within the restless area of an army at war". Errors in the interpretation of air-photographs can often be checked, whereas visual observation is personal to the observer and even the best trained observers are liable to error, as when in 1914 stretches of tar on macadamized roads were mistaken for troops on the move, and shadows cast by gravestones were taken for a military bivouac. Again, photographic interpreters are liable to penetrate camouflage designed, often with success, to deceive the visual observer.

Military circumstances favoured the same trend. During the period of retreat in August and early September 1914 the main task of the Royal Flying Corps was to keep General French informed of the progress of von Kluck's attempted envelopment by reporting troop movements, work in which the time factor was all important and for which visual was therefore more fitted than photographic reconnaissance. With the onset of static warfare in September, visual reconnaissance continued to subserve certain tactical ends as it did till the end of the war, but photography came more and more into the picture. Tactical reconnaissance squadrons attached to corps were mainly employed in directing our artillery to enemy batteries or special military objectives such as wire or trenches, and in keeping Corps Headquarters informed of the point to which our own troops had advanced, in order to avoid their being shelled by our own guns. Most of this was done by visual observation in conjunction with wireless. On the other hand it is of special interest to note that the idea of assessing damage by means of comparing

/photographs

Vol.IV
pp.118-9

War in the
Air, Vol.VI,
p.503

photographs taken before and after bombardments, which was to play so important a part in the bomber offensive of the war of 1939-45, had already been developed systematically in relation to artillery fire during the war of 1914-18. Another use of the camera in tactical reconnaissance was for securing "oblique photographs picturing the lie of the ground in front of the advancing infantry", a task which called for rapid work, the finished prints being dropped at divisional stations "usually within about four hours of the photographs being taken". The task of strategical reconnaissance squadrons was to provide Army Headquarters with detailed information about the enemy's dispositions and intentions by photographing his lines of communication, dumps, depots and airfields in back areas of the battle zone. In a memorandum issued from General Headquarters in January, 1918, on the employment of Royal Flying Corps during the period of waiting for the expected German Offensive, it was ordered that -

Vol.IV,
App.XIV,
p.444

"Photographs of the enemy's possible concentration areas should be taken at such frequent intervals as will ensure that the progress of any preparations may be followed."

It remains to add that part of the effort put into photographic reconnaissance in the service of the Army was directed to various forms of survey. On the Western Front this consisted of rectifying existing surveys and of constructing local trench maps. In regions where no adequate maps existed, however, areas over which military operations were expected to develop had to be surveyed de novo. Thus, during the six months following the second

Vol.V,p.228 battle of Gaza, over 500 square miles of territory in

Vol.V,p.262 Turkish hands were photographed, so that large scale maps could be prepared for Allenby's projected operations.

/Similar

Vol.V,p.178

Similar efforts were made in Mesopotamia and Sinai

Vol.VI,p.264

In addition to the systematic survey of whole areas for mapping purposes, special photographic sorties were commonly flown in such regions to locate waterholes or spot the best routes for movement. The benefits obtained by the Army from topographical air survey during the war of 1914-18 were not forgotten at the War Office in the years that followed. Air Survey established itself as a permanent requirement of the Army.

The great and successful efforts put forth by the air arm in the cause of reconnaissance were undertaken primarily on behalf of the land forces. Not until the winter of 1917/18 was the Royal Air Force given an opportunity to carry on independent bombing operations and then only on the most modest scale. Consequently neither the Royal Flying Corps nor the Royal Air Force made any very striking progress in the development of photographic reconnaissance as an aid to the planning of offensive air operations. On the other hand, we have it on the authority of Lord Trenchard that, although most of the information on targets supplied by his intelligence department in the period of the operations of the Independent Force during the concluding months of the war took the form of plans and maps, these "were supplemented in a large way by the aerial photographs taken by reconnaissance machines".

War in the
Air, Vol.VI
136-137

It is significant that the most promising developments, albeit miniature in scale and thwarted by events, were those sponsored by the Royal Naval Air Service. As in the case of the Royal Flying Corps, reconnaissance was from the first regarded as the prime object of aircraft, but

War in the
Air, Vol.I
456

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the Royal Naval Air Service alone was in the fortunate position of gaining information largely for its own use. On the purely naval side reconnaissance was limited and was mainly visual. Nothing approaching the detailed and accurate knowledge of enemy shipping over wide areas made possible by the development of photographic reconnaissance during the war of 1939-45 was available to the naval authorities in the earlier war, but one instance of the successful use of air reconnaissance, both visual and photographic, in the furtherance of purely naval operations was made in the location in the Rufiji Delta, East Africa, of the German cruiser *Konigsberg*, fresh from her exploits in the Indian Ocean and the Gulf of Aden during the summer of 1914. Since she was invisible from the sea, and the delta extended over 200 square miles of swamp with enemy troops manning the coastal flats between the main channels, air reconnaissance was the only method of locating her exact position. Once this had been achieved, not without disappointments, it was possible to bring two monitors into position and destroy her by gunfire. In so doing the monitors were aided by air spotting, such as the Royal Flying Corps practised on the Western Front. As on the Western Front, also, photography was employed to assess the effect of the bombardment.

More significant as a pointer to the future were the preparations made during April and May, 1918, under the orders of Sir Roger Keyes for the projected blocking of Zeebrugge and Ostend. The whole area of operations was photographed and re-photographed and plans were laid on the basis of information so obtained. The "plans and models of the coast and of the naval objectives" constructed on the basis of the photographs were forerunners of the more elaborate preparations based on

/photographic

War in the
Air,
Vol. III,
1-14

Vol. VI,
385-90

photographic reconnaissance, which characterised the combined operations of 1942-1945. Equally germane were the preparations made by Vice Admiral Bacon of the Dover Patrol, while planning to wrest the Belgian coast from the Germans in 1917. In order to determine the slope of the beaches selected for landing and to detect irregularities, air photographs were taken at recorded time intervals during a falling tide on a calm day; in this way the contours of the beaches were made apparent from successive margins of the water. As a check two surveys were made of a comparable beach near Dunkirk, one by direct survey, the other by calculations from air photographs, the results of which proved reassuring.

Finally, the Royal Naval Air Service based on Dunkirk carried out reconnaissance in conjunction with their offensive air operations, which limited though it was by available means, presaged the requirement which large scale bomber operations would entail. A good example of the tactical use of reconnaissance is afforded by the events of February 1st 1918, when air reconnaissance revealed a concentration of German shipping, including twenty torpedo craft and three U-boats, immobilised in the harbour at Bruges through the freezing of the canals and entrance locks. That the ensuing bombing attacks by naval aircraft were largely ineffective does not detract from the excellence of the intention. On the strategical side the Naval Intelligence Section at Dunkirk in 1917 and the opening months of 1918 built up a remarkably complete picture of the defence system, coastal and inland batteries, beaches and general topography of the Belgian coast, through a combination of air photographs and the

/visual

Vol. IV,
91
also
The Dover
Patrol
Vol.I, 237

War in the
Air, Vol.IV
79

Vol. IV
102-4

visual observations of pilots. Persistent and frequently repeated reconnaissance enabled a close watch to be kept on the progress of modifications to the U-boat shelters at Bruges, designed against air attack. Unfortunately the pull of the Western Front proved too strong and the forces, which it had been hoped to use for bombing the U-boat bases of Belgium, were drawn into the dreary round of Army Co-operation. Thus was cut short what might have proved an essay in miniature of the air war of the future. Still, sufficient had been done to show that, when reconnaissance aircraft were not employed exclusively on artillery and other close military work, they could be used to assemble the intelligence material required for an air offensive.

To sum up, while the war of 1914-18 showed clearly enough the importance and some of the possibilities of photographic reconnaissance, its employment was in practice to a large extent confined to the restricted field of military effort. Within that field, however, so much progress was made that comparatively little scope was left for future development, apart from technical improvements in photography. Invaluable experience was gained both in selecting objectives for photographic reconnaissance and in interpreting the photographs secured so as to obtain the maximum information regarding the dispositions and intentions of the enemy and in assessing damage inflicted by our artillery. On the other hand this advance was won at a heavy cost. Not only was a great proportion of all available aircraft locked up in army co-operation reconnaissance and in the protection of the machines so engaged, at the expense of offensive air operations, but research and development

/were

were cramped in a similar manner. As Minister of Munitions, Mr. Winston Churchill, in a paper dated October 21st, 1917, made the point that -

War in the
Air,
Appendices,
p.20

"The dominating and immediate interests of the Army and the Navy have overlaid air warfare and prevented many promising lines of investigation from being pursued with the necessary science and authority."

So long as the flying arm was kept in the leading strings of the army, its energies were absorbed in satisfying ground requirements, to the detriment of air power. The emergence of the independent striking force was so retarded, that it had barely time to feel its strength before the war ended. As a consequence, the development of reconnaissance for the furtherance of offensive air operations remained in an embryonic state. Photographs taken during daylight strikes proved their value as giving some indication of the success of the raid, but neither the preliminary use of air photographs in the selection of targets, nor the scientific assessment of damage after an air raid appear to have been developed on any extensive scale by the Royal Flying Corps. On the other hand, the principle of damage assessment by comparison of air photographs taken before and after the event had been fully established in relation to artillery bombardment. What was lacking was experience in collating the results of photographic reconnaissance with other sources of information and in utilising the intelligence so obtained for the framing of strategical plans: the Royal Air Force had developed keen eyes, but its vision was utilised predominantly to further designs over which at the highest levels it had no control. Until the closing months of the struggle the exigencies, of what was from the air point of view primarily a war of army co-operation, deprived the Royal Air Force of experience in

the higher appreciation of intelligence as a basis for formulating its own plans.

In 1918 the day envisaged by General Smuts when "aerial operations may become the principal operations of war, to which the older forms of military and naval operations may become secondary and subordinate" was still far off. But between the two wars, the technical development of aircraft, the immense increase in their speed, range and lifting power, had the effect, if not of securing the primacy of air power, at least of adding a new dimension to warfare. Air power would still be used in the service of armies and navies, but reaching over and beyond them it would seek to grapple with the enemy in the depths of his own territory. The war of 1914-18 had been total in a sense never previously experienced, yet with rare exceptions British air operations were not extended deeper than 40 to 50 miles beyond the front line. The extension of air power made possible by subsequent technical development was to have the effect of vastly enhancing the importance of accurate and up-to-date air-intelligence over the whole range of enemy occupied territory, and this in turn was to increase beyond measure the importance of long range photographic reconnaissance by means of which alone a rapid survey of the field of operations could be secured. Thus it was inevitable that long range photographic reconnaissance would prove a necessary function of the strategical use of offensive air power in the war of 1939-45.

3. ROUTINE TRAINING IN THE INTER-WAR YEARS TO 1938.

A.P. 1300

Chap. XII

para. 27

The estimation in which air-photography was held by the Air Staff between the wars was a natural outcome of the experiences of 1914-18. From a theoretical point of view the War Manual, issued for official use in July 1928, recognised the value of air reconnaissance for air forces employed on Naval, Combined and Independent Air Operations as well as for Army Co-operation. Yet it is significant that only in the case of Army Co-operation was its employment defined in any detail. Moreover, it was in this field alone that there was so much as a mention of the interpretation of air-photographs, without which photographic reconnaissance was useless for staff purposes. The ruling that "the air force is responsible for taking and developing air-photographs, while the army is responsible for their interpretation and distribution", although specifically applied in the Manual to air forces engaged in Army Co-operation, in fact describes accurately a division of functions tacitly accepted by the Royal Air Force in general until as late as 1938.

In his Memorandum of 1919 on the Permanent Organisation of the Royal Air Force, Lord Trenchard recognised air-photography along with navigation, meteorology and wireless as one of the "primary necessities" for which training was of "extreme importance". This policy of maintaining air-photography as an essential branch of Royal Air Force activity, entailed on the one hand the continuance of technical research and on the other the training of personnel in the taking and processing of photographs.

/The

The flying side of photographic training was entered for by the ordinary flying training schools and in the course of routine operational training on the squadrons and will not be dealt with as such in the present narrative. It is, however, relevant to point out that the division of functions whereby the Royal Air Force was confined to a merely executive role did nothing to increase the time or enthusiasm devoted to air-photography on the squadrons: on the one hand, photographic training suffered from absence of backing and direction at a high level, and on the other it deprived flying men of the stimulus of seeing palpable results from their efforts.

Nevertheless, in overseas commands keenness was maintained to some extent owing to the operational opportunities presented by photographic survey in badly mapped territories. Economic and even cultural objectives also provided useful practice, all the more valuable in that they were essentially of an intelligence order. An

For details
see
Appendix I

excellent example of the former were the Nile Flood Surveys carried out, at the expense of the Egyptian Government, by Nos. 47 and 208 squadrons during 1920-2 to collect data on the behaviour of the Nile at high and low level for use by the Irrigation Department of the Public Works Ministry. No. 47 Squadron had a widely varying experience, indeed, since it came in for survey work on the Sudan border in connection with the Abyssinian war, and in October, 1936, supplied three aircraft for photographing areas suspected of breeding malarial mosquitoes. A secondary purpose of the Nile Survey was to provide the Antiquities Department with photographs of ancient sites, traces of which, though largely invisible from the ground, can often be seen quite clearly from the air and recorded by the camera. The stimulus afforded

by traces of ancient civilisation was particularly strong in Iraq and many were the discoveries, like the site of the ancient city of Seleucia, made there by Royal Air Force photographers between the wars.

At home the difficulty of finding scope for the practice of air-photography was enhanced by the excellence of the ground survey, but here again archaeology came to the rescue, thanks to excellent liaison with the Archaeology Officer of the Ordnance Survey, whose official duties consisted primarily of marking ancient sites on map sheets compiled by the Survey. Schedules of sites of archaeological interest, with some guidance as to the conditions suited to secure the best results from each variety, were compiled and printed at the Survey and circulated for use by the Royal Air Force, the resultant negatives being returned to the Archaeology Officer by arrangement with the Air Ministry. In this way, not only was much light thrown on the earliest history of our island, but a useful stimulus was provided for air-photography. The need for official encouragement was recognised in 1932 by the Right Honourable Sir Philip A.G.D. Sassoon, Bart., when, as Under-Secretary of State for Air, he presented a trophy for annual competition by "any regular unit in the home commands normally carrying out air-photography", other than the School of Photography. To emphasise the operational value of air-photography, 40% of the marks were awarded for speed of production as against 30% each for flying and technical considerations, but it is symptomatic that the task set was merely that of producing a mosaic for a specified area[■] at a certain scale, marked and titled in the normal service manner, ready for use by another service.

/Provision

■ The areas to be photographed were chosen in conjunction with the Archaeology Officer of the Ordnance Survey, to whom the mosaic was ultimately sent.

Provision for technical training in the ground aspects of air-photography had existed since the war of 1914-18 in the School of Photography at Farnborough. The origins of the school can be traced to the original section attached to No.1 Airship Squadron of the Royal Flying Corps, which occupied itself with photography from airships, balloons, kites and, later, aeroplanes. When the Airship Squadron passed to the Royal Navy in 1913, the section was transferred to the Experimental Flight of the Royal Flying Corps. In 1914, the section was distributed between the squadrons sent to France, but in the following year, when the need for more photographs became acute, a school was set up in a wooden hut constructed to the north of the Balloon Shed at Farnborough. The permanent building erected early in 1917 remained the centre of service photography until the war of 1939-45, when the exigencies of a still greater conflict made it necessary to open a second school at Blackpool. The work of training carried on at the School between the wars was unspectacular, but by maintaining the standard of service photography it can truly be said to have laid the foundation for the subsequent achievements of photographic reconnaissance. It would, however, be difficult to overrate the importance of the fact that, in accordance with the policy defined in the War Manual, the peacetime photographic training of the Royal Air Force was restricted to the executive functions of taking and processing photographs. The interpretation of reconnaissance photographs from an intelligence point of view was reserved to the army and the air force was still in the position of taking photographs for other people's use.

S.O.P.
Form 540

For a
summary of
courses up
to 1938
see
Appendix
IIB

/This

This situation was only modified by the pressure of events during the period of international crisis preceding the outbreak of the war of 1939-45. During the Italo-Abyssinian conflict and the period of tension which followed the application of sanctions, the safeguarding of Egypt and of our communications through the Mediterranean and the Red Sea weighed heavily on the minds of those responsible for imperial defence. In the circumstances, accurate and up to date intelligence was a first essential, and, in view of the long distances involved and the inaccessibility of some of the most vital areas, air photography was the most obvious source. Conversely, it was experience in the successful use of air-photography for gaining vital information during these years (1935-1939) that helped to secure its recognition as an essential branch of Air Intelligence.

4. THE YEARS OF DEEPENING CRISIS: 1935-1939.(a) Oblique photography by the R.A.F. of Italian territory.(i) Eritrea, Abyssinia, Cyrenaica, Sicily, 1935-1936.

Appendix III
Form 540
M.E. Command Form 540

It was the period of tension immediately following the Abyssinian war that did so much to stimulate the photographic activities of the Royal Air Force overseas. A certain amount of precautionary survey work on the Sudan side of the borders of Eritrea and Abyssinia was carried out by No. 47 Squadron (Khartoum) between September 1935 and May 1936. Infra-red oblique photographs of Bardia and Tobruk on the coast of Cyrenaica were secured from a polite distance by flying-boats of No. 4 Wing in March, 1936. Again, in the latter part of June photographs were secured of the east and south coasts of Sicily, from Catania to Cape Passero and from Licata to Cape Scaramia, and also of the islands of Pantellaria, Linosa and Lampedusa. It was not, however, until the following year that any very specific causes for anxiety made themselves felt.

(ii) Pantellaria: 1937-1938.

S/40886/1A

Reports began to trickle in from various sources during March 1937 that the Italians were undertaking the construction of an underground air base on the island of Pantellaria athwart the narrows that divide the eastern and western basins of the Mediterranean Sea. On March 22nd the Naval Attaché in Rome informed the Director of Naval Intelligence at the Admiralty of reports received earlier in the month by H.M. Consul-General at Naples of the construction of an air-base on the island sufficient for 140 aircraft. This was confirmed by H.M. Consul at Palermo, who reported having seen a commercial enquiry for the supply of no less than 20,000 tons of cement to the island to be delivered at the rate of

/3,000

3,000 tons a month. Further, in a despatch to the Foreign Office dated March 23rd H.M. Consul at Trieste quoted a report of a member of his staff, recently liberated after confinement on the island for a political offence, to the effect that "six underground air ports" were being installed in the island. These reports from Italy were soon followed by others from Paris based on notes on military works on Pantellaria handed to the Military Attaché by the Chief of the French Military Intelligence.

On April 15th the Air Officer Commanding the Royal Air Force, Mediterranean, Malta, was informed of these reports and requested to obtain "distant air photographs ... to determine so far as possible the present state of aerodrome construction in Pantellaria", while being careful to avoid "any accusation of infringement of the recently imposed prohibited air zone around Pantellaria". It proved easier to frame than to meet what might have appeared, in view of the effort put into service photography between the wars, a sufficiently modest request. In point of fact nearly six weeks elapsed before the photographs could be secured. The reasons for this appear in a letter from Mediterranean Command to Air Ministry, dated May 27th, in which the "considerable delay in carrying out the reconnaissance" is ascribed to the fact that "202 Squadron flying boats, the only aircraft suitable for the job, have recently shown many weaknesses inseparable from old age, and have had to be largely reconstructed during the last six months". Moreover, when the photographs came to be examined, they proved to be unsatisfactory. In accordance with the policy then prevailing the photographs on reaching London were passed to the War Office for interpretation. The

S/40886/200

/report

S/40886/
30B report was negative, but with the significant reservation that examination had been impeded by "the blurred appearance of the photographic images", ascribed in part to faulty developing.

S/40886/
25 In the face of ground reports so circumstantial as those received and in view of the potential menace of the installations, the Air Ministry declined to regard this negative report as conclusive and a further photographic reconnaissance was requested. The insistence was justified by the event. On July 15th photographs giving stereoscopic cover of the whole island were secured by a flying-boat of No. 202 Squadron. They proved to be of excellent

S/40886/
37A definition and revealed an aerodrome under construction east of Mount Gelkhamar, trees and hedges being cleared from the fields over an area 1700 x 700 yds. in extent. On the other hand, no trace of the submarine base, mooted in 1924, though not mentioned in recent ground reports, was visible. The fact that an aerodrome was under construction having been verified, it remained to keep an eye on progress. In November (16th and 18th) a flying-boat of No. 202 Squadron on the way to and from Arzeu secured fresh photographs, which in this case were examined by the army instructor[¶] in photographic interpretation at the School of Photography, whose scrutiny revealed progress in the shape of levelling operations and military construction. Additional photographs were taken by No. 202 Squadron on April 7th, June 21st and December 9th, 1938. Examination of the last batch at the War Office revealed the tunnel entrances of an underground hangar.

/(iii)

S/40886/
63A, 64A

¶ Capt. T.B.L. Churchill.

(iii) The Red Sea: 1937.

Meanwhile, anxiety for the freedom of passage through the Red Sea was stimulated by reports received by the Foreign Office from secret sources through H.M. Ambassador in Cairo "regarding exodus of labour from the Yemen due, it is alleged, to the construction of forts and an aerodrome on the islands opposite Perim". The Foreign Secretary, in bringing the matter before the Lords of the Admiralty, in a letter dated May 28th 1937, intimated that "since the potential danger appears to concern the Air Ministry as much as the Admiralty, Mr. Eden would suggest that their Lordships should consult with the Air Council before replying to this letter, a copy of which has been sent to the Air Ministry". On June 18th the Director of Naval Intelligence passed to the Director of Operations and Intelligence the gist of a report received from the Senior Naval Intelligence Officer, Red Sea, to the effect that guns of large calibre were being placed on the island of Dumairah, with the request that he might "be informed whether, in view of the air facilities at Aden, arrangements can be made to obtain photographs of the island and adjacent mainland", the matter to be treated as one of urgency. On July 3rd the Air Ministry signalled British Forces, Aden, to obtain photographs of the islands and mainland from 5 miles north to 5 miles south of Dumairah, the reconnaissance to be carried out inconspicuously from outside the six-mile radius, and on July 7th photographs taken by No. 8 Bomber Squadron were despatched to Air Ministry.

Unfortunately, despite the fact that Air Ministry had taken steps to ascertain that equipment was available at

/Aden

S/41438/
1A

S/41438/
8A

S/41438/
16A

S/41438/
10A, 13A

Aden before issuing orders for the reconnaissance to be undertaken, the photographs when they arrived were found to be so lacking in definition as to be almost useless; other faults noted at the time were that the specified area was not fully covered, that although of a highly confidential nature the photographs were not marked 'Secret', that they were not fully titled, and that through lack of specific directions in the original order they failed to provide the overlap needed for adequate stereoscopic examination. In view of the urgency of the requirement it was decided in the middle of July to despatch additional equipment * to help overcome the difficulties of obtaining detail on distant oblique photographs. Nearly two months elapsed before these supplies were in fact despatched and it was not until October 1st that the area was re-photographed, this time with a 60% overlap. On receipt at Air Ministry the negatives were sent down to the School of Photography where they were perforce referred to an Army officer † for interpretation. In forwarding the report to Air Ministry, the Commandant of the School enlarged on the fact that there were no Royal Air Force officers trained to interpret air-photographs and regretted that existing policy appeared to be limited to the production of photographs without provision for extracting intelligence from them.

S/41438/
38, 39

S/41438/
50A

(iv) Italian North Africa: 1937-1938.

Many other centres of Italian influence in the Mediterranean basin and beyond came under the scrutiny of the air-camera during the unsettled period of the Abyssinian

/War

* viz. Tricolour (red) filters, type 4 Service type filters and a supply of newly coated panchromatic film.
† Capt. T.B.L. Churchill.

War and the years that followed. During 1935 and 1936 a watch was kept on the ports of Cyrenaica close to the Egyptian border, and towards the end of 1937 the Admiralty showed special concern over Tobruk. On November 17th the Director of Naval Intelligence requested photographic cover "with the object of gaining information on the coast defences, and general lay-out of the port", and on December 2nd instructions were accordingly passed to the Air Officer Commanding, Middle East. Here, again, what might have appeared a simple request, proved in fact a matter of difficulty; the Air Officer Commanding was compelled to signal that he had no aircraft suitable for the photography of Marsa Tobruk and that in addition he needed a larger (20") lens than any available in his Command. In the upshot it was found necessary to employ the aircraft used to convey

the Inspector-General and his Staff Officer to Alexandria, on the return journey to Malta on January 3rd, 1938, when photographs were secured of Tobruk, Bardia, El Adem, Derna, El Burda Island, El Fateyah and Appollonia. Some time after their arrival at the Air Ministry the photographs were forwarded, on February 4th, together with secret ground reports on fortification works, to the Commandant of the

School of Photography with the request that he would "have these photographs examined and forward a report in triplicate at (his) earliest convenience". The Commandant, in

acknowledging the prints, had to excuse himself from rendering an immediate report on the grounds that the only person on his staff trained to interpret air-photographs was an Army officer who would not be available for duty till March 1st. Finally, it was not until March 19th, four months after the Admiralty request, that an Interpretation Report was forwarded to Air Ministry.

(v) Lessons of 1935-1938

The effect of alarms and excursions in the Mediterranean basin and in the area round Italian East Africa was to emphasise strongly the possibilities of air photography as a method of obtaining strategical intelligence. Approaching the Director of Operations and Intelligence, Air Ministry, on the subject of reconnaissance of Marsa Tobruk, the Director of Naval Intelligence stated in a letter dated November 17th, 1937 that for some time he had "been impressed with the difficulty in obtaining up-to-date reliable information at certain Italian ports in the Mediterranean; this drawback has proved increasingly difficult in ports in North Africa, on account of the stringent regulations in force to prevent persons landing and obtaining access to the requisite areas". The Director of Naval Intelligence added that "the assistance of the Royal Air Force has recently been called upon and has been much appreciated in providing excellent air photographs of the Island of Pantellaria in the Mediterranean, and the Island of Dumeira in the Red Sea".

At the same time, the reconnaissance flown to procure the information sought by the Admiralty drew sharp attention to the exiguity of the means at the disposal of the Royal Air Force in the Middle East. Equally, the dependence of the Royal Air Force on the goodwill of another service for extracting relevant information from photographs taken by its own squadrons was thrown into strong relief. Practical experiences of this kind, reinforced by an appreciation of future requirements by Bomber Command, examined in a later section, emphasised the necessity both of expanding and improving the means of securing photographs and, above all, of training personnel to interpret them.

(vi) Italian North Africa: 1938-1939

The watch on the coast of Italian North Africa

S/43029/
24A continued to be maintained by No. 202 Squadron*. Photographs were secured in October 1938 by aircraft returning from Mersa Matruh, where the squadron had been based during the Munich crisis, and, again, on the initiative of Mediterranean Command, but with the consent of the Air Ministry, in November. On February 17th, 1939, in response to urgent requests from the Admiralty, the Air Ministry signalled the Air Officer Commanding, Mediterranean:-

S/43029/
33A "Admiralty require as soon as possible photographs of anchorages at Tobruk and Bomba for purpose of locating certain submarines. Arrange flight immediately..."

It is symptomatic of the improvement brought about through earlier adverse experiences that Mediterranean Command was able to despatch a flying-boat immediately to secure the photographs en route for Alexandria, and that the very next day (February 18th) the required information was signalled to Air Ministry:-

S/43029/
35A "Photographic reconnaissance completed. Nothing observed at Bomba eight definitely at Tobruk anchorage..."

Photographs taken on the return flight to Malta (February 20th) confirmed the presence of submarines at Tobruk, on this occasion six being present. On the 22nd the photographs were sent under the hand of a naval officer returning home by boat to Marseilles and thence overland. Thus within a few hours the Admiralty obtained the information it required and within a few days received the actual photographs for confirmation. Judged by the old standards of acquiring intelligence the rapidity and objectivity of air reconnaissance was almost miraculous.

/(vii)

* It is interesting to recall that as No. 2 Squadron, Royal Naval Air Service, this squadron had taken the photographs used in planning naval operations against Ostend and Zeebrugge in 1918.

(vii) Dodecanese: 1939

By 1939, indeed, No. 202 Squadron had reduced the task of securing clandestine photographic intelligence to an affair of clockwork precision. As a final instance may be quoted the cruise of two flying-boats of the Squadron to Greece and Egypt during the early spring, which combined training in navigation and wireless communication with extended international courtesies in Athens, including a call by the officer commanding the flight on H.E. The Reich Minister Herr Dr. Goebbels, a survey of Mersa Matruh Bay from a small rowing-boat, and in the early stages of the cruise some excellent photography. Leaving Malta early on March 30th for Athens, the flight alighted at the Phaleron Bay anchorage, but early moved to Megalo Pefko owing to an adverse southerly wind. The following day was spent carrying out the photographic reconnaissance which was one of the main objects of the cruise. Leaving at 0800 hours, the flight proceeded to Chios (Zea Island), where oblique photographs were secured of the emergency seaplane anchorage at Port S. Nikolo ($37^{\circ}40'N$ $24^{\circ}19'E.$), and thence to the mainland of Argolis, where photographs were taken of Port Kheli ($37^{\circ}10'N$ $23^{\circ}09'E.$); alighting and anchoring in the seaplane harbour for lunch, the return flight was made to Megalo Pefko, starting at 1100 hours. April 1st was devoted to visiting the Greek aerodrome at Tatoi and the seaplane base at Phaleron. On the 2nd the aircraft proceeded to Alexandria, where it was found necessary to obtain and fit a new exhaust push rod from R.A.F. Depot Aboukir - the only trifling mishap of the cruise - before leaving the following day for Mersa Matruh. The 4th and 5th were occupied in surveying the harbour and on Tuesday 6th the return flight was made to Malta. Photographs were forwarded to Air Ministry on April 14th.

S/1190/
4BS/1190/
1A

(b) Vertical photography of Italian and German territory by the Secret Intelligence Service: 1939

(i) Introduction: Origins of the Secret Intelligence Service Flight, alias the Aeronautical Research and Sales Corporation.

Although international tension first became acute as a result of Italian aggression against Abyssinia, it had been evident since Hitler's rise to power that from a long-term point of view Germany was the enemy most to be feared. Developments in the Mediterranean and on the margins of Abyssinia and Italian East Africa brought to the fore the value of photographic reconnaissance as a source of intelligence, but it was in the course of planning for war against Germany that its full necessity became manifest. When on October 9th, 1934, the Chiefs of Staff instructed the Joint Planners to prepare plans for war with Germany in five years' time, they in effect set in motion machinery which required the accumulation of accurate and detailed information, not only about military installations, but also about the whole field of Germany's economic activity.

The immense widening of the scope of intelligence necessary for total war between highly industrialised communities making full use of the air arm was amply recognised in a report drawn up on January 1st, 1936 by the Deputy Chiefs of Staff. In their report they urged that the field of intelligence to be covered in peace, in order to be adequately prepared for war, had been immeasurably extended, both by the degree to which modern war involves the total resources of a nation and by "the vast extension of the zone of operations that has been brought about by the advance of aviation". Accepting the principle that air power was the ideal weapon for striking at the economic sources of a hostile power, the report went on to emphasise the importance of accurate target intelligence:

/ "As

"As regards air targets in foreign countries, we consider that our aim should be to ensure that the Defence Departments are in possession of such information as will enable our Air Forces to obtain the maximum effect on an enemy nation, by means of air attack against those objectives the destruction or dislocation of which the Government consider would contribute most towards the attainment of the national aim."

Whereas military objectives in the restricted sense could be dealt with adequately by the Defence Departments, provided their efforts were co-ordinated by an Inter-Service Intelligence Committee, industrial targets involved questions beyond their competence. Accordingly, it was recommended that the scope of the Sub-Committee on Industrial Intelligence in Foreign Countries, set up in 1929 and provided with a permanent staff in 1931, known as the Industrial Intelligence Centre, should be widened to cover Air Target Intelligence. The first terms of reference of the Sub-Committee were recommended to be:

- "(a) To supervise co-ordinated interchange of information and reports between the Defence Departments and other departments concerned in regard to:
 - (i) Industrial Intelligence
 - (ii) Air Targets Intelligence
 } in Foreign Countries
- (b) To deal with all matters arising out of this interchange which may require joint discussion; and
- (c) To discuss the significance of the more important information."

C.O.S.
161st
Meeting
C.I.D.
273rd
Meeting

As an outcome of the report and its recommendations, approved by the Chiefs of Staff on January 13th and by the Committee of Imperial Defence on January 30th, a special Air Targets Sub-Committee⁷ was set up to assemble and grade information relating to German industry most readily usable by those engaged in planning the disorganisation of German economy in the event of war. At the meeting of the Sub-Committee on
/December

A.M.
Office
Memo.No. 52
of 1936

⁷ The joint secretaries were Colonel F.B. Webb of the Industrial Intelligence Centre and Squadron Leader G.C. Burge, who with another retired officer, Group Captain H.L. Reilly, D.S.O., staffed the section (A.I.1(b)) of the Deputy Directorate of Intelligence in the Air Ministry, inaugurated on May 18th, 1936, to prepare the target information needed for planning.

F.C.I.
(A.T.)13

December 17th, 1937, held to receive and consider the revision of their Paper completed by the joint secretaries on December 1st, 1937, it was agreed that the collection of relevant information should continue without intermission* and that the Report should be reviewed at intervals of six months, or more frequently if circumstances warranted.

In assembling material the Section depended to some extent on liaison with the Industrial Intelligence Centre and the Intelligence Sections of the Air Ministry, Admiralty and War Office, but more direct methods were also employed. Squadron Leader Burge travelled extensively in Germany and collected the maps and photographs which were for a time still readily forthcoming, while Captain Faure undertook liaison with the Deuxième Bureau de l'Armée de l'Air. It was through this French liaison that the Air Ministry obtained its first up-to-date air-photographs of German territory, other than those secured through ordinary commercial channels. After lapsing in 1928/9, the French resumed photographic sorties over German territory in the summer of 1936. From the photographs in the dossiers prepared by the Deuxième Bureau and handed over to the Air Ministry, it is possible to form a clear picture of the scope of this French reconnaissance, which quite evidently reflected a purely defensive outlook, implying the subservience of air-power to military operations, in a manner seen to be out-of-date by General Smuts as long ago as 1917. The French were primarily interested in the Siegfried Line and in the approaches to their own Maginot Line, particularly in the vulnerable zone between the Moselle and the Rhine, and in the areas where German armies might be expected to concentrate for turning movements through the Low Countries or through Switzerland and the Belfort

/Gap

See
Appendix
IV

* Accordingly, the staff of A.I.1(b) was increased by the addition of two retired officers, Captains D.M. Faure and W.A.T. Synge.

Plans
W.A.5 and
W.A.15

Gap. Thus, the zone of photography, while it extended from Nordhorn, Rheine and Wesel in the North to Basle in the South, reached in depth only to Munster and Hamm, the Black Forest, the upper reaches of the Rhine and the Danube and the shores of Lake Constance, with sporadic penetrations as far East as the Munich area. On the other hand, the French photographs provided target data useful for planning offensive air operations by the aircraft of restricted range then available, such as attacks on German industrial resources and the mining of the Rhine. But the most important result of liaison with the Deuxième Bureau was that it led the British Secret Intelligence Service to take an active interest in photographic reconnaissance on its own account. As the international crisis deepened, so the normal channels for obtaining the information needed to pin-point targets dried up. In the most vital sense the onrush of war impelled those responsible for obtaining detailed information about potential targets in German territory to enlist the aid of air-photography.

Through his dealings with the Deuxième Bureau, Wing Commander F.W. Winterbotham, head of the section of the Deputy Directorate of Intelligence concerned with secret air liaison, became interested in photographic reconnaissance as a source of intelligence about the defence system of Western Germany. The French, on their side, were anxious to extend their aerial espionage. With a view to obtaining a suitable foreign agent, the Deuxième Bureau approached Mr. A.J. Miranda Jr. of the American Armament Corporation. The scheme appealed to an old associate of Miranda's, Mr. F. Sidney Cotton, an Australian and a pilot of the war 1914-18. Through Mr. Paul Koster, an agent of the Secret Intelligence Service, who was at the same time European representative of the American Armament Corporation, Mr. Cotton was introduced in November 1938 to Wing Commander

/Winterbotham.

Winterbotham. In this way began an association destined to play a vital part in the origin of the later Photographic Reconnaissance Units of the Royal Air Force. Cotton was keen to help. Two American Lockheed XII aircraft were ordered through the agency of British Airways Limited, one for the British Secret Intelligence Service and one for the French. A private company, known as the Aeronautical Research and Sales Corporation, was founded to cover operations. A co-pilot was secured, in the person of Flying Officer R. H. Niven.* On February 15th the first Lockheed (G-AFKR) was taken for a trial flight at Southampton, and on the following day it was flown to Heston, the Corporation's English base. The latter half of February and March were spent working in the machine with Cotton and Niven as co-pilots, at first locally, but during March including a number of flights to France.

(ii) Reconnaissance of Western Germany from French bases 7

Operations began from Toussus Le Noble near Paris, where Cotton and Niven arrived in the original Lockheed (G-AFKR) on March 25th. After a few days spent in local flights from Toussus, the first sortie was flown on the 30th of March. During a flight of 4 hours and 5 minutes, which ended at Nancy, photographs were secured of the area Krefeld, Hamm, Munster and the Dutch frontier, cover of which was required for the implementing of the plan for 'Attack on rail and road communications in Western Germany in a concentration period.'* Sorties on
/April

*Flying Officer Niven's transference from the Royal Air Force to the Reserve of Officers became effective as from February 1st, 1939.

7Details of the pre-war Secret Intelligence Service sorties have been reconstructed from Flying Officer Niven's Flying Log (Appendices V, VI), from photographs in the C.I.U. Library, and from photographs and plots kindly handed over by G/C. Winterbotham of A.I.1(c). For specimen plots and photographs, see A.H.B. folder.

*The value of air photographs of vulnerable points in the German communication system was stressed during discussions on this plan in the early summer of 1939. (S/1359/6A and 11B).

Appendix
VII

April 1st and 7th were directed to the Black Forest and Wurttemberg, evidently to supplement photographs previously obtained by the French of key points in the area of concentration of an enemy preparing to break into France by way of the Belfort Gap. The last of the Secret Intelligence Service sorties over German territory from French bases was flown on April 9th: after photographing the southern and eastern outskirts of Karlsruhe, Cotton and Niven headed north up the railway through Bruchsal to Heidelberg, thence down the Neckar to Mannheim, north-west of which they looped back across Ludwigshafen and Heidelberg, up the Neckar to beyond Eberach, then north-west to the Rhine, down again to Mannheim and south-west to the French frontier by way of Neustadt and Pirmasens. As these sorties were flown at approximately 5,000 m. and the French camera used had a focal length of 30 cms., the photographs obtained were of a scale of about 1/16,700. A number of them were used to illustrate the target dossiers later supplied by the Deuxieme Bureau to the Air Ministry.

(iii) Reconnaissance of Italian possessions in the Mediterranean and Red Sea Areas.Appendix
VIII

Vertical photography of key Italian possessions in the Mediterranean and Red Sea areas began with a single sortie over Tripolitania later in the month of April. The original Lockheed XIII (G-APNR) was used, fitted with a French camera. Leaving Toussus at 06.10 hours on the 18th, Bastia was reached by 11.50 hours after breaking the journey for breakfast at Orange. On the 20th the crossing was made to Tunis, where final arrangements were made. The sortie was flown between 09.20 and 15.00 hours on April 25th. So as to lessen the chances of arousing undue suspicion, an approach was made from the north. Striking the coast some six or seven miles due east of Tripoli at a height of 5,800 m., Cotton photographed the coastal strip almost

/continuously

continuously to the frontier of Tunisia where he doubled back with his camera still working, to a point some miles short of Tripoli; here he looped southwards to take in Castel Benito aerodrome, finally swinging back across the port of Tripoli and out into the Mediterranean immediately short of his point of entry. The sortie lasted in all, allowing for the detour into the Mediterranean, for 5 hours, 40 mins. On the 27th the Lockheed returned to Toussus bringing back 282 overlapping photographs of excellent quality of a scale of approximately 1/20,000. In addition to the ports of Tripoli and Zuara, five airfields (Pisidia, Zuara, Sorman, Tripoli/Mallaha and Castel Benito) were covered, together with a number of gun positions and road and rail communications. On the return, the Lockheed was handed over to the French by previous arrangement, being subsequently used by them for photographic missions to Spezia (28.6.39), Sardinia (8.8.39 and 15.8.39) and Sicily.

During May two more Lockheeds became ready for use. One of these (G-AFFH) was flown from Southampton to Buc on May 20th and handed over to the French. The other (G-AFTL) was flown to Heston on May 11th, where it was prepared for a more ambitious series of reconnaissances over Italian territory. A pair of standard service F.24 cameras with 5" lenses was fitted in an improvised frame, one vertical, the other inclined at an angle of 40° from the vertical, in such a way as to give a slight overlap. Thus it was possible to photograph a strip approximately 11½ miles in width, when flying at a height of 21,000 feet. By the middle of June all preparations were complete, and on the 14th the Lockheed (G-AFTL) was flown direct to Malta by Cotton and Niven, leaving Heston at 09.30 and arriving at 16.40 hours. In Malta, contact was made with Flying Officer M.V. Longbottom, who had taken an active part

in the activities of No. 202 Flying Boat Squadron, described earlier in this narrative, and had thereby developed the keenest interest in the possibilities of photographic reconnaissance. Although only able to assist personally in the first of the series of sorties made on this expedition, Longbottom thus made his first contact with colleagues who were later to succeed as a team in putting the Photographic Development Unit of the Royal Air Force on its feet. As full details of the flights, together with the areas photographed, are given in Appendix VIII, it will be sufficient here to indicate the character of the achievement and to emphasise how effective a demonstration it must have afforded of the value of photographic reconnaissance for securing intelligence about enemy activity and installations even in the most remote areas. Within ten days (June 15th - 24th) a single aircraft, piloted by a supposedly wealthy Englishman with a taste for desert ruins, was able to secure photographs of key points in most of the areas of the Italian Empire, which during the past few years had been exercising the British and French naval and air staffs - viz. Sicily, the Dodecanese, Eritrea, the Red Sea Islands, Italian Somaliland, and Cyrenaica. It is a striking fact that in nearly every case the Secret Intelligence Service was re-photographing vertically localities previously covered obliquely by Royal Air Force machines flying discreetly beyond the six-mile limit; only the angle of photography was modified as the need for information grew more insistent.

(iv) Reconnaissance of North-West Germany from British bases

As war loomed closer it became imperative to obtain as much information as possible about the enemy seaboard nearest Britain. Consequently the final series of Secret Intelligence Service reconnaissances prior to the outbreak of war was

/devoted

devoted to the coastal regions of north-western Germany. To provide a pretext for reconnaissance, Cotton chose this period to develop business discussions between a photographic firm with which he was associated and interests in Berlin. By developing a northward arc on the journey from Heston to Berlin it was found possible to reconnoitre certain areas visually without arousing suspicion. Flights were made to and from Berlin in the Lockheed (G-AFTL) on July 26th/27th and July 28th/31st. The first photographs were taken on August 12th or 13th, when Cotton and Niven co-piloted the Lockheed on a flight of 6 hours and 10 minutes, to the neighbourhood of Wilhelmshaven. Photographs were secured of airfields under construction at Rülstringham and, on the return journey, of the whole series of East Frisian Islands from Wangeroog to Borkum.

The climax to the pre-war Secret Intelligence Service flights came at the end of August. Further flights to Berlin were made in the Lockheed on August 17th/19th and 22nd/24th. On the 28th Niven secured photographs of Wilhelmshaven and Schillig Roads from the Beechcraft and on the following day he and Cotton co-piloted the Lockheed and secured additional pictures. It was from these that the Admiralty were first appraised of the composition of the German naval force closest to our shores. An entry in the Daily Report of the O.I.C. Admiralty for August 30th 1939 based on the interpretation of photographs shows the naval force in the Jade immediately off the port to have comprised:

- 1 SCHARNHORST class
- 1 Armoured ship *
- 1 Cruiser EMDEN
- 1 Yacht GRILLE //
- 2 Destroyers

/(v)

* There is a slight uncertainty as to the exact date. Some of the prints recovered from S.I.S. were dated August 12th 1939, while Niven's log gives the following day.

* It is probable that the armoured ship was in fact the SCHEER, an excellent close-up of which was obtained on September 4th, by one of the Blenheims which attacked her on the Schillig Roads.

// The GRILLE was, of course, the Führer's yacht, which later in the war saw service in far northern waters.

(v) The Longbottom Memorandum

Meanwhile F/O Longbottom, who had returned home on leave at the end of June, was temporarily attached to Air Ministry with the interpretation of the photographs secured in the Mediterranean and East African sorties. During this period and in a spell of leave which followed Longbottom saw much of Cotton and Niven and with them discussed ways and means of continuing long range photographic reconnaissance in the event of hostilities. Before being recalled to his squadron in Malta at the end of August, Longbottom found time to formulate the ideas which crystallised from these discussions in a Memorandum on "Photographic reconnaissance of enemy territory in War".

Appendix
XII

The interest of this document, a copy of which is appended, is that it forecasts the main outlines of the developments which led ultimately to the Photographic Reconnaissance Unit. Appreciating the importance that long distance reconnaissance was likely to play in time of war, the memorandum foresaw the difficulties likely to be encountered by using the methods that sufficed in the war of 1914-18 and were still to a large extent standard in the Royal Air Force in 1939. In his memorandum Longbottom argued, as events proved correctly, that to secure photographs deep in enemy territory and bring them securely back to base under war conditions, it would be necessary to use a small machine stripped of armament and relying for safety entirely on its height, speed and relative invisibility. The suggestion that Spitfires suitably cleaned up and camouflaged pale blue, should be used for stratospheric photographic reconnaissance appears to have been formulated for the first time in this memorandum.

5. THE EVOLUTION OF AIR MINISTRY POLICY: 1936-1939.

As has already been shown, the logic of events in the Mediterranean and nearer home had first impelled the Royal Air Force to take oblique photographs of Italian territory, and then induced the Secret Service to adopt unorthodox methods to secure vertical photographs of parts of Germany. One effect of these activities was not only to emphasise the possibilities of air-photography as a means of gaining intelligence, a lesson which had already been learnt to a limited extent in the war of 1914-18, but in particular to bring home to the Air Ministry the humiliating facts that:

- (i) the Royal Air Force was unprovided with the organisation or trained personnel required to extract intelligence from the photographs taken by its own squadrons, and
- (ii) even the standard of execution in the taking of photographs for intelligence purposes left much to be desired.

Both these defects were early appreciated by Bomber Command, the success of whose operations in war would depend to a large degree on adequate air reconnaissance and intelligence, and it was the pleas of successive Commanders-in-Chief, which, reinforced by the practical lessons from the Mediterranean, caused the Air Ministry to take action, albeit halting and belated. Bomber Command made their first representations on basic photographic training.

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On October 29th 1936 Air Chief Marshal Sir J.M. Steel wrote to the Secretary of State for Air expressing dissatisfaction with the existing "organisation for the control of photographic policy". In particular he stressed the need for a more clearly defined policy for photographic training, which, he said, "has to a large extent been crowded out" of "the general syllabus

/of

of service training"; in addition he called for a more rapid development in photographic technique and more operational development particularly "in connection with the bombing offensive". Summing up he went on to state that "a more forceful and progressive policy" could not be expected until "photography has been made a whole time concern of an individual or Section of the Air Staff at the Air Ministry. Only in this way can operational requirements, training policy, and technical development be properly related and given that impetus which is essential to progress, and I would strongly recommend some reorganisation in this respect".

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Following this plea from Bomber Command, the Director of Organisation at the Air Ministry "raised the whole question of future photographic policy of the R.A.F.". As an immediate outcome the Director of Training proposed that a specialist photographic post should be established in his directorate comparable with those already existing for armament and navigation. The Deputy Chief of Air Staff in an important policy minute dated January 25th 1937 stated "we must regard the development of long range photography as highly important and accord it a high degree of priority in research, development and training". The post in the Directorate of Training was duly established and filled as from February 22nd 1937 by Squadron Leader G.S. Shaw.

One of Squadron Leader Shaw's first tasks was to establish contact with the photographic specialist officers at commands and groups. On April 16th 1937 he presided over a conference held at the Air Ministry, attended by command and group photographic officers, other than those serving overseas, together with representatives from the Air Ministry Directorate of Research, the School of Photography and the Royal Aircraft Establishment. To judge from the minutes, the proceedings of

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this conference rarely transcended the level of administrative and technical detail, but in the course of a concluding statement the Commandant of the School of Photography (Wing Commander C. Porri) made the significant observation that "...looking back, he felt that service photography was at present no better, if as good, as it was at the end of the war". The Deputy Director of Training summed up the impression created by the conference in the following minute:-

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"We held a conference of Command and Group photographic officers on the 16th April, 1937. It is apparent that at present in Commands there is very little knowledge and no clear realisation of the photographic requirements in war.

All war experience, both during 1914-18 and in operations overseas since, has proved that one of the first and one of the most urgent requirements on the outbreak of hostilities is air photography. It is very apparent from the small amount of photography undertaken and the comparatively poor results frequently obtained during the last 10 years that a more vigorous policy is urgently needed if the Air Staff and flying crews are to be supplied with the air photographs which they will undoubtedly require in war conditions. We suggest therefore, that some amplification of the Air Staff requirements as laid down in minute 3 by the D.C.A.S. is desirable and that the policy as applied to the various types of unit, e.g. general reconnaissance, flying boat, army co-operation etc. should be defined in this file and a suitable letter setting out this policy addressed to all Commands".

The role of photographic reconnaissance as a source of operational intelligence in war was one which came to the fore during the latter part of 1937 when the Air Staff was engaged on considering detailed plans for the Western Plan. As one method of ventilating the subject, a draft memorandum on "Photographic Tasks for which squadrons of the Royal Air Force are to be trained" was prepared by the Air Council and sent out to all Commands on September 22nd 1937, inviting comment. Having tested the reactions of the various commands, among which Bomber Command was the only one to offer much constructive criticism, the Air Staff issued its general conclusions in March 1938 in the form of Air Staff Memorandum

AP.1633

No. 58, a document which, in amplifying the policy minute of the Deputy Chief of Air Staff of January 25th 1937, marks the most important turning point in the development of photographic reconnaissance during the pre-war period.

To begin with it recognised that the operational uses of air photography in the Royal Air Force related to the provision of information for each of the three services, as well as meeting merely survey requirements, and established the principle that the main use of air photography in war was that of providing intelligence for each of the fighting services, air and sea, as well as land. As for the air, it laid down that:

"The general strategy of the air campaign, and also the tactics to be adopted by our own units, will be considerably influenced by information received from various sources as to the enemy's plans. Much information in this connection may be obtained from a study of air photographs of his naval, military, air force, industrial or other organisation, and of important changes, actual or potential therein. For such purposes continuous photographic reconnaissance may be required in order to detect changes of enemy intention or development of enemy plans."

para.8

paras.5-7 For bombing operations, in particular, it recognised that photographs taken prior to a raid would be valuable for briefing pilots, that those taken by the raiding aircraft at the time of the explosion of the bombs would help "to check the objective bombed, the accuracy of the bombing, and also to assist in assessing the damage done", and that photographs obtained after the attack would reveal "how severely a particular objective has been damaged". It thus confirmed the experience of Bomber Command communicated to the Air Ministry by Air Chief Marshal Sir Edgar Ludlow-Hewitt, Air Officer Commanding-in-Chief, in a letter dated January 7th 1938, to the effect that:

"It was most evident during the operational exercise which was recently held in this Command how exceedingly valuable and essential photography will be in war in order to obtain the required information of the results of raids, and of enemy activities, so as to enable the Bomber Commander to direct operations. Owing to the speed of modern aircraft and the height at which it may be necessary to fly, visual observation will be of comparatively little value."

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In addition it was made clear that photographic reconnaissance was required "in order to supply information, mainly to the Army Command, of the enemy's tactical dispositions, rear organisation, transportation and supply systems, and for recording the results of operations", as well as "to supply information of enemy harbours, docks, naval bases and coastlines, and to confirm observers' reports of surface craft or submarines..."

para.13 While it was recognised that for the purpose of operations overseas survey flights might have to be formed "for the express purpose of supplying survey photographs of any area over which the Army may be required to operate", it was clearly para.16 envisaged that photographic intelligence for the three services was to be undertaken by the Royal Air Force. Thus demands for air photographs were normally to be initiated by either the Operations or Intelligence Branch of the Air Staff, responsibility for co-ordinating these devolving on the former. Moreover, a radical new departure was made in the assumption that the Royal Air Force would itself interpret its own air photographs, a function previously left to the Army: the Memorandum roundly declared that "the responsibility for the interpretation of air photographs rests entirely with the Intelligence Branch of the (Air) Staff".

In his first reply (November 23rd, 1937) to the draft memorandum Sir Edgar Ludlow-Hewitt had stressed that:

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"As photography will of necessity provide a very large proportion of the available information concerning the enemy, the photographic work of the squadrons should be under the direction of the Intelligence Organisation, and to this end it is hoped that it will soon be possible to provide Station Intelligence Officers² to direct the peace time training required."

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* The importance of developing an intelligence organisation in Bomber Command below the level of Headquarters had already been emphasised at the Conference on the Preparation of Detailed Plans for the Western Plan held on October 1st. (S/41432/26B, Minutes 4.W.1.(VII)).

S/42910/20A
para. 8

In his letter of January 7th he emphasised "that the vital question of training sufficient Intelligence Officers in peace to undertake photographic interpretation should be taken up at once to ensure that full value may be obtained from all photographs that it is found possible to obtain under war conditions."

A.P.1633
para. 18

In view of the representations of the Commander-in-Chief, Bomber Command, it was only to be expected that, while reserving detailed interpretation to the Intelligence Staff, responsibility "for the preliminary examination, plotting and annotation of prints" should be laid on Station Intelligence Officers, who formed an essential link between aircrews and staff.

(A.I.1(h))

To implement the new policy a special section was created in March 1938 in the Directorate of Intelligence to further the application of air-photography to intelligence. Prior to the outbreak of war the section was staffed by a single officer, the first occupant being S/L. H.G. Wheeler, a former instructor at the School of Photography, lately returned from a tour of duty as photographic specialist in India. S/L. Wheeler's most pressing task was the training of the Station Intelligence Officers in the elements of photographic interpretation.

It must be remembered that interpretation had hitherto remained a close preserve of the army and it is of interest to note how Air Ministry policy broke down the monopoly. Already, since the summer of 1937, Capt. T.B.L. Churchill, the Army Instructor at the School of Photography, had been engaged, by arrangement with the Directorate of Training, in the assembling of material on the "uses to which air photographs may be applied in order to satisfy

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Appendix
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the requirements of the intelligence branch of the Air Staff", material which was to serve in due course as the basis of instruction for Royal Air Force officers, and which was ultimately issued in March 1939 as Air Publication 1356. The first Royal Air Force officers to receive instruction in the interpretation of air-photographs were four senior intelligence officers from Bomber Command, who attended a special course between January 24th and February 5th 1938. In June 1938 the first three-weeks course for Station Intelligence Officers was held, to be followed by others in September, 1938, January, January/February, and March 1939.

Although held at the Royal Air Force School of Photography under Air Ministry auspices, the lectures were inevitably given mainly by army officers and the instruction was basically military in character. Thus, airfields, industrial plants and docks were treated as features of rear areas on a parity with army depots and bases and lines of communication, instead of as primary targets of the air arm, while shipping seems very largely to have been ignored. Again, a large proportion of the instruction was concerned with the interpretation of artillery, camouflage and the details of forward areas, trenches, tracks, wire, cables and all the paraphernalia of positional warfare. In a word, the instruction, which characteristically enough was illustrated almost exclusively by photographs of the Western Front in the war of 1914-18, related to Army Co-operation rather than to the long distance operations by Bomber Command. Moreover, not only was the instruction out of date from a Royal Air Force point of view, but the pupils were mainly retired army

A.P.1356

/officers

officers unsuited by age and experience for pioneering novel methods under conditions for which there was no adequate precedent. Nevertheless the training of a relatively large number of intelligence officers in photographic interpretation marked a big advance and military interpretation made an excellent grounding.

The next step was to supplement this preliminary training by familiarising all concerned with the types of target with which the Royal Air Force would be preoccupied in the course of long range operations. With this in mind a paper was prepared at Air Ministry and early in March, 1939, circulated throughout Bomber Command, which set out the principal types of industrial target - oil refineries, power-plants, iron and steel-plants, and the like - detailed their most vulnerable points and indicated the probable effects of damage. A further step was to set squadrons of Bomber Command to work photographing various types of industrial installation in this country from lists of examples carefully prepared in the Air Ministry. It was arranged that photographs should be taken both vertically and from oblique angles, as well as at varying altitudes, so as to give maximum practice in recognition. And here it may be emphasised that aircrews were concerned as much as intelligence officers. The scheme was designed as much to give practice to aircrews in the speedy recognition of industrial targets as to train intelligence officers in briefing and interrogation and in the preliminary assessment from photographs of the success of daylight bombing attacks. In addition a manual was prepared "to assist those officers whose duty it is to interpret air photographs in the recognition of potential bombing targets".

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In this special attention was paid to those industrial targets, which the earlier publication had so largely ignored. The distribution of this first manual of photographic interpretation, designed by and for the use of the Royal Air Force, was completed early in July, 1939. As a further method of maintaining and stimulating interest a series of visits was made to Groups and Stations during the summer to confer with the intelligence officers, who in the event of war would be most closely concerned.

It was, of course, recognised that air photographs of enemy targets would mainly have to be obtained after the outbreak of hostilities. The only sources available in peace were the commercial agencies, systematically combed by the Air Ministry Target Section, and irregular sorties flown by the French and British Secret Services. Once hostilities began, the task of securing photographs over enemy territory would obviously fall on the Royal Air Force. This requirement had always been appreciated in theory; it was for this reason that Lord Trenchard had recognised air-photography as one of the "primary necessities" for which the Royal Air Force should be trained. During the years of peace stereotyped training in the elements of air-photography had been given in the squadrons and taking air-photographs was recognised as one of the many functions of the all-round flying man. That air-photography was regarded as one of the generalised functions of the Royal Air Force was one cause of its comparative backwardness: large expenditure must have been incurred over the years in purchasing and maintaining quantities of photographic equipment and training and maintaining technical photographic personnel on the

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squadrons, with comparatively small return when the emergency came. The lack of an adequate policy governing air-photography, of which Air Chief Marshal J.M. Steel complained in October, 1936, was of course due to the purely executive role to which, as part of the legacy of the war of 1914-18, the Air Force had been assigned in relation to Photographic Intelligence.

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(Photos))

(A.I.1(h))

The 'Cinderella' position of air-photography was clearly reflected at the centre. Prior to the institution of a post in the Directorate of Training, in February, 1937, as a direct consequence of Air Chief Marshal Steel's intervention, the only Air Ministry posts concerned with air-photography had been those dealing with the technical development of cameras and with their issue as items of equipment. Not until March, 1938, was there a single officer concerned with the application of air-photography to Intelligence. As a result, although large numbers of cameras were fitted in aircraft, and large numbers of flying-men were able to take photographs from the air, there was no central direction to ensure that the training, equipment and organisation were such as was calculated to give the best results under operational conditions. Indeed, there is little evidence of any very serious thought being given to the operational problem. With a few notable exceptions, when for practical reasons the operational problems had to be faced, as with 202 Flying-Boat Squadron in the Mediterranean during 1937/9, air-photography had remained a mere matter of routine, to which lip-service was paid in official papers, but about which little was done.

Evidence of the lack of policy regarding the means whereby the photographs, the importance of which was by then

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generally conceded, could be obtained in time of war can be found in the 'Annual Report on the Present State of Bomber Command and its Readiness for War' submitted to the Air Ministry in March, 1939. Air Chief Marshal Sir Edgar Ludlow Hewitt, appreciating "that after the war has started, the main source of our information regarding our objectives will be the units themselves", went on to emphasise the necessity of facing "the full implications of this fact. As the success of the bombing offensive will necessarily depend upon the accuracy and completeness of the information obtained by photographs and reconnaissances, the Command must be adequately equipped and trained in this respect. At present, reliance must be placed on the actual bombing mission to obtain the information and photographs required. It is undesirable, however, to detain the mission for one moment longer over enemy country than is necessary to carry out its primary task of bombing. The photographic equipment should therefore be designed to obtain satisfactory results during the actual run-up on the target up to the time when the bombs are released and the aircraft turns away. This will be some distance up to $1\frac{1}{2}$ miles short of the target. There is also the question as to who should be responsible for taking the photographs. These, and other similar problems, will I hope be thoroughly investigated during the current season. So long, however, as we have to depend only upon the heavy bombing missions to obtain our information and photographs, we cannot expect the best results, which will only be obtainable when we have aircraft suited for special reconnaissance missions which would normally be combined with harassing bombing."

para. 15

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From the terms of his Report it is evident that the Commander-in-Chief despaired of convincing the Air Ministry of the necessity for providing speed bombers for the combined purposes of reconnaissance and harassing attack, a course which he had been advocating over a period of eighteen months. It may be observed that in his reply dated January 7th, 1938, to the draft of the Air Staff Memorandum No. 58, Air Chief Marshal Sir Ludlow Hewitt had expressed the view that "in the absence of special long range reconnaissance aircraft" reconnaissance photography would have to be carried out by "special bomber aircraft detailed for this important work in addition to the normal photographic duties which will be required of aircraft actually forming part of raiding formations". It is not clear whether the "special bomber aircraft" in this passage were normal bombers detached for special missions or bombers of a special character, such as were envisaged in the Report. If the latter was intended, then "the special long range reconnaissance aircraft" must have been regarded as an additional requirement over and above the "speed bomber". In any case it is clear that it was appreciated at Bomber Command that special measures would have to be undertaken if the intelligence photographs required for the planning of the operations were to be secured, other than on actual raids. It was, indeed, part of official Royal Air Force doctrine that "in order to avoid the necessity of employing on (long range) missions formations of aircraft strong enough to overcome opposition, the usual practice should be to allot single aircraft flying at such an altitude as to minimise the chance of hostile interference". So far as it went this was sound enough, but, as was foreseen by the C.-in-C. of

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Bomber Command, something more than tactical measures was needed to ensure success. Unfortunately, recognition of the requirement for special reconnaissance aircraft was not sufficiently widespread to prevail against the many other pressing claims for aircraft development at this time. This was no doubt due to two leading factors:-

- (a) The lack of appreciation of the intelligence, as opposed to the executive side of air-photography in the Royal Air Force, due ultimately to experience in the war of 1914-18.
- (b) The dislike of specialisation, whether of personnel or machines, bred of the long inter-war period of financial restrictions, when the air force had been too small for specialisation to be practicable.

6. THE MACHINERY FOR RECONNAISSANCE AT THE OUTBREAK OF WAR.

So far as the basic task of obtaining air photographs was concerned, the position at the outbreak of war was, broadly speaking, that the normal General Reconnaissance and Bomber Squadrons of the Royal Air Force were equipped and trained to take air-photographs and that photographic sections staffed by personnel trained at the School of Photography, Farnborough, were available at stations to process the films brought home. Technical development was in the hands of the Directorate of Supply and Research at Air Ministry in conjunction with the Experimental Station at Farnborough. The maintenance and improvement of photography in the Royal Air Force was supervised from a training aspect by a special staff officer in the Directorate of Training. An important role in maintaining the efficiency of photographic sections and in stimulating interest in the squadrons generally was played by the photographic specialists attached to the staffs of Overseas Commands and at home to Bomber, Coastal and Training Commands and to No. 22 Army Co-operation Group.

On the vital tactical side - the matter of precisely how, under war conditions, air-photographs were going to be secured - ideas were not in all respects clear cut. At Bomber Command it was anticipated in December, 1938, that photographs would have to be handled from the following sources:-

- (a) Aircraft on raids - either singly, or in the case of formations one for each sub-flight. Photographs taken on raids would be designed to confirm the location of the target attacked and the position at which the bombs burst in relation to the target. / (b)

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- (b) Sorties flown after an attack to assess damage.
- (c) Sorties flown for intelligence purposes, including the discovery of potential targets.

BC/S.20443/ 13 An idea of the expected numerical ratio of photographs

obtained to satisfy requirement (c) in relation to (a) and (b), can be had from the estimate of approximately 2,500 exposures per month to cover the latter, out of a total of approximately 3,000. In the case of (a) the photographs would necessarily be obtained by the aircraft

BC/S.20443/ 10 in common operational use, Battles, Blenheims, Wellingtons and Hampdens, flying either singly or in formation at normal operational heights. In default of special aircraft similar conditions would presumably have to apply to (b) and (c). Air-photography was still regarded as one of the functions of all operational aircraft other than specialised fighters.

Thanks to repercussions from anxieties for the defence of Egypt and to the foresight of successive Commanders-in-Chief of Bomber Command, some provision had been made for enabling the Royal Air Force to extract information by interpreting its own photographs. The general function of co-ordinating air-photography with the requirements of Air Intelligence was in the hands of a special section of the (A.I.1(h)). Directorate of Intelligence at Air Ministry. At Bomber Command the machinery for handling photographs had been brought to an advanced stage of development. The preliminary plotting and interpretation of photographs was entrusted to the newly instituted Intelligence Officers at Stations, each of whom had been trained in photographic interpretation at the school of Photography. Annotated prints and plots were then to be passed up by way of Group to Headquarters where further

/interpretation

interpretation could be undertaken by a special Photographic Interpretation Section formed during the summer of 1939.

In March 1939 Sir Ludlow Hewitt had invited F/Lt. P.J.A. Riddell of No. 142 Bomber Squadron, who had served him as personal assistant in India and had had experience of air-photography with No. 28 Army Co-operation Squadron, to organise a Photographic Interpretation Section at the Headquarters of Bomber Command under the Chief Intelligence Officer. During the summer, working from scratch with little assistance, but with a free hand, S/Ldr. Riddell devised the organisation and procedure needed for the efficient running of photographic interpretation in Bomber Command in the event of war, and on August 25th BC/S. 20443/55A an 'Outline of Procedure' was sent out to all groups of the command. A system of filing and reference was devised, by means of which incoming photographs could rapidly be collated with earlier ones of the same area and a direct comparison instituted. To begin with only British photographs were available, but, through liaison with the Air Ministry Target Section, it was found possible gradually to assemble photographs of enemy territory, although on a scale quite inadequate for the operations envisaged by the various Western Plans. The relations between Bomber Command and the Directorate of Intelligence were left undefined, although it can be assumed that the Bomber Command section was concerned primarily with photographs bearing directly on the pin-pointing of targets and the assessment of attacks. The Air Ministry section, on the other hand, was more concerned with intelligence of wider application in strategical planning.

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As events were to prove, the weakness lay not so much in the processing or interpreting of the photographs, as in their taking. Under war conditions it was to be found that special aircraft were a necessity, if adequate photographs were to be obtained with reasonable economy. Although the requirement for some such aircraft was appreciated in theory, it was not in practice provided. The position could not be more justly stated than it was

A.C.A.S.(C) in a minute, addressed by Air Marshal Sir Richard Peck, folder 70C/1, enc. 26 Date: 17/9/40. to the Deputy Chief of Air Staff, looking back over a year's experience in war: "Our pre-war policy was to organise for the taking of photographs by a large number of kinds of squadrons and to process them on the station with a small photographic section. We provided a programme for the production of a large number of cameras. We found, however, that for the most part the squadrons which we had organised to take photographs were tactically unable to penetrate to their targets".

PART II

FROM THE OUTBREAK OF WAR TO THE FALL OF
FRANCE

1. INTRODUCTION

It is symptomatic of the primary role of air reconnaissance that the first sortie of the war of 1939- should have been one designed to secure information. At noon on September 3rd a Blenheim of 139 Squadron, Bomber Command, piloted by Flying-Officer McPherson, took off from Wyton with a naval observer (Commander Thompson) and an air-gunner (Cpl. Arrowsmith) to locate and photograph the German warships off Wilhelmshaven. Within less than five hours the Blenheim returned to base with pictures of Wilhelmshaven and the Schillig Roads taken from a height of 24,000 feet. The first mission of the war was flown to secure photographs of the German naval force nearest our shores and it was achieved successfully. But it did not in fact do more than confirm what was already known. The force in the Schillig Roads had, as we have already seen, been photographed by agents of the Secret Intelligence Service on August 28th and on subsequent occasions immediately prior to the declaration of war on Germany.

At the outbreak of war there were, indeed, two organisations in being for securing air-photographs of Germany. On the one hand there were the medium squadrons of Bomber Command on whom the task officially devolved, a force large in size, with an impressive quantity of aircraft, cameras, and trained personnel at its disposal, but which in the opinion of its Commander-in-Chief was unfitted to discharge its function under war conditions; on the other a handful of enthusiasts with two or three civil aircraft and an idea - the idea of discarding fighting equipment and taking to the stratosphere in the fastest flying machines available. In this section of the narrative will be traced the gallant but unavailing efforts of the official apparatus to secure results at a tolerable cost, side by side with the testing and

/forging

forging by unorthodox means of a new, more economical and infinitely more effective means of achieving the desired end, that of exposing the lenses of the R.A.F. over the localities in Germany calculated to yield the information most needed for planning and encompassing her defeat.

2. PHOTOGRAPHIC RECONNAISSANCE BY BOMBER COMMAND
FROM SEPTEMBER 1939 TO JANUARY 1940.

(A) Home Operations

Between September 3rd 1939 and the end of January 1940, the reconnaissance effort of Bomber Command was centred on the provision of intelligence required for the implementation of three main plans:

- (i) Attack on the German Air Force. Accurate information about the disposition of the G.A.F. in North West Germany was an essential preliminary to forestalling attacks on this country.
- (ii) Attack on the German fleet or the bases of enemy surface, submarine and air forces operating against our trade. The dispositions of naval units, obstructions in enemy ports and possible balloon barrages protecting sea-plane bases were among the subjects on which accurate and up-to-date information was required.
- (iii) Attack on German military rail, canal and road communications. Since it was of the essence of this plan to attack communications during the period of concentration by the Germans prior to invasion of the Low Countries and/or France, a main function of reconnaissance was to determine when in fact such a concentration was taking place. A first step was to determine normality of movement, both by night and day.

In addition preliminary information was required for the possible implementation of plans, which it was not policy to execute in the immediate future, notably -

- (iv) Attacks on German industrial resources. During the period under review efforts in this field were

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limited to photographing certain objectives in the Ruhr, and attempting to discover by visual means the extent to which the area was protected by balloons.

To assist in establishing the normal activity of marshalling yards and systems of communications generally, it was necessary to undertake reconnaissance during the hours of darkness, as well as by day. With this night reconnaissance, which was undertaken by Whitleys, we are not here concerned. As to day sorties, normally made by Blenheims, it must be remembered that during this early period reconnaissance was carried out at altitudes which allowed visual observation of **greater** detail than was practicable when photographic reconnaissance was carried out from higher altitudes. Sometimes, indeed, it was not considered necessary to take photographs at all. For example, when on the second day of the war it was desired to confirm the presence of the German naval force in the Schillig Roads, already proved by photography, the task was carried out by a single Blenheim, carrying a naval observer, and the report brought back to Wyton was based on visual observation alone. Photographs were secured on the 5th and on the 6th were again confirmed by visual reconnaissance. Reports based on visual observation were also considered adequate to test the absence or presence of balloons at Seaplane Bases on the Friesian Islands on December 14th, 1939, and January 2nd, 1940.

For details
see
APPENDIX X.

Of the photographic sorties, with which we are here concerned, there were in all a total of forty-eight flown from the outbreak of war up to the end of January, 1940. Analysis of the tasks shows the following numbers of sorties allocated to the requirements outlined above:-

Naval	G.A.F.	Naval + G.A.F.	Communications	Ruhr
18	11	6	11*	2

* In three sorties combined with visual reconnaissance for RUHR balloons.

All the operations were carried out by Blenheim aircraft of No.2 Group, based on Wattisham (107 Squad.), Watton (21 and 82 Squad.) and Wyton (114 and 139 Squad.). The cameras used were the standard service type (F.24), fitted with 5" or 8" lenses.

The tactics adopted were, either to fly near the operational limit of flight around 20,000', or to come down to a low altitude in the neighbourhood of 3/4,000'. Analysis of existing records gives the following distribution of sorties according to altitude:-

3/4,000'	6/7,000'	16,000'	20,000'	22,000'	24,000'
9	2	1	15	3	1

In a few cases single aircraft were dispatched, but more often two or more went together:-

Single	In pairs	In threes	In fours	In fives	In sixes
4	16	9	8	5	6

In gauging the success of photographic reconnaissance by No.2 Group, Bomber Command, during the opening months of the war, one fact overshadows all others, namely that out of forty-eight sorties, no less than eight Blenheims were shot down by enemy aircraft. A casualty rate of one in six, involving the loss of skilled personnel and specialised apparatus and offset by little or no enemy losses, was sufficient of itself to show that things were very far from satisfactory. Indeed, losses of this weight were clearly not to be borne, even had the aircraft returning to base

/invariably

invariably brought with them photographs of the highest value for intelligence. In point of fact, this was very far from being the case. Of the forty aircraft which returned, a fifth brought back no photographs at all, and others photographs of little or no value. For example, all the four Blenheims sent out from Wattisham on November 25th, 1939, returned safely; out of the objectives set, no photographs were secured of Wilhelmshaven or Brunnstüttel; three vertical photographs were taken of Heligoland; and of Cuxhaven twelve were obtained, all of which were failures, apart from one which showed two trawlers. Again, of the two Blenheims sent out from Watton on December 31st, 1939, one returned after abandoning reconnaissance on account of weather; the second brought back 50 photographs of exposures over the Friesian Islands, but of these the 30 obliques were valueless, and of the 20 verticals only one showed anything except rough ground. A proportion of failures due to adverse weather was only to be expected, but failures due to the freezing of the camera at normal operational heights, such as occurred on the sorties to Sylt on September 16th and Wilhelmshaven on December 27th, were more disturbing. The freezing of cameras, at heights for which they were designed, was commonly to be experienced by No.70 Wing in France and was a fertile source of photographic failure.

It would be wrong to paint a picture of failure unrelieved. The chief point to remember is that, in the adverse conditions under which they were required to operate, the aircrews of No.2 Group, Bomber Command, were bound on missions of high danger from which the odds were as one in six that they would not return. Under the circumstances to bring back any photographs was creditable. In point of fact they secured many of exceptional quality. The task of locating German naval forces off the coast of north-west Germany early in September was satisfactorily discharged. Useful photographs were obtained of Heligoland and the Friesian Islands. Reports of an exceptional

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concentration of enemy aircraft on Sylt, received on the night of September 15/16th, 1939, from the British Minister at Copenhagen, were disproved within a few hours by a Blenheim, which took off at 1000 hours on the 16th; although the photographs as a whole were failures owing to freezing of the camera, an infra red photograph was secured, which revealed no more than 10 aircraft on the three fifths of Westerland A/F covered. Photographs of outstanding quality were secured on sorties flown from low altitudes. Special mention should be made of those of Harburg in the port of Hamburg taken from only 3,000' by a Blenheim of No.139 Squadron on October 30th, and of a number of inland airfields taken by aircraft of No.82 Squadron on September 27th. On that date five Blenheims were detailed to secure photographs of specified airfields in north-western and western Germany. On their return it was found that they had secured photographs of 17 out of 18 of those required in the north-western area and of 5 out of 10 of those for the western area; many of those reached a high level of excellence, among which may be cited outstanding ones of the airfields of Langen Haagen and Gutersloh, each taken from 3,000' and showing aircraft and details of lay-out with great clarity.

B. Strategic Reconnaissance by the Air Component:
October - December 1939

The zone allotted to the British for strategical reconnaissance was bounded on the south by a line drawn from Lat. 51°N. on the Dutch frontier through Munchen-Gladbach, Dusseldorf and Paderborn to Hildesheim, and to the east by a continuation of this line to Ulsen and Lubeck. Included in this zone was the course of the possible northward continuation of the Siegfried Line behind the Dutch frontier, as well as the area where the German Army might be expected to concentrate,

/prior

prior to a movement through the Low Countries to turn the Maginot Line. The main objectives of strategical reconnaissance by the Air Component of the British Expeditionary Force during the opening months of the war were therefore to investigate the possible northward extension of the Siegfried Line and to obtain prior warning of any German attempt to advance through the Low Countries, by watching road and rail movement and troop concentrations in North-West Germany between the Dutch frontier and the Hanover - Bremen line, and by keeping a watch for any bridge-building on the Rhine.

For a detailed description of the requirements and of the operations designed to satisfy them the Narrative covering the French Campaign of 1940 should be consulted. Treatment in the present narrative will take the form of analysing the relative success of the results obtained up to the end of 1939. Only after doing this can we appreciate fully the reasons which prompted the Air Staff, early in the New Year, to accord high priority to the development of alternative methods of reconnaissance. Since we are concerned with photographic reconnaissance, and night photography was not yet in use, night sorties, which were employed a good deal for attempting to detect rail movement, are excluded from consideration. The first few sorties, early in October, were flown by No. 53 Squadron, but as from the 9th of the month responsibility was transferred to No. 70 Wing, of which two squadrons (Nos. 18 and 57) were available during the period in question.

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/No. of

	No. of sorties	Partial Successes	Returned without result	Losses
<u>1939</u> October	23	7	11 (all weather)	5 a/c lost (also 1 crashed on landing; another crashed on return for repairs)
November	16	5	8 { 4 weather 2 camera freezing 1 engine failure 1 observer fainted	3 a/c lost
December	3	2	1 (navigation)	-
Total	42	14	20	+ 2 8 (incidental

Summary of daylight reconnaissance operations by No. 53 Squadron and No. 70 Wing (18 and 57 Squadrons) for the period October - December, 1939.

For
details
see
Appendix XI

The most striking fact which emerges from an analysis of operations, such as is attempted in the above table, is that photographs were obtained at a cost even more prohibitive than those of home-based squadrons of Bomber Command over a comparable period. Nearly 1 in 5 aircraft failed to return from sorties and in addition there were added losses on ancillary flights; of those that returned nearly three-fifths came back with neither photos nor information; and of the value of such photos and visual reports as were brought home by the remaining third there is unfortunately room for doubt. On the important matter of German movement westwards, including indications of bridging the Rhine, the Report on the War Employment of the Air Component throughout the campaign as a whole gave the considered judgement that -

/Despite

"Despite the persistent efforts that were made....., and the comparatively high price that was paid in crews and aircraft lost, the reconnaissance may be said to have failed in this object, in as much as nothing of a decisive nature was discovered right up to the last moment".

Bad visibility, due to weather conditions, and tactical inability to escape destruction at the hands of enemy aircraft were the two principal causes of failure, but camera freezing was an important contributory factor, as it had been with No.2 Group.

3. THE EARLY DEVELOPMENT OF HIGH ALTITUDE
PHOTOGRAPHIC RECONNAISSANCE

(A) Establishment of this Special Flight, later No. 2
Camouflage Unit: September, 1939.

The difficulties and losses liable to be encountered by medium bombers of standard service types attempting to secure photographs deep over enemy territory had long been appreciated, but as we have seen no effective steps were taken prior to the outbreak of war to devise aircraft especially for the purpose. Indeed the Memorandum of August, 1939, drawn up by F/O M.V. Longbottom in association with Mr. F.S. Cotton of the Aeronautical Research and Sales Corporation, alias the Secret Intelligence Service Flight, appears to contain the first detailed suggestions of the type of machine needed to be set on record. The idea of using fighter prototypes stripped of armament to take photographs from a great height was one fundamental to Photographic Reconnaissance as it was subsequently developed in the Royal Air Force. In this section it will be shown how, despite the fact that it cut across the whole existing organisation, the idea was given the opportunity to prove itself in practice.

When early in September, 1939, W/C F.W. Winterbotham, who had been responsible for applying photographic reconnaissance to the collection of Secret Intelligence in the months preceding the outbreak of war, approached the Director-General of Operations, Air Vice-Marshal R.H. Peck, with a view to furthering the idea of a special photographic reconnaissance flight, he met with a ready response, but the problem of how best to develop the idea was beset with difficulties. Clearly it was undesirable for the work to go on solely under the aegis of the Aeronautical Research and Sales Corporation.

On the other hand the difficulties involved in bringing it within the organisation of the Royal Air Force were formidable. The problem was how to incorporate an experimental unit within the framework of the Royal Air Force without cramping the freedom of those whose ideas were unorthodox, and how to secure the priorities and freedom from red-tape that was necessary if the development was to be advanced sufficiently rapidly to be of use in winning the war. It must be remembered that, even though a few at the top, notably the Commander-in-Chief, Bomber Command, appreciated that all was not well with the official machinery for obtaining air-photographs under war conditions, the organisation was in being and constituted a formidable dead-weight against radical change. Fortunately the highly secret nature of the operations still needed to obtain information from neutral territories gave scope for considerable latitude.

In the first instance W/C Winterbotham sought and obtained an establishment sufficient to cover the operations of the existing Secret Flight. The initial establishment for the Special Flight which it was decided to form as early as possible at Heston, the headquarters of the Aeronautical Research and Sales Corporation, was passed down from the Air Member for Supply and Organisation to the Directorate of Organisation on September 14th, 1939, and was dated from the following day. It provided for eight officers - a Commanding Officer, Photographic Officer, Adjutant, Equipment Officer, and four officers for flying duties - and nineteen other ranks, including aircraftsmen hands, an electrician, an instrument maker, five fitters, three flight mechanics, two flight riggers and four photographers. The establishment also provided cover for a twin-engined and one single-engined aircraft, the Lockheed XIII and the Beechcraft respectively, of the Secret Intelligence Service flight. The nucleus of the flight was already in existence in the shape of the Heston premises of the Corporation, the two aircraft, two

/pilots

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pilots (Mr. F.S. Cotton and F/O R.H. Niven) and a small ground staff.

No time was wasted in setting about the task of increasing accommodation, filling the establishment and putting the flight on its feet as an integral part of the Royal Air Force. On September 18th possible additional accommodation at Heston was inspected, but it was not until October 20th that the British Airways hangar, originally suggested as suitable, was requisitioned. In the meantime the flight had to be content with a small hangar and a wing of the Heston Club, taken over as from September 22nd.

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Meanwhile, Mr. F.S. Cotton had been sounded by W/C Winterbotham as to his willingness to command the flight. In his reply of the 19th, Mr. Cotton accepted the proposal that he should form a Special Flight to develop photographic reconnaissance and welcomed the assurance of a free hand. It may be noted that Cotton referred to the Director-General of Operations in his letter as "our Patron" and understood that he was to work under him, W/C Winterbotham acting as intermediary. On the 23rd, the date at which premises were requisitioned,

Heston
Form
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W/C Winterbotham formally handed over the Secret Intelligence Service Flight to the Air Ministry at a meeting presided over by Air Vice-Marshal Peck. Next day the Air Officer Commanding-in-Chief of Fighter Command was informed that "the Heston Flight.....formed at Heston as from 23rd September 1939" was to come under No.11 Group of his command and be administered by Northolt as its parent station.

The Heston Flight was now established. It remained to assemble personnel and aircraft for initial development. W/C F.S. Cotton, whose commission dated as from September 22nd, took command. A specialist officer, S/L A. Earle, was selected to take charge of the photographic development. The

/two

* The date is here wrongly given as 22.3.39, instead of 22.9.39. This has been kindly verified by W/C Winterbotham. Also present was S/L C.L. Stubbs who handled the establishment of the Flight.

two star pilots were Flying Officers R.H. Niven and H.V. Longbottom. The former, who had co-piloted the Lockheed on Secret Service missions, was recalled to Active Service on September 2nd, and posted to Heston. F/O Longbottom, who had returned to Malta after drawing up his Memorandum, was recalled and reported at Air Ministry to join the Unit on September 29th. Liaison was maintained with the Secret Intelligence Service through E/O J.H. Blyth, for it must be remembered that the Heston Flight, as it existed at first, was basically no more than the Research and Sales Corporation, agent of the Secret Intelligence Service.

B. Operations of this Special Flight From Britain:
September - October, 1940.

The best evidence for continuity is that the flight continued to undertake sorties of a non-service character until as late as May, 1940. This was found particularly convenient for photographing neutral territory. During the period of waiting for service aircraft, the Lockheed and the Beechcraft were employed on photographic reconnaissance of the coasts of Ireland and the Low Countries, the former to check reports of the refuelling of U-boats, the latter to test the presence or otherwise of boom defences at the principal ports. The first of the Irish sorties were flown in the Lockheed on September 12th and 26th. The third of the Irish series, flown on October 4th by way of St. Albans, West Freugh and Filton, was notable as the first in which F/O Longbottom shared, since in June, 1939, he had flown in the Lockheed to Sicily. On October 12th Cotton, Niven and Longbottom examined the Belgian coast from Ostend to Zeebrugge, both of which were photographed obliquely from a height of 18,000'. Eight miles short of Zeebrugge the Lockheed turned for home, though not without securing additional photos. Visual observation through

/binoculars

binoculars, confirmed by the study of the photographs, showed clearly enough that no booms were in fact present. Additional oblique photographs of the Dutch coast were obtained by Niven and Longbottom in the Beechcraft on October 20th.

C. Acquisition of Service Aircraft

By this time, however, steps had been taken to secure service aircraft. Although it was of the essence of the scheme to use machines capable of outstripping the fastest fighters in enemy service, it was impossible to secure Spitfires immediately, and it was decided to begin by improving Mark IV Blenheims (long nose), which in modified form might have a sporting chance against MEs at low altitudes. Two machines of this type were delivered at Farnborough on Thursday, September 21st, and the work of cleaning up with a view to increasing performance was at once put in hand. Modifications included:-

- (a) Rubbing down the machine, getting a smooth finish and then re-doping.
- (b) Blocking up a number of cracks which caused turbulence.
- (c) Fitting a spinner to the propellor, which assisted in cooling the engines, and so eliminated the necessity to open the cooling gills.
- (d) Fitting 'tear-drop' windows.
- (e) Retracting the tail wheel and dump valves under the petrol tank.
- (f) Eliminating the fairing in front of the under-carriage and fitting doors parallel with the underside of the engine housing.

By these means performance was improved by an additional 25 m.p.h. But this improvement was not of itself sufficient. Nothing less would suffice than the allotment of Spitfires.

to ensure that two Spitfires would shortly be supplied.

Although the new war establishment dated October 20th showed two Spitfires as well as two Blenheims, it was not until the end of the month that the fighters were actually delivered to Heston.

October 30th, 1939, was a red letter day in the history of Photographic Reconnaissance, because it was then that the first

test was given to one of the original Spitfires (N.3071), a machine which was destined to prove the operational success of the new methods, before it was lost, on April 21st 1940, on a sortie from Nancy. It should be added that the Air Ministry was by no means wedded to the Spitfire. What was persistently kept in view was the paramount necessity of using prototypes of the fastest machines prior to their coming into general service, for by such means alone could we be certain of our unarmed reconnaissance aircraft being capable of outpacing enemy fighters. The possibilities both of American aircraft and of other British types were continually under review. Considerable hopes were placed in the Whirlwind as early as October, 1939, but these were dashed when in the following April the ceiling of these machines was found to be only 28,000 feet. The decision to allocate the most modern fighter aircraft to a non-fighting role at this stage of the war called for a high appreciation of the potential value of photographic reconnaissance. The scarcity of the machines can be gauged from the reactions of Fighter Command when two Spitfires were placed on the Heston establishment. In reply to his signal "Earnestly request that my Spitfire resources may not be treasured upon for any purpose whatever other than home defence fighting. Dowding. "the Commander-in-Chief was informed that the Spitfires would be provided by Maintenance Command, that the allotment had been endorsed personally by the Chief of Air Staff, and that in due course the machines would be returned when others with longer range became available to the Special Flight.

D. Operations of this Special Survey Flight from France:
November, 1939 - January, 1940.

So as to avoid further delay it was decided to test the idea of high altitude photographic reconnaissance by using one of the Spitfires without waiting for extra fuel tankage. As this meant that the maximum endurance was less than two hours and it was desired to carry out the trials over enemy territory, this, in effect, entailed operating from French bases. Accordingly, on November 5th a Special Survey Flight was detached from the parent unit, known since November 1st as No.2 Camouflage Unit, and sent to Lille/Seclin. The Spitfire (N/3071) was flown over by F/L M.V. Longbottom, and his colleague in the venture, F/L R.H. Niven, was ferried over by W/C Cotton in the Lockheed. The ground crew, comprising three fitters, two riggers, one electrician and three photographers (1 sergeant, 2 airmen), were transported in the Hudson piloted by F/O S.D. Slocum. The flight was completed by a Rolls-Royce engineer, put into uniform for the purpose (P/O White) and a doctor, F/O Robson, whose job was to watch physical effects of high-altitude flying under operational conditions. After a fortnight F/O Slocum returned to Heston and subsequent movements of personnel were effected by the Lockheed and the original Mark IV Blenheim. Throughout operations the Commanding Officer of No.2 Camouflage Unit moved freely between Heston, Paris, the various bases of the Special Flight and the Headquarters of the Air Component. The Special Flight was essentially a field test. On its outcome depended the future of high altitude photographic reconnaissance in the Royal Air Force.

During this period of preliminary tuning up the flight remained at Lille/Seclin, but on November 20th it removed to a new base at Coulommiers some thirty miles east of Paris. In the course of the move F/L Longbottom made the first operational flight in a Spitfire for the purpose of

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obtaining reconnaissance photographs. Taking off from Lille he refuelled at Challerange and from there undertook "about one hour's flight over almost 10/10 cloud over Germany". After

For successful sorties,
see
APPENDIX XV.

landing at Etampes for refuelling he proceeded to the new base at Coulommiers, whence four operational flights were made.

Owing to the short range of the aircraft it was necessary to operate from forward fuelling points and for these use was made of Etain and Bar le Duc. Owing to bad weather only one sortie was successful. This, the first successful photographic sortie in a Spitfire, was flown by F/L Longbottom, who during a flight of 1 hr. 40 mins, from Bar le Duc, obtained pictures of the Eupen - Elsenborn region of Northern Luxembourg.

On December 5th a move was made to Nancy, from which forward base the majority of the successful flights were made by F/Ls Niven and Longbottom. At first the pilots were dogged by bad weather; low cloud, fog and snow delayed operations until December 21st and 22nd, on both of which each pilot made successful sorties. On December 29th Longbottom made a successful sortie in the Aachen - Cologne area and on New Year's Day, 1940 Niven secured photographs of Kaiserslautern, following this up on January 2nd by extending cover to include Wiesbaden and Mainz, Longbottom taking photographs of the Ruhr on the same day. Thereafter flying was brought to a standstill by 10/10ths cloud, bad visibility and fog until January 10th when Longbottom made the final sortie. In all fifteen sorties were flown, on ten of which photographs were obtained. Of the five unsuccessful sorties, four were due to weather and one to interference by enemy aircraft. The total area photographed during the ten successful sorties, the flying time of which aggregated no more than fifteen hours, is shown on the attached diagram.

See map
Appendix XV.

Although the photographs obtained were not of sufficiently large scale to make it possible to extract the

/intelligence

intelligence information that might have been desired, it is of interest to record the main objectives of these first sorties, and the degree of their attainment, bearing in mind the fact that the effective range of the available Spitfire hardly extended beyond the Rhine. Broadly speaking, the tasks fell into two main categories, the Siegfried Line with its northward extension, and specific air targets in Western Germany. As for the Siegfried Line, its course from South of Aachen to the neighbourhood of Bitburg was a requirement of the French Deuxième Bureau, which ever since 1936 had been preoccupied with its study; examination of its northerly extension from north of Aachen to the Crefeld area, across the Rhine between Cleves and Emmerich and thence to Borken and Ahaus was allotted to the Air Component. The Special Flight secured photographs of the course of the line from the neighbourhood of Cleves southwards to the Saarbrücken area. The flight also provided cover of a number of bombing targets. Air Ministry sought and obtained photographs of the Urf-See with its dam; Bomber Command obtained cover of many objectives in the triangle Aachen, Cologne and Düsseldorf, although it had to wait until the Spring for its mosaic of the Ruhr from Duisburg to Dortmund; and, finally, the Advanced Air Striking Force was provided with illustrations of many objectives in the valleys of the Moselle and the Nahe, as well as in the neighbourhood of Wiesbaden, Mainz, Kaiserslautern and Saarbrücken, though it had to forego the more southerly and south-easterly of its targets in northern Baden and eastern Württemberg.

The scope of the reconnaissance aimed at by the Special Reconnaissance Flight was limited geographically by the restricted range of the aircraft, but this was a defect which could be eliminated by the addition of extra fuel tanks.

/again

Again, the photographs were too small in scale (down to 1/70,000 to 1/80,000) for it to be practicable to extract detailed intelligence information from them. This also was due to deficiency in the equipment, which only time could remedy. The cameras fitted into each wing were of standard service type F.24, fitted with lenses of 5" focal length, designed for altitudes of from 16,000 to 20,000 feet. But the Spitfire carried the cameras far above the heights attained by normal reconnaissance aircraft, and it is headly surprising that photographs taken from an average altitude of 33,000 feet should have been found too small in scale. This, again, was a defect which could easily be overcome by development. Two further points should be remembered when assessing the achievements of the Special Flight. The experiment was in every respect novel and it was conducted during a spell of atrociously bad weather. Not least of the benefits derived from it were data applicable to other forms of flying, including observations on the effects of high altitude on the human body and on the phenomena associated with condensation, both topics of vital concern to men who had to rely on their own skill and capacity for high flying and on the speed and relative invisibility of their machines to achieve results.

Appendix XVI

Appendix XVII

4.

THE REORGANISATION OF
PHOTOGRAPHIC RECONNAISSANCE.

(A) Lessons from operations: September, 1939 -
January, 1940.

At the start of 1940, when plans were being laid for the expected campaign on the Western Front, the Air Staff had to consider from a very practical stand point what was the right policy to pursue in relation to photographic reconnaissance. The system inherited from peace time had, beyond all disguise, proved a costly failure. The facts were patent and were recognised as fully by the Commander-in-Chief of Bomber Command as by the Air Staff. As early as mid-October, Air Chief Marshal Sir Edgar Ludlow-Hewitt had noted in his appreciation of the Ruhr Plan that -

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Oct. 16th,
1939

"Unfortunately, reconnaissance by Blenheims has recently proved expensive and in the last three carried out by this Command, four out of a total of seven Blenheims have failed to return".

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In a minute to the Deputy Chief of Air Staff, dated December 29th, 1939, Air Marshal Sir Phillip Joubert drew attention to another field in which the existing machinery had proved itself defective. Both as regards reconnaissance and attack, he considered that our operations against the German fleet were "causing us loss out of all proportion to the results achieved". Even more catastrophic were the losses and failures of No. 70 Wing in France. Aggregating the photographic reconnaissance sorties flown from home stations and from France from the beginning of the war up till the end of 1939, we get the following results:-

/Sorties

	Sorties	Photos	No- photos	Percent- age of failures	Losses [*]	Percent- age of losses
No.2 Group Bomber Command	47	31	16	34%	8	17%
Air Component	42	14	28	66.6%	8	19%
Aggregate	89	45	44	49%	16	18%

* Excluding those lost on incidental flights

By comparison, the two months' trial by the Special Survey Flight of No.2 Camouflage Unit between November 5th, 1939 and January 10th, 1940, gave the following results:-

Sorties	Photos	No photos	Percentage of failures	Losses	Percentage of losses
15	10	5	33.3	0	0%

The contrast is the more striking when it is remembered that the Special Survey Flight consisted of a single machine, the first of its kind applied to such work, against seven squadrons (Nos.18, 21, 57, 82, 107, 114 and 139) of Blenheims carrying out functions for which they had been trained over a lengthy period. Moreover, operations by the Special Flight extended over little more than two months, as against the four by Bomber Command and the three of the Air Component up to the end of 1939. But the strongest argument in favour of developing the new methods was that they promised to be infinitely more economical of life and aircraft. Whereas the Special Flight had operated without loss, the Air Component had, without counting casualties on ancillary flights, incurred the loss of eight aircraft and their crews to secure 1,450 photographs, of which 255 were wholly or in part spoilt.

The glaring disparity between the performances of the Blenheims and the Spitfire drew sharp attention to the need for overhauling the organisation for photographic reconnaissance. A Conference on Requirements for Air Photography was held at Air Ministry on January 3rd, 1940, when Air Vice-Marshal Peck, Director-General of Operations, put the position in a nutshell by explaining that reconnaissance could be carried out either by single aircraft using evasion or by a formation fighting its way through opposition. Since it was evident that the Blenheim lacked the speed and the defensive armament to obtain information on the old lines, the best way of carrying out strategical reconnaissance in the future was to use small numbers of aircraft possessing the highest possible speed, aircraft which should always be kept ahead of the contemporary production fighter of the enemy. His contention that the operational experience obtained by the Special Flight in France justified further development on these lines was fully endorsed by the Conference, which agreed that a number of Spitfires should be added to the High Speed Reconnaissance Unit for survey work behind the enemy lines, in replacement of Blenheims.

At the same conference W/C F.C.V. Laws reported on the technical aspects of air-photography. The two main points, which had emerged from experience in the opening four months of war, were the frequency of camera failure and the inadequacy of service cameras for high altitude work. On the first, W/C Laws reported that such good results as had been secured were mostly obtained from heights below 10,000 ft. "Above that height, camera failures had been frequent. None of the equipment provided for heating the camera etc. had proved successful, but the new electrically heated muff and

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lens heater had not yet been tried". It is relevant to point out here that, although the Blenheims had been troubled by freezing of cameras, the Spitfires, although commonly flying at twice the altitude, met with no failures from this cause. The Commanding Officer of No.2 Camouflage Unit explained to the Conference that the trouble could be eliminated quite simply by directing a flow of cool air from outside the aircraft past the lens; by preventing condensation, this removed the root cause of the trouble. The Conference agreed that a Blenheim should be sent immediately to Heston for modification along the lines indicated. On the second point the Conference agreed that a camera larger than the F.24, standard in the service, was a requirement. As a first step it was decided that a camera with a plate 9"x9" was needed on a high priority in place of the 5"x5" type.

If it was generally conceded that the ideas tried out at Heston, when carried to their logical conclusion, promised to fill the gap caused by the inadequacy of the existing machinery, it was equally evident that much development was necessary before the flight could be expanded sufficiently to take over the task of strategical photographic reconnaissance for the Royal Air Force as a whole. Moreover, if it was necessary to plan for the future, the claims of the present were insistent and had to be met. The solution was a compromise. The bulk of photographic reconnaissance would necessarily have to continue to be carried out by squadrons of Bomber Command and of the Air Component, but in the meantime every opportunity was to be given to translate the new ideas into terms of operational achievement. The subsequent operations of the Blenheim squadrons will be found chronicled in the narratives concerned with Bomber Command and the 1940 campaign in France. The present narrative will be concerned with the development of the new methods of reconnaissance and their application to operational requirements.

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During the period from January down to June, 1940, the activities of what from January 17th had come to be known as the Photographic Development Unit, remained focussed on Heston, the centre of research and training and the base from which operations from this country were directed. The parent unit, however, established advanced bases in France, and the aircraft operating from these acquired a distinct status as No. 212 Squadron, discussion of which is reserved for a later section.

(B) The growth of the Photographic Development Unit.

From the time of its formation in September, 1939, the Heston Unit underwent rapid and almost continuous growth. This is reflected most clearly in the establishments, which, as appears from the following table, succeeded each other at intervals of little more than a month:-

Date	Est. No.	Officers	Other ranks	Civilians	Total
15/9/39	WAR/HD/417	8	19	-	27
20/10/39	WAR/FC/116	9	52	4	65
23/11/39	WAR/FC/116A	17	91	13	121
15/ 1/40	WAR/FC/129	21	171	13	205
24/ 2/40	WAR/FC/142	22	166	13	201
12/ 4/40	WAR/FC/142A	28	278	10	316

Broadly speaking, the staff fell into three categories:-

(i) The headquarters staff, including the administration, intelligence, photographic, liaison and operational control officers, and various services, such as signals, accounts and equipment.

(ii) The workshops and servicing staff, mainly concerned with 'cleaning up' aircraft with a view to

/improving

S/57848

improving performance, and including engineers, armourers, carpenters, draughtsmen, electricians, fabric workers, instrument makers, metal workers, wireless and electrical mechanics and various grades of fitter.

- (iii) The flight or flights, including pilots, wireless operators (air) and air gunners, together with ground-crews.

From November, 1939, onwards, the headquarters and associated staff showed a steady increase and maintained a proportion of nearly one half of the whole. The increase was due to the ever-expanding activities of the unit, at first mainly experimental, but later progressively more operational. So far as officers were concerned, the main increase - from six to fifteen - came with the new establishment in mid-February, and was part of the preparations for active operations. The new posts were concerned primarily with intelligence and with arrangements for the extension of activities to France. The growth of the Unit, and the fact that its Commanding-Officer had also to exercise control in certain fields over No. 212 Squadron in France, made it desirable to appoint a senior officer to act as second-in-command. S/L G.W. Tuttle, brought in to fill this post at the end of February, came in due course to control the operational side of the activities at Heston, and so acquired the experience which qualified him to assume command, when the time came to incorporate the Photographic Development Unit within the regular framework of the Royal Air Force in June, 1940. As between the workshops and flights, on the other hand, there were substantial fluctuations. Whereas the former increased nearly fourfold between November and January, the latter remained stationary during this period, only to double between February and April when the workshop staff increased only slightly. This merely reflected the evolution of the Unit from an experimental to an

/operational

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operational role. The substantial increase in workshop staff during the winter was necessary in order to cope with the requirements of Bomber and Fighter Commands, each of whom wanted standard machines 'cleaned up' to improve their speed. The doubling of the flight staff during the early Spring was needed to operate the increasing number of aircraft; for instance, the newly authorised flight of Hudsons required fourteen extra aircrew alone, including six pilots, four wireless operators and four photographers.

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Neither in the case of personnel, nor of machines, do the successive establishments accurately reflect the resources available to the Photographic Development Unit at any given time. The special and novel character of the unit's functions imposed exceptional difficulties in the recruitment of suitable pilots. It was early found that the fighter pilots, posted to the unit on account of their familiarity with Spitfires, were commonly unsuited to the work of photographic reconnaissance whether by temperament or training. The matter was put in a nutshell by the Commanding Officer in a demi-official letter, dated February 2nd, addressed to the Director of Military Co-operation to whom the Director-General of Operations had delegated much of the detailed work connected with the Photographic Development Unit:-

".....The efficiency of this unit depends to a large extent on the individual qualifications of the pilots, as we know from experience.....As a guide, we can lay down the ruling that it is much easier to teach a man to fly a Spitfire than to teach a Spitfire pilot with the wrong temperament to do the work we are doing."

It is notable that neither of the two pilots, who originally blazed the trail in the special Spitfire, were fighter pilots; F/Lt. Longbottom came from No.202 Flying Boat Squadron and F/Lt. Niven's experience had been with bombers. The posting to Heston of fighter pilots unsuited to the work, led Air Marshal Peck to minute the Director of Postings

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direct in April and formulate in writing the special requirement:-

"The tasks of this unit- strategical reconnaissance at high altitude with unarmed Spitfires and with Hudsons or other aircraft in cloud and bad weather by day or night - require special characteristics in the crews."

Para. 3

"The Fighter pilot is not ordinarily suitable. Long distance reconnaissance in a single seater requires a skilful air pilotage and a temperament or aptitude different from that primarily required of a Fighter pilot. The knowledge which strategical reconnaissance Bomber or Army Co-operation pilots possess is most valuable and suitable. As the Spitfire aircraft is unarmed it is most desirable that the pilot should have had experience of the war conditions which will confront him in the air, otherwise he runs grave risk of being surprised. In view of the great height which has to be maintained for long periods by the Spitfire pilots special physical endurance and resistance to the effects of altitude are necessary. Commissioned pilots are required."

Further operational experience seems to have confirmed the view that pilots of outstanding quality were needed for the task of special reconnaissance. When, after having been taken over by Coastal Command in June, 1940, the Unit was being prepared to shoulder the immensely greater burden which devolved upon it on the fall of France, the A.O.C.-in-C. wrote demi-officially to secure the personal co-operation of the Director of Postings. The qualifications specified by Air Chief Marshal Bowhill for the twelve pilots required were:-

- "(i) considerable experience;
- (ii) ability to navigate;
- (iii) Above average classification as pilot for Common Sense"

He further suggested that the pilots be "obtained from bomber and army co-operation squadrons, but not from fighter squadrons, in view of the fighter pilot's limited navigational practice". Ability to fly a Spitfire was among the least of the qualities required of men who had to be capable of finding their way to and securing photographs of selected points at specified scales, and of doing this alone and unarmed. All in all the work called for a rare combination of conscientiousness, daring, self-reliance and initiative. One of the most important

/functions

functions of the Heston Unit was the further training of the pilots needed for operations both at home and in France (212 Squadron). Normally, a course of from two to four weeks was given, during which time the pilots were converted from twin to single-engined aircraft.

The growth of the Heston Unit was also reflected in the increasingly large numbers of aircraft allowed in successive establishments, although here the disparity between establishment and what was actually available was even greater than in the case of men. The first nominal establishment was framed for two aircraft, one twin-engined, one single-engined, and was designed to cover the Lockheed and the Beechcraft operated by the Aeronautical Research Company for the Secret Intelligence Service. These aircraft, together with a Hudson, remained at Heston throughout the period down to the fall of France for use on Secret Intelligence Service business, although not always shown on establishment returns. On October 1st the establishment was amended to allow of two Spitfires and two Blenheims, to which in late November was added a flight of three Hudsons; in practice, as we have seen, the first Spitfire did not materialise until the end of October and the second until mid-January (1940), while the flight of Hudsons was not available till the Spring. The enlargement of the Unit and, in particular, the formation of 212 Squadron, for the training of which Heston was responsible, led to the addition in the February establishment of a Harvard which, together with a Blenheim and a Spitfire, formed the Training Flight. The decisive increase in operational machines came in the Spring, when the establishment of April 12th allowed four Spitfires with an additional four in immediate reserve, apart from the three flights, each of two Spitfires with one in reserve, in France.

More important than numbers were the performances of

/tho

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the machines and cameras available, for upon these depended the range of reconnaissance and the scale and quality of the resulting photographs. It will be remembered that the first operational trial had to be made with a standard Spitfire I (type A), stripped of armament and mounting an F.24 camera with 5" F.L. lens in each wing. With such a machine, range was too restricted for sorties to be flown from English bases and the scale of photographs obtained ranged between 1/70,000 and 1/80,000, when taken from normal operational heights. The type B or medium-range photographic Spitfire, the first of which was collected from the Royal Aircraft Establishment in mid-January, 1940, was fitted with an extra (29/30 gall.) tank behind the pilot, which extended its range at cruising speed to 750 miles and made it practicable to initiate sorties from south-eastern England. The greater focal length of the lenses fitted to the wing cameras - 8" instead of 5" - meant that from a height of 32,000 ft. photographs could be secured at a scale of 1/48,000 as against 1/76,800. The first of the long-range Spitfire I's (type C), fitted with a 30-gallon bulge tank in the port wing, in addition to one behind the pilot, and having two F.24 cameras compensating in the starboard wing, did not become available until towards the end of March. The range of the Type C at cruising speed was increased to 900 miles, bringing Kiel within the scope of reconnaissance. At the time of the fall of France the Spitfires of the Photographic Development Unit and No. 212 Squadron were all of types B and C; the only example of type A had been lost on April 21st, and the new super long-range type was still in course of preparation. To those responsible for the Unit and its activities the delays were exasperating, since the whole development of photographic reconnaissance was bound up with the problem of securing extra range. On the other hand, the technical problem of how to add additional fuel tanks and instal air-cameras without impairing the speed, which for

/tactics

tactics of evasion was a prime essential, was one which could not be solved in a moment, more particularly at a period when technical and inventive resources were fully stretched to meet other requirements.

The natural anxiety of the Commanding Officer of the Photographic Development Unit sometimes led him to adopt a course of action which in practice may have retarded rather than accelerated the delivery of successive types. By treating direct with manufacturers, as with Supermarines at Southampton, and short-circuiting the 'usual channels' he not only caused irritation in the quarters best placed to help him, but endangered the even flow of production. On the other hand it may be argued that unorthodox methods did in fact gain time for the Photographic Development Unit and that, since it was high policy to have this ready for operations in the Spring, the irritation caused in official circles, and even some dislocation in general production, may not have been an extravagant price to pay. Certainly, the matter was fully appreciated by Air Vice-Marshal Peck, in whose hands the matter ultimately rested, and whose ungrateful task it was to smooth ruffled feelings, while keeping his eyes fixed on the main objective. In a minute to the Deputy Chief of Air Staff dated March 30th, the Air Vice-Marshal spoke from the heart when he referred to -

"the difficulties we have constantly to smooth out. The ideas have been good but to get the benefit of them we have suffered great inconvenience."

As he continued in his minute:

"The first and fundamental question is whether we go on with Cotton enduring much tribulation for the value of whatever further ideas there may be - and I think there will be good ideas - or whether we regularize everything and dispense with Cotton."

The achievements of the Unit during the following months and its quality when the time came to "regularize" it in June, 1940, amply justified the policy pursued.

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(C) The control of the Photographic Development Unit.

So soon as the Photographic Development Unit was ready to carry out photographic reconnaissance, it became necessary to decide who was to control its operations. During the opening phase inter-service questions, although implicit, remained in the background. The problem was how to incorporate the new activity within the framework of Royal Air Force control, without cramping the freedom of its development or prejudicing the services which it was capable of rendering to all engaged on planning the war on land and sea, as well as in the air. Since, from the beginning, the Heston Unit had been sponsored by Air Vice-Marshal R. Peck (Director-General of Operations), control of its activities rested de facto in his hands and in those of the Director of Military Co-operation (G/C H.H.L. Fraser), to whom he delegated its detailed supervision immediately before becoming Assistant-Chief of Air Staff for Operations and Intelligence early in February, 1940. It was, however, always recognised that the control of an operational unit could not properly be carried on from Air Ministry. Routine administration was provided for at the outset by placing the Unit at Heston under Northolt as a parent station, and, up till the time of its transference to Coastal Command, the Unit remained for this purpose under Fighter Command, an arrangement which worked all the better from the circumstances that this of all operational commands had the smallest 'axe to grind'. So far as the actual air-photographs which it produced were concerned, the Unit came within the purview of the Director of Intelligence, who during December 1939 issued instructions regarding the scale of photographs and the distribution of prints, which applied to No. 2 Camouflage Unit, along with all other units engaged on photographic reconnaissance.

G/C Fraser's first concern was to institute a certain minimum routine, which, while calculated to avoid cramping the

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Dec. 6th and
22nd. See
Appendices
XVIII and XIX

Unit's scope, might yet serve to keep the Air Ministry accurately informed of the current position. His instructions, issued on February 22nd, required:-

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- (a) that each photographic demand should be given a serial number;
- (b) that the time of take-off, serial number of task, length of time and a brief reconnaissance report should be telephoned to Air Ministry (F.O.7);
- (c) that a Bomber Command form 'K' should be rendered to F.O.7 daily;
- (d) that a detailed reconnaissance report (Form 401) should be rendered for each sortie;
- (e) that two copies of each photograph, together with a short preliminary interpretation should be forwarded at the earliest possible moment to F.O.7.
- (f) that one enlargement and six further copies of each contact be forwarded to the Director of Military Co-operation for forwarding.

One effect of this routine was to assist the Air Ministry to reduce and ultimately to eliminate overlapping between the various agencies engaged in photographic reconnaissance. In addition, it put the Ministry in a position to allocate priorities, and so to ensure that tasks were dealt with in order of importance by the strictly limited forces available. Yet, at first, the Commanding Officer at Heston was allowed a large degree of latitude, which was necessary when every sortie was in the nature of an experiment. The measure of this may be illustrated from the fact that it was agreed at the meeting on the subject of Special Photographic Reconnaissance, held at Headquarters B.A.F.F. on February 27th, 1940, that "all requests for special photographic reconnaissance will be referred, for the time being, straight to the P.D.U. Heston". Yet, it was

/inevitable

inavoidable that the further the Unit progressed on the road from experiment to operational routine, the more pressing would be the call to subordinate its activities more strictly to the Royal Air Force as a whole.

The fundamental question was whether the Air Ministry should maintain, and tighten, control over the Unit, or whether it should be handed over to one or other of the Commands.

There was general agreement that direct Air Ministry control of an operational unit was improper in principle, but counsels were divided as to the wisdom of handing the Photographic Development Unit over to Bomber Command. This course of action was certainly favoured in some quarters of the Air Ministry during February, 1940, and no one was keener than the

A.O.C.-in-C. of Bomber Command himself that the problem should be solved in that manner. Air Chief Marshal Sir Edgar Ludlow Hewitt was mindful of the inability of the aircraft under his command to secure the information needed for planning his operations, and was fully alive to the possibilities of the

Photographic Development Unit. Doubtless it was with the splendid photographs of the Ruhr, obtained on March 2nd, in mind that at a meeting held on March 5th, in the Chief of Air Staff's room[■], he maintained that the Heston Unit ought to be placed under the direct control of its principal user, namely his own Command. In a letter dated March 10th his case was stated in greater detail:-

"In the absence of speed bombers capable of doing reconnaissance and photographic work over Germany, the Photographic Development Unit is a vital necessity to this Headquarters.....the needs of the Command in respect of Intelligence and "eyes" can only be really efficiently met by the inclusion within the Command of a unit capable of carrying out reconnaissances and photographic flights whenever and wherever required.....conditions are often such that Blenheims cannot operate, and I have then no alternative means of doing the work. Consequently, days pass when urgent information is required which I am unable to get and although Blenheims are sent out, again and again they only come back reporting

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■ There were present besides the C.A.S., D.C.A.S., A.O.C.-in-C. Bomber Command, and W/C J.N. Boothman.

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that the weather on the other side is too fine and clear for them to obtain the information and return safely to base."

In addition, the Air Chief-Marshal complained of overlapping between the Unit and his own squadrons, and the lack of conformity of some of its photographs with Bomber Command requirements, particularly as regards scale, and of delays between the taking of photographs and their reception at Bomber Command. In conclusion, he requested that a special unit should be incorporated in his Command, preferably the Photographic Development Unit so that he could "have the advantage of the advice and assistance of W/C Cotton, of whose experience, initiative, and enterprise (he had) the highest opinion".

On the same date that the A.O.C.-in-C. of Bomber Command wrote his letter, demanding, in effect, the body of the Photographic Development Unit, the Director of Military Co-operation, who for two months had been intimately associated with its development, submitted an important paper on the 'Evolution and Future Control of the Photographic Development Unit' to the Air Staff. In this paper G/C Fraser raised the question of how the unit at Hoston, as distinct from No. 212 Squadron, which for operational purposes was placed under the orders of the A.O.C.-in-C., B.A.F.F., could best be controlled. Among the leading factors to be taken into account, he laid down:-

- (a) that "it is most undesirable that an operational squadron should be controlled direct by the Air Ministry."
- (b) that "the function of the Photographic Development Unit is to provide intelligence information to satisfy the needs of the Admiralty, the Air Ministry, and Bomber Command respectively".

/(c)

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- (c) that the "ultimate responsibility for obtaining this information rests with the Director of Intelligence".
- (d) that "up to the present W/C Cotton, acting as a free-lance, has been permitted to use his own discretion entirely as to how and when he despatches his aircraft in order to obtain the information for which he is asked. It is fair to say that his methods have been more successful than those employed by Bomber Command, both as regards the results achieved, and the avoidance of casualties to personnel".
- and (e) that if W/C Cotton "were to be placed under the operational control of Bomber Command he would have to subordinate his ideas to those of the Commander-in-Chief".

17 In his comments on Air Chief-Marshal Sir Edgar Ludlow Hewitt's letter, G/C Fraser made the interesting suggestion, doubtless inspired by the Commanding Officer of the Photographic Development Unit, that "one solution might be the formation of a Photographic Reconnaissance Group, to include the whole of the organisation both at home and in France. This would ensure that not only Bomber Command, but also all the other 'users'..... received consideration, according to the degree of priority laid down by the Air Ministry, and that there was no duplication of effort....."

In the outcome, those who opposed the transference of the Unit to Bomber Command won the day, and it remained under Air Ministry control until transferred to Coastal Command at the time of the fall of France. At a meeting^x held on March 15th at Air Ministry, it was agreed among other things that the Unit should remain under Fighter Command for routine administration, but that for policy and operations it should come under the Director of Intelligence, who should form a

/Liaison

^x Attended by D. of I., D.M.C., D. of Plans, and A.D.I.

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liaison branch to co-ordinate photographic demands. Owing to delays in the taking over of the Aircraft Operating Company, described in a latter section, the interpretation side, which was an integral part of the unit's work as conceived at the meeting, the formation of the new liaison branch in the Directorate was delayed. Not until May 11th, when the Director of Organisation issued a Secret Organisation Memorandum on 'Reorganisation of P.D.U. and No. 212 Squadron', was A.I. 8⁴, as the new branch was termed, formally instituted. Its functions were defined as including:-

- (a) "Consideration of and transmission to the appropriate Air Ministry branches, with their recommendation, of the requirements of P.D.U. in personnel and equipment which are outside the normal establishment or scale."
- (b) "Transmission to the P.D.U. of all demands for air photography and intelligence target models, etc."
- (c) Transmission of demands for new photographs to F.O. 7, who would allot priority.

(D) The organisation and control of Special Reconnaissance in France

If the novel methods, demonstrated by the Special Flight during the winter of 1939, were to be applied to the spring campaign on the Continent, it was evident that there was no time to lose. In fact, the main outlines of the organisation for high speed strategical reconnaissance in France were drafted by A-V-M Peck before the initial experiment had been fully completed. In a paper prepared for the guidance of a conference on the organisation and equipment of a special reconnaissance unit in France, held at Air Ministry on January 5th, 1940, he declared his intention

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of forming a service unit to carry out strategical reconnaissance on the same basis as such units as Nos. 18 and 57 squadrons. The leading difficulty was recognised to be how to submit the unit to the control necessary for service conditions without cramping that freedom for development, which from a long term point of view was so vitally necessary. The original proposals put forward by A.V-M Peck, which in fact were broadly adopted, were that operational control should be vested in A.O.C.-in-C. France, Air Marshal Barratt, to whom the Commanding Officer at Heston should be responsible "for the technical efficiency of the unit in France" and with whom he should maintain close relations. The Unit in France was to have its own Commanding Officer, but was to be subordinate "for technical development and technical administration, provision of trained personnel and the like" to Heston. Such a scheme could be, and was, criticised as one of divided controls. On the other hand, the ideas being evolved by the Photographic Development Unit were still fluid, and it would have been most unwise at this stage to have formed them into some rigid service mould. Moreover, it should be remembered that the Photographic Development Unit still incorporated a Secret Intelligence Service flight, and that, as will appear when we come to consider operations, it was sometimes called upon to undertake tasks which fell outside the normal service range. A.V-M Peck's scheme endeavoured to make the best of both worlds, to preserve the freedom essential for development and at the same time to provide the essential minimum of service organisation for the unit to function smoothly under the stress of a campaign. The compromise had the supreme merit of working in practice, even if it led to certain irregularities. e.g. The short-circuiting of the competent authorities during the movement of No. 212 Squadron to France and the transference of the C.O. of the Squadron to the Middle East without authority.

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Towards the end of January the Chief of Air Staff ruled that a special strategical reconnaissance unit should be set up in France, its function being to secure photographs, not only for the Army, but also for Bomber Command and Air Ministry. On February 12th the A.O.C.-in-C., British Air Forces in France, Air Marshal Barratt, was officially informed that the squadron would be operating under his direct operational control, while remaining "from the photographic aspect, under the technical control and technical administration of the Officer Commanding the Photographic Development Unit at Heston". It was further intimated that since "the new reconnaissance squadron will be taking over some of the more difficult tasks which have previously been the responsibility of Nos.18 and 57 squadrons", these would in course of time "become available for the normal tasks of medium bomber squadrons". In the same communication the purpose of the new unit, which was to be known as No.212 Squadron, was defined as strategical reconnaissance to meet the requirements of:-

- (a) Air Ministry
- (b) Air Forces in France
- (c) British Expeditionary Force
- (d) French authorities
- (e) Home Commands.

Detailed decisions as to the organisation of Special Photographic reconnaissance in France were reached at a meeting* held at Headquarters, B.A.F.F., on February 27th, under the chairmanship of A.V-M D.C.S.Evill. It was agreed that, following a direction given in the Air Ministry letter of February 12th, all demands for photographs should be addressed to B.A.F.F., H.Q., but that a copy of demands from home authorities should be sent to the Photographic Development Unit

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* Attended by A.V-M D.C.S.Evill, A/Cdre F.P.Don, W/C A.P.Ritchie, W/C F.S. Cotton and S/L McPhail.

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at Heston: at the same time it was suggested that, in the case of requests from home, the process might in practice be reversed; the only essential was that requests should be repeated to both ends. The tendency to divide immediate responsibility was further seen in the decision that requirements of all home commands and authorities should be issued by Heston, and those of all commands and authorities in France by B.A.F.F., H.Q. Again, where requests involved additional reconnaissance, the Photographic Development Unit was detailed to make the necessary arrangements direct for home authorities, while for authorities in France responsibility rested on B.A.F.F. All requirements for photographic tasks were to be referred to No.212 Squadron. The squadron was to open its own operations room, and was to be responsible for processing, plotting, interpreting and issuing the photographs to B.A.F.F., H.Q. Intelligence Staff, who would pass the results to the commands affected. A first necessity, if the scheme was to function smoothly, was the organisation of photographic libraries: only with such would it be possible to obtain rapidly the photographs needed for comparison with newly flown sorties, the essential basis for photographic interpretation. It was consequently decided that photographic libraries, containing all photographs taken by the Photographic Development Unit and No.212 Squadron, should be built up at Heston, No.212 Squadron and H.Q., B.A.F.F. The library at B.A.F.F. would also comprise photographs taken by Air Component and the French, and tracings showing the areas covered by these were to be issued to Heston and No.212 Squadron.

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The initial establishment for No.212 Squadron, dated February 10th, 1940, provided for a Headquarters Staff of 92, including 14 officers, and for three Flights, comprising 12 officers, 51 other ranks, and 8 Spitfires (6 I.E., 2 I.R.), together with the transport necessary to maintain contact with base and the various forward airfields, from which the sorties

/were

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142A

were made. Apart from comparatively minor adjustments, the establishment remained fixed throughout the period of the French campaign. The new establishment, dating from April 12th, which was issued in combination with that of the Heston Unit, provided for a total of 25 instead of 26 officers, the engineering officer having been dropped, and for 189 other ranks in place of 155, the increase being due largely to provision for messing. The Spitfire establishment was adjusted by the addition of a third machine I.R., and three Moths were added for intercommunication. The size of the Headquarters staff was due to the special character of the work: the officers included seven Intelligence officers, of whom two each were held for plotting and interpreting air-photographs, a liaison officer (French-speaking), a medical officer (height specialist), a photographic officer, and, at first, an engineering officer, in addition to a Squadron-Leader in command,² an adjustment ^{Adjutant?} and an equipment officer. A large proportion of the other ranks at Headquarters were photographers (40) and it was also necessary to maintain 8 R.A.F. police, owing to the special need for security. The staff of the flights calls for no remark, other than a reminder that, in accordance with policy, all the pilots were of commissioned rank.

(E) The early development of Photographic Interpretation in the Royal Air Force.

At this point it is convenient to consider the facilities available for the interpretation of air-photographs. Up till March, 1938, it will be remembered, interpretation remained exclusively in the hands of the army, a relic of conditions evolved during the war of 1914. The section of Air Intelligence formed in that month to apply air-

A.I.1.(h)

/photography

photography to intelligence was principally occupied up to the outbreak of war in arranging courses in photographic interpretation for intelligence officers, so that in the event of war the Royal Air Force would be in a position to extract the information required from its own photographs. Yet it is important to remember that the section was itself an agency for interpretation, constituting as it were the domestic centre for the Air Staff.

S/43029/27A

It was for example this section which interpreted the oblique photographs of Cyrenaica taken by No. 202 Squadron in October, 1938. When in August, 1939, it was desired to interpret the photographs of North West Germany obtained by the Aeronautical Research and Sales Corporation for the Secret Intelligence Service, the Air Staff turned again to A.I.1(h). Since the post was filled at this time by a technical specialist, it was necessary to attach an officer with interpretation experience. The choice fell upon S/L W.H.G. Heath, who had interpreted photographs in the war of 1914-18 and had latterly attended the Royal Air Force course in photographic interpretation at the School of Photography, arranged by S/L H.G. Wheeler, the original holder of the post in Air Intelligence. S/L Heath in due course replaced S/L Hall^x and set to work to build up an interpretation section at Harrow. The general line followed by the Air Ministry section was already made clear in the first Interpretation of Air Photographs Summary issued on October 21st, 1939, and distributed to Bomber and Coastal Commands, Advanced Air Striking Force, and Air Component as well as in the Air Ministry itself. The photographs used were drawn from all available sources, principally from No. 2 Group Bomber Command, but also from the Secret Intelligence Service flight. The section was thus in a sense a central clearing house, receiving photographs from all sources and distributing the information

/derived

See
Appendix XX

^x S/L F.F.W. Hall, who succeeded S/L H.G. Wheeler in January, 1939, was himself posted away in November, 1939.

derived therefrom to all the principal users. But the Interpretation Summary was essentially an intelligence document; it was based on the collation of information from photographs taken over a longish period of time, and was therefore precluded from serving any directly operational function.

Bomber Command had its own machinery for interpreting photographs taken by its aircraft. Station Intelligence Officers were trained to make a rapid first interpretation, but more detailed work was reserved for Headquarters. Here, as we have seen, S/L P.J.A. Riddell had been working since the Spring of 1939 to assemble material that might be of value to intelligence officers, both for briefing aircrews and for identifying and comparing reconnaissance photographs. As war approached the problem of staffing the Photographic Interpretation Section became acute. The search for suitable officers to man the section was beset with difficulties. In view of other numerous and insistent calls on the small body of serving officers, it was evident that the photographic interpreters must be drawn from elsewhere. The source which at first suggested itself for Intelligence officers in general, namely retired officers, proved to be far from satisfactory. The freshness of outlook needed to develop a new source of intelligence almost from scratch was most likely to be found in civilians, but recruits from civil life suffered from lack of precise knowledge of military detail. This meant that, even when a team had been selected, the interpreters had to be put to school and familiarised with air-craft and ship types and military detail, as well as the lay-out of industrial undertakings, power plants and lines of communication. Another difficulty lay in age: as a rule it was only among younger individuals that the requisite adaptability, keenness of eye and the stamina

/necessary

necessary for rush work were found, but it was precisely on this section of the country's man-power that alternative calls were most insistent. A partial solution to this latter difficulty lay in the employment of W.A.A.F. officers, a solution to which Bomber Command was early driven. S/L Riddell's first recruit was P/O G.D. Hamilton, a volunteer reserve officer who put in spare time during the Summer in helping to build up the section. At the end of August the section was granted an increase in staff, comprising two elderly retired officers,[†] neither of whom took to the work and both of whom were posted away in due course, and two civilian clerks, each of whom was later commissioned in the W.A.A.F.[†] During the Autumn three Intelligence officers were obtained to train as interpreters, to whom was added a fourth in January, 1940.^x By the end of January the nucleus of the Photographic Interpretation Section at Bomber Command was in being.

BO/S. 20428/1

An excellent insight into the functions of the Bomber Command Photographic Interpretation Section, as it had developed by the Spring of 1940, can be had from a review drawn up by S/L Riddell on March 27th, 1940. The functions of the section were detailed as follows:-

- (a) Maintenance of target map files and reference files.
- (b) Provision of a continuous watch to ensure that no avoidable delay occurred between the return of reconnaissance aircraft and the distribution of information and photographs.
- (c) Servicing Group and Station Intelligence Officers with photographs and information.
- (d) The supplying of Air Ministry and Admiralty with information from photographs taken by Bomber Command.

/(e)

[†] Hon. F/Lts. T.W.K. Hider and T.W. Shepherd.
 / Commissioned February 26th, 1940, as A/S/Os L.A. Wilson and C.M. Wood.
^x P/O A.F.P. Fane (12/9/39); P/O E.L. Fuller and R.H. Windsor (16/10/39); P/O T. Muir Warden (25/1/40).

- (e) To supply the Director of Intelligence at Air Ministry with immediate interpretations of all photographs, covering enemy activity and the intention of Bomber Command operations.
- (f) To provide Bomber Command with detailed information, covering enemy activity and installations, including flak, balloons, batteries, barracks, dumps and other military matters; industrial plants; naval and commercial ports; W/T and D/F stations; new roads, bridges and works.
- (g) To provide "information necessary to give analysis of industrial targets".
- (h) To provide land-marks.
- (i) To provide information, drafts and prints for press purposes.

It will be seen that the Section was attempting to fill three distinct roles. First, it was discharging domestic functions, serving as a clearing house for photographic intelligence throughout Bomber Command, drawing photographs from the various lower formations, and in return diffusing intelligence and aids to intelligence to Groups and Stations. Second, it acted as the channel of supply for the photographs and the interpretation reports, by means of which the Air Staff might best be able to check the efficacy of operations by Bomber Command. And thirdly, it was attempting to supply both Air Ministry and Admiralty with general intelligence derived from air photographs. In so far as the Section was concerned with providing Bomber Command with targets and in due course assessing the effectiveness of any attacks made upon them, it was carrying out the task for which, prior to the outbreak of war, it had been designed. The Air Officer Commanding-in-Chief

/appreciated

appreciated that he would need this service and he took steps to provide himself with it. The large question of policy, whether from the point of view of the general responsibility of the Air Staff for operations as a whole it was desirable for a Command to obtain its own intelligence and still more check the results of its own attacks, was not raised at this stage.

But the Bomber Command Section aspired to more than a purely domestic role: in passing general intelligence information from photographs, other than that immediately concerned with Bomber Command operations, to Air Ministry and Admiralty, and by extending the target interests of Bomber Command to cover every activity of the enemy, it was in effect shaping as a centralised photographic interpretation unit for the Air Ministry, Admiralty, and, by logical implication, the War Office as well. In this S/L Riddell was aided by the restricted view of his functions taken by S/L Heath. There was a gap and it was natural that S/L Riddell should attempt to fill it. The review of the Section's activities previously summarised was in effect drawn up in support of an application for the substantially larger establishment, which would obviously be needed for the development of S/L Riddell's ideas. But in the meantime the gap was being filled from another quarter and by the end of April it was evident that the requirement for extracting general strategical intelligence from air photographs would be adequately

BC/S. 20428/ met outside Bomber Command.

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In refusing the application for a greatly increased establishment on April 29th, 1940, the Senior Air Staff Officer of Bomber Command minuted that the role of the Bomber Command Photographic Interpretation Section was likely in the future to be limited to the "immediate interpretation of such photos as affect our own immediate operations". By the Spring of 1940 it was evident that, just as the Blenheim Squadrons were likely to

/be

be ousted from the field of strategical reconnaissance by the new high-speed high-altitude unit, so equally was photographic interpretation for strategical planning destined to be carried out elsewhere. Logically it might have been expected that, with the development of a special reconnaissance unit under the control of the Directorate of Intelligence, a parallel development of the section of the Directorate concerned with interpretation might have occurred. In practice this did not happen. Instead an organisation built round a private firm passed under Air Ministry control, absorbed the Interpretation Section of the Directorate of Intelligence and ultimately most of the personnel and many of the functions of the Photographic Interpretation Section of Bomber Command. Photographic Interpretation, like photographic reconnaissance, was destined to be centralised, but not within the body of Bomber Command.

The Aircraft Operating Company Limited², which specialised in air survey, first approached the Air Ministry with a view to acting "as a specialised unit for service with the Royal Air Force in emergency" in September, 1938, at the time of the Munich crisis. This offer was rejected in July, 1939, after full and careful consideration, in a letter which welcomed "individual offers of service from such of the personnel in question as are not already under a Reserve liability".

In brief the situation was that the Company wished to maintain itself as an entity in the event of war, whereas the Air Ministry took the view that it would employ, when the time came, only such assets of the company as might prove of direct value in the prosecution of the war. From a narrowly financial point of view it is clear that the Ministry's attitude was correct under the circumstances likely to prevail in time of war. It was evident that the Company's civil

/business

² The holding Company also controlled Aerofilms Ltd. of Wembley, and The Aircraft Operating Company Limited of South Africa.

business would rapidly dry up and that its value as a going concern would soon decline steeply, and that in consequence it was bad policy to come to terms until this had occurred. Moreover, much of the company's plant and personnel was, at any rate on paper, redundant and its few unique assets could, in the event of need, be appropriated at will at any convenient time. But the company's main preoccupation was naturally to survive and that this could only be achieved in time of war in the service of the State, since its civil work would vanish, its personnel be dispersed and some of its plant be impressed.

No effort was spared to enlist official support to this end. Rebuffed by the Air Ministry the company turned elsewhere and, with the near onset of war, approached the First Lord of the Admiralty; in a letter dated August 31st, the earnest hope was expressed that some use might be found for its services, which might prevent its disintegration. The Admiralty replied non-committally and on September 23rd forwarded copies of the correspondence to Air Ministry. At the beginning of September the Company also approached the Deputy Chief of the Imperial General Staff, suggesting that it should be taken over by the War Office as a going concern before it was broken up. This likewise was referred to Air Ministry. Thus, having failed by a frontal attack the Company approached the Air Ministry indirectly from each of two flanks. In effect the Air Ministry was invited to reconsider the question of taking over the Company as a unit for purposes of air survey, although only a few weeks previous the Air Council had come to a contrary decision. First reactions were favourable, but on further consideration difficulties soon appeared: in particular, it was pointed out that, since the responsibility of the Royal Air Force in Air Survey was confined to taking the photographs, a function for which a special flight of No. 53

/Squadron

Squadron was already provided, there seemed no adequate reason why the Air Ministry should be required to take over the Company. Extra weight was lent to this argument by the fact that the photographic part of the Company's assets, which incidentally consisted of no more than two civilian aircraft (D.H. 89 Rapides) with pilots and photographers, was earmarked for use by the Camouflage Branch of the Home Office. Given the sub-division of Survey functions as between the Air Ministry and the War Office, it seemed clear that the ground staff of the Company, employed mainly on the mapping side, fell within the latter's province. The War Office for its part, having made adequate arrangements for the drawing of maps for the Army overseas, felt no inclination to absorb the Company's drawing staff or stereo-plotters. As a result, Major H. Hemming, Managing Director of the Company, was informed in a letter, dated November 14th and signed by the Permanent Under-Secretary, that the Air Council after due consideration had finally refused to reconsider their decision of July 24th.

Rebuffed for a second time at the departmental level, Major Hemming persisted in his importunity. On November 28th his proposals came up before the 16th meeting of the Deputy Chiefs of Staff (39), who deferred their decision pending further investigation by the Admiralty, War Office and Colonial Office. Each of these departments arrived at the same conclusion as the Air Ministry, and at the 2nd meeting of the Deputy Chiefs of Staff (1940), held on January 10th, 1940, the Secretary was instructed to inform Major Hemming that the Government did not wish to take over the organisation of the Aircraft Operating Company. The most exhaustive enquiries had been made and, so far as air survey was concerned, none of the appropriate departments of State could find a use for the organisation, which Major Hemming was convinced could render vital service.

/But

But the impasse was not complete. If the ground staff of the Company could not profitably be used for survey purposes, it was conceivable that its experience might be utilised in the plotting and interpretation of air-photographs; in particular the firm owned a Wild Automatic Plotting machine and retained the services of an expert operator, Mr. M. Spender. Already on September 23rd, 1939, Major Hemming had been put in touch with the A.O.C.-in-C. Bomber Command, who was anxious to obtain help with personnel skilled in the interpretation and plotting of air-photographs, and on the following day S/L Riddell inspected the premises at Wembley. Nothing came of this meeting for the moment, but arising out of the talks which ensued it was suggested that the Company might consider operating with the Special Flight at Heston under W/C F.S. Cotton. Accordingly on October 2nd Hemming and Cotton, whose paths had previously crossed in private business, met to discuss their possible association for the furtherance of photographic reconnaissance. During the following months the Heston Flight, and the Aircraft Operating Company were destined to draw into an even closer association. Both were outside the established organisation, and had yet to prove themselves, and their potential functions were complementary.

Although the early Heston experiments were conducted with backing of the highest authority, it is natural that their early success was not everywhere viewed with the same enthusiasm. One of the easiest lines of criticism was the small scale of the photographs secured by the Spitfires, a 'defect' which was the inevitable result of employing cameras with 5" and 8" F.L. lenses from twice the intended altitude, and for which the remedy lay at hand in the bringing into service of cameras fitted with lenses of greater focal length.

If, fundamentally, criticism of the smallness of scale of the Spitfire photographs was unintelligent, it nevertheless formed an admirable stick wherewith to belabour sponsors of the new idea. It was disconcerting that the photographic interpretation section (A.I.1(h)) of the Directorate of Intelligence should declare the Heston photographs virtually useless for intelligence purposes. The official reaction to the epoch-making photographs taken by the original Spitfire was hardly encouraging. The Directorate of Intelligence War Instruction No.8, covering Photographic Reconnaissance, opened with the following paragraph:

"It has been observed that when photographic reconnaissance has been carried out, the resulting photographs are often of such small scale that in many cases they have negligible interpretation value."

The attitude of the Photographic Interpretation Section at Bomber Command was no more helpful on this point. As late as mid-May, 1940, the complaint was voiced with almost pathetic vehemence. In reporting on Photographic Development Sorties HAA/018 and HNA/016, it was stated from Bomber Command that

"sadly enough the scale of the photographs taken by both sorties defies interpretation, reduces the effort expended to futility and the writer to tears. There is absolutely nothing to be gained by the activities of these aircraft. The sole achievement is waste of petrol, time, paper, energy and imagination".

Two days latter, the Interpretation Report covering sortie HAA/020 of May 16th was even more explicit:

"On yet another occasion, excellent but completely useless photographs have been produced by this unit. A scale of 1/48750 or 1 inch to 1,350 yards on the photographs is utterly futile for the assessment of damage caused by bombing or for reporting of activity."

In face of such an attitude on the part of the only official agencies for interpreting photographs, the Commanding Officer of the Heston Flight had necessarily to turn elsewhere. Here, the Aircraft Operating Company was

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P.I.S.
Final
Int.Rep.
Nos.129,
131.
May 15th
1940

Final Int.
Rep.No. 136
May 17th,
1940

able to help, principally by means of its photogrammetric section. By use of the Wild apparatus it was found possible to overcome many of the admitted difficulties of interpreting air-photographs at a scale far below those normally regarded as essential. As a trial, photographs taken by the Special Flight in France during the winter of 1939 were passed to the company for examination, and the first report, together with a mosaic, was returned to W/C Cotton on December 11th, 1939. During the following weeks the company experimented with a view to making the most of the photographs and by the middle of the month Major

Letter to Hemming, in reporting certain details disclosed by re-
Cotton examination of photographs taken by the Special Flight from
dated Jan. 17th, 1940, pointed out significantly that "this supports the data
I gave you and will enable you to refute the statement that
has been made that 1/80,000 scale photos are useless for
obtaining such detail".

The results obtained from experimenting with the
Special Flight photographs only convinced Hemming that his
S/1818/67B company had something valuable to offer. In his reply dated
January 23rd to the letter informing him of the adverse
decision of the Deputy Chiefs of Staff Committee taken on
January 10th, he claimed that his company's experiments in the
application of photogrammetric methods to mapping and to the
extraction of intelligence "even from air photographs on so
small a scale as 1/80,000" had been carried to so advanced a
stage as to warrant investigation by an Inter-service Technical
Committee. Hemming's new demarche caused the Joint Intelligence
Committee to consider whether certain apparatus, in particular
the Wild Machine, should not be impressed and certain of the
more expert members of the staff enlisted. On February 1st

D.O. letter the Director of Intelligence, Air Ministry, visited the
from D.N. I.
to D.of I. Wembley premises of the company, together with the Director
S/57875

of Naval Intelligence. The latter was much impressed with the Wild apparatus which he thought "would help us tremendously in identifying ~~enemy~~ naval units". In the draft of the Joint Intelligence Committee's paper, prepared for submission to the Deputy Chiefs of Staff, it was urged that this "would greatly improve our present standard of interpretation of air-photography both in respect of the detail which can be observed and also the speed with which a first interpretation can be carried out". In addition, it was considered possible "that by adopting the Wild machine for general survey use we might obtain results from high altitude photography which, even if not so exact as those obtained by our present standard system, may represent the only practical compromise under conditions of modern warfare".

While the Joint Intelligence Committee's draft was still under consideration, events occurred which transferred the whole matter to a higher level. On February 10th, 1940, the first type B Spitfire succeeded in scouring photographs of the Ems and the Jade Estuaries. These photographs were of the highest interest to the Admiralty at this time owing to operations planned against naval units in the area of the Jade Estuary and of Heligoland; in particular it was designed to locate any obstruction which might impede the manoeuvres of the Motor Torpedo-boats. As soon as the sortie was available the photographs were rushed from Heston to the Aircraft Operating Company's premises at Wembley. Here a plan of the port of Emden was plotted to a scale of 1:10,000 by means of the Wild machine; individual vessels were marked on the plan and tentative identifications appended in the form of a key. The speed and facility with which the information was made available so delighted the Naval Intelligence Division that on February 12th the plan was passed up to the First Lord,

/who

S/1818/69B

A.H.B.
folder
II.H/138

who was immediately impressed by the possibilities. The following day Mr. Churchill wrote direct to Sir Kingsley Wood, expressing the view that "Major Hamming's organisation..... including the expert personnel, should be taken over by one of the Service Departments without delay". The sting of the letter came at the end, when the First Lord intimated that "if for any reason the Air Ministry do not wish to take it over, we should be quite prepared to do so". The reply of the Minister for Air was to the effect that "immediately the value of the organisation became apparent in connection with the TMs photographs we decided that we must take over control of the apparatus and the personnel necessary to work it".

For text
of letters
see
Appendix XXI

During the discussion which followed the adoption of this policy, three alternatives were debated. Either the Company's premises and equipment might be requisitioned and such of the personnel as might be willing and eligible be commissioned or enlisted, or the Company might be paid for work done on a piece-basis, or, thirdly, a contractual arrangement might be entered into whereby the whole of the Company's services might be secured to the Director of Intelligence. The first alternative was dismissed on the score of the interruption, delay, and possible loss of efficiency which it might impose, and the second on the ground of economy, on the assumption that the work would very greatly increase in bulk. In the event, a contract was entered into to operate as from April 1st, 1940. The controlling authority was to be the Director of Intelligence, Air Ministry, one of whose functions would be to co-ordinate demands for interpretation and to decide on priority, and the Company was to operate as a branch of the Photographic Development Unit.

S/1818/118A

S/1818/98A

Already, prior to this date, the Company had undertaken work, both for the Photographic Development Unit and the Admiralty.

It will be remembered that as early as December 11th, 1939, the Company had completed its first report for the Heston Unit, based on photographs in the Aachen area taken by the Special Flight operating from a French base. This first task was in the nature of a trial and the Company made no charge. During the first three months of 1940 work was done for Heston to the tune of £1,300. This included making Wild plans of a number of aerodromes in Belgium based on photographs obtained under conditions of special secrecy from Lille/Seclin and air-bases on the Friesian Islands of Langeoog and Norderney. In addition, ^cwhere was the important work done on photographs of North-West German naval bases, by which the company made available to the Admiralty and other interested parties information contained in photographs secured by the Photographic Development Unit. The famous report on Emden, which elicited the decisive letter from the First Lord of the Admiralty, has already been mentioned. The superiority of the Company's work over that of the Air Ministry Interpretation Section (A.I.1.(h)) can be well illustrated by comparing their respective reports on the cover of Wilhelmshaven obtained on March 2nd. The Air Ministry Section prefaced its report by complaining of the smallness of their scale. "The scale of these photographs is approx. 1/48,000. Anything smaller than 1/30,000 makes the task of identifying battleships difficult, and of smaller vessels almost impossible" - and achieved little more than a bare count of the various classes of shipping in the port. The Company, on the other hand, making use of its Wild apparatus and its trained personnel, assisted by two naval officers^x, was able to produce a wealth of more or less exact information, due largely to its capacity to obtain accurate measurements of the vessels shown

/on

S/1818/109

Sortie
HNA/001Sortie
HNA/004

^x Paymaster Lieutenant-Commander Denning R.N., and Lieutenant Barrow Green R.N.

on the photographs. Not only were the large naval units in some cases tentatively named, but even the Torpedo-boat and Destroyer classes were distinguished.* In addition the profile of a liner "possibly in process of conversion to (an) armed merchant vessel" was drawn out at a scale of 200 ft. to an inch, entirely by stereoscopic methods. It is of the utmost interest that here in embryo we find many of main lines, on which the interpretation of shipping was later to develop in the Royal Air Force, notably the production of port plans giving the position of individual units, the more or less exact identification of naval units, and the beginnings of the study of individual merchant ships by means of profiles reconstructed by stereoscopic means.

The development of the Wembley organisation up to the period of the fall of France may be traced in a few words. To begin with, it should be emphasised that the fortunes of the Aircraft Operating Company were linked primarily with the Photographic Development Unit, which it served in effect, as an Interpretation Branch. Consequently, it gained progressively in importance as the Unit extended its range and came gradually to occupy a unique and progressively more predominant place in the machinery for strategical reconnaissance. As was only natural, Wembley came to exercise a centripetal influence in the field of photographic interpretation. This can most clearly be seen in the case of A.I.1.(h). When the Air Intelligence sections, which had been evacuated to the Hibbart Road Schools, Wealdstone, the day before war was declared, returned to London on April 22nd, 1940, S/L Heath moved his section to the premises of the Aircraft Operating Company at Wembley, now working for the same

/directorate

* Tentative identifications included:-
 TIRPITZ under construction
 Battleship 'possibly SCHLESWIG-HOLSTEIN class'
 SCHARNHORST (probably)
 SCHEER or DEUTSCHLAND
 Cruiser of KONIGSBERG CLASS
 Cruiser which 'appears to be HIPPER'.
 Destroyers: ten MAASS and one ROEDER
 Torpedo-boats: three MOWE and one THETIS.

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Office
Memorandum
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P.D.U.
Heston
540

directorate, in order to be near an important source of his material. For the first month the section worked within the Wembley organisation without losing its identity, but on May 22nd its independent existence was terminated. The merger became effective on the following day when seven officers,* including S/L Heath, were absorbed into the Wembley organisation. Since this still formed part of the Photographic Development Unit, S/L Heath was thus brought directly under the orders of W/C Cotton. At the beginning of June S/L Heath asked for and obtained a posting from Wembley.

Meanwhile, the Photographic Interpretation Section at Bomber Command maintained its separate position, just as the Blenheim squadrons continued to carry out strategic reconnaissance side by side with the Photographic Development Unit. Since, even with the added assistance of the A.I.1(h) interpreters, Wembley was still short of the skilled personnel liable to be required when the scope of reconnaissance should expand, the Director of Intelligence at Air Ministry wrote to the A.O.C.-in-C. on May 9th to enquire whether interpreters could not be spared from the Photographic Interpretation Section at Bomber Command:

BC/S/20443/
115A

"As all urgent interpretation of photographs taken by Photographic Development Unit and Coastal Command is now being done by Photographic Development Unit, Wembley, I am directed to enquire whether you could not spare some or all of the skilled interpreters who up to the present have been doing this work at Bomber Command. Photographic Development Unit, Wembley, have a great deal of work on hand and a very small number of trained interpreters, and it would be of great assistance to them to have your trained personnel transferred."

BC/S/20443/
116A

The A.O.C.-in-C in his reply, directed to the Under-Secretary of State on May 15th, viewed the suggestion with marked disfavour:

* S/L W.H.G. HEATH, F/L JONES, F/L F.W. TURPIN, F/O D.C. FORREST, P/O D.M. GOODBODY, P/O M.C. DAVIDSON, and P/O A.M. DASTON.
/ e.g. On May 31st W/C COTTON wrote demi-officially to S/L Heath laying down certain categorical instructions relating to the titling of photographs and to the preparation of paper transparencies. Copies of this letter were sent to Major Hemming and to A.I.8.

para.2

"I would like to emphasise at once that the Photographic Interpretation Section is an integral and very necessary part of the Intelligence staff of my Headquarters, and I am not prepared to forego in any way the services at present provided by this Section. The rapid interpretation of photographs showing potential targets and showing the results of bombing attacks, and the need for close consultation between the Air Staff and those officers who are concerned with the interpretation of photographs affecting bombing missions are of first importance in the conduct of bombing operations.

para.3

I cannot contemplate relying upon any outside authorities for this immediate and vital service which is at present provided by a part of my staff. Whilst I am willing to do all that is possible to assist the P.D. Unit by loaning one or possibly two of my staff to assist in the instruction of the staff at Wembley, I am not able to concur in any suggestion that any of the staff at present filling an establishment of the Photographic Interpretation Unit of this Headquarters could be permanently transferred to the Photographic Development Unit at Wembley."

It will be seen that what Bomber Command resented most strongly was the suggestion that it might have to rely upon "outside authorities" for necessary information. Yet the implication that Bomber Command should control photographic reconnaissance and the interpretation of air-photographs was one, which in the long run it would be impossible to sustain, since the intelligence obtainable from air-photographs was of vital importance, not only to the other Royal Air Force Commands, but still more to the Air Staff. Moreover, owing to the manner in which the air arm interlocked with land and sea operations, photographic reconnaissance and interpretation was equally vital to the other fighting services, not to mention other Ministries, concerned in the prosecution of the war. As already stated in connection with the organisation of photographic reconnaissance, the Air Staff had in fact set its face against Bomber Command control, on the score that it was undesirable for a single user to manage the collection of information needed by many others.

So far as photographic interpretation was concerned, it became obvious with the opening up of land operations on

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the continent, the rapid development of the Photographic Development Unit, and the taking over of the Aircraft Operating Company, that the Bomber Command organisation would be confined more and more to the requirements of the Command itself. Full appreciation of this was shown in the minute of the Senior Air Staff Officer of April 29th, previously quoted. From the point of view of the officer-in-charge of the Photographic Interpretation Section at Bomber Command, S/L Riddell, the rejection of his plea for substantially increased establishment meant the curtailment of his plans. Filled with ideas for developing photographic interpretation into a potent weapon in the armoury of Air Intelligence, he found himself in danger of frustration. At first this found an outlet in rivalry with the Photographic Development Unit, a rivalry which culminated in the outspoken disparagement of its photographs in Reports already quoted issued on May 15th and 17th. In a demi-official reply to the letter of protest from the Officer Commanding the Photographic Development Unit, the A.O.C.-in-C., Bomber Command admitted "that the wording of these Interpretation Reports was unfortunate" and promised to add the weight of his Command to any pressure that might be exerted to secure the equipment needed to obtain photographs of a larger scale.

CFAP/DO
21 J. of
May 22nd

" About this time S/L Riddell applied for posting. His services were immediately requested by the Officer Commanding the Photographic Development Unit, who wrote to W/C Cooper of A.I.8 in the following terms:-

FSC/DO/9
May 21st

"I understand that S/L Riddell is leaving Bomber Command. In view of the nature of the work being done by the P.D.U., i.e. photographic reconnaissance, it has been admitted that we must strengthen our Interpretation Department. S/L Riddell is one of the most experienced men in the country on interpretation work, and I think it would be advisable to get his services for this unit. Can you arrange it?"

A similar application was made to the same quarter by Major

/ Hemming

S/57848/49B

Hemming on June 3rd, and on the 26th of the month S/L Riddell was in fact posted to Wembley, with effect from June 17th.

On the same day that his services were originally applied for (May 21st), S/L Riddell was present at a Conference^{*} held at Heston "to discuss the existing facilities for the rush interpretation of air photographs", a function which military events on the Continent were rendering of greater and greater urgency. It was recognised by the Conference that the only ultimate remedy for the confusion, overlapping and delays, characteristic of the existing chaotic conditions under which these understaffed agencies were operating, was that all photographic interpretation should be carried out by a single organisation. The absorption of A.I.1(h), regularised by the Office Memorandum of the following day, was a step in the right direction, but the great impediment lay in the pretensions of Bomber Command. That the Conference agreed as a temporary measure, that rush interpretations of all Photographic Development Unit sorties, other than those ordered by Bomber Command, should be done at Wembley throws a clear light on the situation; in effect it was proposed that Bomber Command should graciously allow the interpretation branch to interpret those of the photographs of the parent unit, in which the Command was not particularly interested. It is hardly too much to say that the main line of development in the future organisation of photographic interpretation was its progressive weaning from the control of Bomber Command, a process not completed until September, 1941.

As a result of the Office Memorandum of May 22nd, the Photographic Development Unit ~~was~~ as a whole was placed

/ under

* Also present at the Conference, which was presided over by S/L Maxwell of A.I.8., were representatives of the Photographic Development Unit (W/Cs Cotton and Tuttle and P/O T.V.Craig), A.I.1(h) (S/L Heath) and the Aircraft Operating Company (Major Hemming and Mr. M. Spender).

control of the Director of Intelligence, save for routine administration, which remained in the hands of Fighter Command. At a meeting* held at Air Ministry on June 12th, following a decision of the Director of Intelligence that the Wembley organisation should become a separate entity instead of continuing as the Interpretation and Intelligence Branch of the Photographic Development Unit, "it was decided that the administration, discipline and equipment of the P.D.U.I. would have to remain under the P.D.U. but that it should be a separate unit and have its personnel posted to it". The reconnaissance unit at Heston was to process the films and produce rush contacts for plotting, in order to determine the extent to which targets had been covered; the negatives and plots were to go to Wembley, where orders for reproduction would be received direct. Thus, the lines of division were clearly defined between, what was to become, in July, the Photographic Reconnaissance Unit and the Photographic Interpretation Unit of Coastal Command.

The origins of the Photographic Interpretation Unit, later the Central Interpretation Unit, were thus as unorthodox in their way as those of the Photographic Reconnaissance Unit itself. Yet, the interpretation Unit as it emerged in July, 1940, to play its part in defeating the menace of invasion, enjoyed the supreme advantage of organic growth. It combined in itself many of the best features of the various elements of which it was composed: from the Photographic Interpretation Section at Bomber Command it inherited, through the transference of S/L Riddell, a comprehension of the scope and range of enemy activity amenable to photographic interpretation, which was to determine in due course the main lines of the organisation of the interpretation at the

/ Central

* Present: W/Cs Laws, Cooper and Tuttle; S/L Maxwell.

Central Interpretation Unit; from A.I.1(h) it derived the tradition of long term study of airfield activity, which was to form the original core of 'third phase' or specialised interpretation; from the Aircraft Operating Company it acquired what were to prove growing assets, ²² in a body of young men trained and practised in the plotting and elementary interpretation of air-photographs, and in a handful of technicians specialised in the use of the Wild apparatus for photogrammetry; from the Company, and also from the Commanding Officer of the Photographic Development Unit, it caught more than a touch of that commercial spirit of showmanship that was needed at this stage to persuade potential users of information of its value; and, finally, from the intelligence officers who returned with 212 Squadron from France, it gained, not only experience of interpretation under operational conditions, but also, through the medium of P/O D.N. Kendall, who had been attached to the photographic section of the Deuxième Bureau, a close knowledge of French methods of interpretation. What above all united the Wembley Unit, so diverse in its origins and affiliations, was the conviction that it was pioneering: just as the pilots were triumphantly demonstrating an entirely new method of securing photographs over enemy territory, in the teeth of failure by the official machine with years of experience stretching back to the war of 1914-18 behind it, so did the photographic interpreters, both service and civilian, experience the stimulus of extracting information of vital interest from photographs rejected in some quarters as valueless. Here could be seen at work those qualities of adaptability, successful improvisation, teamwork and intolerance of official apathy or antagonism, which have helped so powerfully in wider spheres to shape the destinies of the race.

²² When in the Spring of 1941 the militarisation of C.I.U. was completed, not all the Wembley staff were found suitable; it may, however, be recorded that among those commissioned as interpreters are to be numbered many of those who contributed most to the development of photographic interpretation in the Royal Air Force in all the main theatres of war.

5. OPERATIONS OF THE PHOTOGRAPHIC DEVELOPMENT UNIT:
JANUARY - MARCH, 1940.

A. Operations from Heston

During the opening months of 1940 the German Fleet and its bases in north-west Germany continued to be among the prime objectives of photographic reconnaissance. The Admiralty was particularly interested in securing photographs of the Jade Estuary with a view to detecting any obstacles likely to interfere with an operation by Motor Torpedo Boats projected from the period February 8th - 15th, 1940. Air Marshal Sir Philip Joubert had drawn attention to the costly failure of the Blenheims and on his suggestion the task of securing photographs of parts of the north-west German coast of naval interest was entrusted to the Heston Unit, which it will be recalled, had on January 17th changed its name from No.2 Camouflage Unit to the Photographic Development Unit.

A.H.B.
 folder
 IHH/128/1

(N. 3069)

Until a machine with sufficient range became available, however, no such operation could be undertaken. The supply of extra petrol tanks to the two Spitfires of the Unit had been approved on November 5th, 1939, but it was not until mid-January, 1940, that one of them had been so equipped. On January 16th the machine was collected from Farnborough by F/L Longbottom. The Spitfire I type B differed from the type A machine in that it was fitted with an extra (29/30 gallon) tank behind the pilot, which increased the range at cruising speed to 750 miles. Another improvement was that the wing cameras were fitted with F.L.8" instead of F.L.5" lenses. By the device of using forward fuelling points in East Anglia - Debden, Stradishall, Bircham Newton and Horsham St. Faith - it was possible for the type B Spitfire to reach the ports of north-west Germany.

No time was lost in seeking to gain the information needed. At 1255 hrs. on January 18th F/L Longbottom took off

/from

from Birchan Newton for Wilhelmshaven on the first sortie by the Photographic Development Unit. About 50 miles out from the Norfolk coast the pilot ran into 10/10ths cloud, and finding no signs of a break, returned direct to Heston. On the 20th he came nearer to success, when baulked by cloud while actually over the Emden - Wilhelmshaven area. At the third attempt F/L Longbottom was successful. Taking off from Debden at 1205 hours on February 10th, 1940, he crossed the German coast at 33,000 ft. just south of Emden and, after photographing the port, proceeded to Wilhelmshaven. While over Schillig Roads he saw a formation of five twin-engined aircraft away in the east heading west at approximately 10,000 ft., so, continuing northwards, he swept round over Wangerooze and doubling back to Emden made for Heston. From this sortie, which lasted in all 3 hours 20 minutes, he brought back the first photographs of enemy territory taken from a Spitfire flying from a home base. As we have already seen, the information obtained from these photographs by the Aircraft Operating Company made a great impression both at the Admiralty, and at Air Ministry, leading to the taking of the concern and the ultimate development of a Royal Air Force Photographic Interpretation Unit at Wembley.

Another result of the successful sortie of

February 10th was to stimulate the desire for more, and on the 15th of the month the Unit was instructed to undertake reconnaissance "at the earliest opportunity" of Heligoland, Brunsbüttel, Cuxhaven and Bremerhaven "with the object of locating units, flotilla craft and submarines of the German Navy". At the same time it was requested that reconnaissance of Wilhelmshaven, the Schillig Roads and Emden be repeated, if practicable, on the same flight as the foregoing. On the 19th these instructions were modified by an Air Ministry signal according first priority to the anchorages at Heligoland. Owing to persistent low cloud there was some delay in securing photographs. On the 23rd

/F/Lt.

Sortie
Ref. No.
HNA/001

A. H. B.
Folder
JH/43/12

F/Lt. Niven and on the 24th both Niven and F/Lt. Longbottom, had to turn their Spitfires back in the face of low cloud layers. Not until March 1st was Longbottom able to secure photographs of Heligoland, taken uneventfully from a height of 34,000 ft.

The limitations imposed on high altitude photography by low cloud had already led to the idea of reserving the high altitude Spitfires for clear weather and using a Hudson in cloudy weather. The idea was that the Hudson would utilise clouds for cover, emerge at the right point to secure photographs and withdraw again into the clouds and make good its escape. Should the Hudson run into clear weather it would notify base by wireless and, returning home, leave the field clear to the Spitfire. In this way it was hoped that Spitfire and Hudson would work together, one for fair weather, the other for foul. The use of a Hudson with a crew under F/O S.D. Slocum, was secured in mid-February and between February 21st and March 3rd a number of sorties were made. In all nine reconnaissance sorties, totalling 37 hrs. 20 mins. flying time, were flown between February 21st and March 2nd. The most successful from a photographic point of view was that of February 29th, when oblique pictures of the North and South shores of the Elbe estuary, including Cuxhaven and Brunsbüttel, were secured from an altitude of 0 - 300 ft. Among other details revealed by this sortie were ships, including an old battleship of the Schlesien class at Brunsbüttel, and details of the shore defences of the estuary.

The loss of the Hudson on March 3rd was the first flying casualty sustained by the Unit, but what made it all the more tragic was that the machine was shot down by British aircraft. The Hudson was intercepted at 7,000 ft. and shot down by a Hurricane fighter while taking photographs of Gravesend airfield, one of a series requested by the French Mission. According to a statement by the sole survivor,* Sergeant-Pilot J.A.M. Reid, the

/crew

Appendix
XXII

Sortie
HNA/002

(N.7334)

* Other members of the crew were F/C S.D. Slocum, I.A.C. Hutton and L.A.C. Butcher.

crew made efforts to identify themselves by firing Verrey lights and using a signalling lamp. The machine bore British identification markings, but the greenish-blue colouring was non-standard, which may have caused it to be confused with a German type. Regrettable though this loss was, the short career of the Hudson had not been in vain, since it proved the possibilities of low-cloud reconnaissance. As a precaution the new flight of three Hudsons was rapidly fitted with I.F.F.

On the same day, March 1st, that Longbottom succeeded in securing photographs of Heligoland, Niven attempted to secure photographs of the Ruhr, for which Bomber Command had long been impatient. Weather conditions proved unsatisfactory, but on the following day, March 2nd, the same pilot secured a series of historic photographs, giving the first mosaic of the Ruhr, since the outbreak of war. The photographs gave immense satisfaction at Bomber Command and no doubt increased Air Chief Marshal Sir Ludlow Hewitt's keenness to secure the Photographic Development Unit. The mosaic also proved most acceptable to the Deuxième Bureau of the Armée de l'Air, who made extensive use of it for their target dossiers. On the 3rd F/L B.C. Le Mesurier covered the region immediately to the north-west of the Ruhr, including Emmerich, Duisburg, Kempen and Geldern. Meanwhile, efforts had begun to obtain fresh photographs of Emden and Wilhelmshaven. On March 2nd Le Mesurier got photographs of Wangerooge and Borkum, but the ports proved elusive. Between March 3rd and 15th five attempts were made, baulked in each case by cloud.

The raid on the seaplane base of Hornum on the island of Sylt on the night March 19th/20th, the first on enemy territory during the present war, led to the first of the long series of damage assessment sorties. Reports from aircrews engaged on the operation claimed "many direct hits" on the Air

/Station,

S/3672/7A

N.7334

S/3672/5A

Sortie
HAA/010

B.C. Form 'K'
March 20th,
1940

Bomber
Command
Photographic
Interpretation
Report No. 51

Station, including hits on "hangars, living quarters, slipway and light railway", and one stated that two hangars were seen burning. When photographs taken by a Blenheim aircraft of No. 82 Squadron on the following day were examined by interpreters of the Photographic Interpretation Section at Bomber Command, they showed that the base could not have been damaged as seriously was thought, nor, indeed, did they reveal any evidence that it had been hit at all. To quote from the Interpretation Report:-

"All the Hangars, buildings, the Slipways and the Crane appear to be intact. No signs of damage can be seen and photographs seem to compare exactly with those taken earlier. Although slight damage would perhaps pass unnoticed on photographs of such poor quality it is certain that no considerable damage could have been inflicted as the vast majority of buildings are certainly intact.

Note: Although no signs of Bomb Bursts are apparent, in view of the dune type of country, it is possible that some bombs have been dropped on the sand dunes and on rough ground, as those would be difficult to notice. It can, however, be said that at Westerland and Hornum no damage is apparent and there are no signs of damage to civil habitation in the area covered."

On the 22nd F/L Le Messurier attempted to secure further photographs of Sylt, but had to return without photographs owing to cloud. The sortie was, however, notable in the annals of the Unit, because it was the first one for which a 'long-range' Spitfire of type 'C' was available, enabling Sylt to be reached from Heston direct. The same machine was to secure the first photograph of Kiel, rather more than a fortnight later.

N. 3069

(N. 3069)

March 22nd was also memorable for its reminder that, although the use of fast aircraft flying at great heights had reduced them, casualties could not be entirely eliminated. Flying the original type B Spitfire, F/O C.M. Wheatley left the refuelling base at Stradishall at 11.15 hrs. His Spitfire was reported to have been shot down about noon over the German - Dutch frontier in the Arnhem area. Reports

/from

from other pilots indicate the presence of conditions near the scene liable to give rise to condensation trails between 26/33,000 ft. It is possible that F/O Wheatley descended below 26,000 ft. in order to eliminate a trail and was surprised by an enemy fighter. His aircraft was reported to have fallen in flames in marshes near the Waal in Dutch Territory.

Sortie
HNA/005

Opposition was also encountered on the only subsequent sortie of the month, when on March 28th F/L Le Mesurier, having secured photographs of Cuxhaven, set course for home only to observe a flight of fighters - probably Me.109s - coming up in a spiral turn near Wilhelmshaven some 10,000 ft. below him at about 20,000 ft. Opening up his engine, Le Mesurier soon left the fighters behind and below. The ease with which the Spitfire left its rivals behind and brought its photographs home was the justification of the new methods of strategical reconnaissance introduced into service use by the Photographic Development Unit.

The operations of the Spitfires based on Heston during the first quarter of 1940 may be summarised as follows:-

Sorties	Photos	No Photos	Percentage of failures	Losses	Percentage of losses
19	6	13	68%	1	c. 5%

It will be seen that compared with the performance of the Blenheim squadrons of No. 2 Group, Bomber Command, and for Air Component, up to the end of 1939, previously summarised, the Spitfires showed a rather higher proportion of failure. On the other hand the failures were due to weather and not at all to such preventable causes as freezing of cameras, nor must it be forgotten that the weather was even more unfavourable for the later quarter. The really important point, however, is

/that

that such successes as they did obtain, were won at low cost: the proportion of losses to sorties at 5% was between a third and a fourth of the Blenheim figures. This was due to the much greater speed and ceiling of the Spitfire. All photographs were taken at heights ranging from 30,000 to 34,000 ft., a good 10,000 ft. higher than the Blenheims operated, when they were not working at much lower altitudes.

Finally, it may be recorded that on March 21st the gallantry of the unnamed reconnaissance pilots was recognised for the first time by the bestowal of the Distinguished Flying Cross on the two pioneers, F/Lts. M.V. Longbottom and R.H. Niven. In the years which followed the hand-picked pilots of the Photographic Reconnaissance Units were destined to win numerous awards: none were better earned than these, the first of a long series.

B. Secret survey of Belgium for the British Expeditionary Force.

During the winter of 1939/40 military authorities were keenly preoccupied with problems arising from a possible invasion of the Low Countries by the Germans. As we have already noted, one of the main tasks of No.2 Group, Bomber Command, and of No.70 Wing, Air Component, during the first few months of the war was testing by reconnaissance the possible concentration of enemy forces. During the winter of 1939/40 there were recurrent scares and it was always probable that sooner or later the Germans would attempt to turn the Maginot Line by invading Belgium. Consequently, one of the problems to be solved during the period of preparation prior to the opening of the campaigning season in the spring was that of providing adequate maps of Belgium in case of a German attack and an advance by the Allied armies into Belgium. In a letter

/to

to the War Office from General Headquarters, dated December 19th, 1939, General Lord Gort, in drawing attention to the problem, wrote:-

S/59597/10

"The existing British maps of Belgium have been prepared from material which is in considerable need of revision, being based on a survey dating back to before 1914. The only way of meeting our deficiency is to obtain suitable air photographs, and then revise our maps. Otherwise, the British Expeditionary Force will be faced with fighting with obsolete maps of the operational area."

The difficulty of satisfying this requirement lay in the fact that the Belgian government, anxious not to afford a pretext to the Germans, was particularly sensitive at this time to any activity that might be construed as infringement of her neutrality by the western allies. Consequently the matter had to be handled as one of extreme secrecy. As there was obviously no question of twin-engined bombers, flying at 16,000 - 20,000 ft., being used to secure the photographs, the obvious course was to employ the photographic Spitfires, the first of which was at this time winning its spurs in France: flying in the stratosphere, these small aircraft might reasonably hope to accomplish the task without becoming conspicuous. In all this, the association of the Photographic Development Unit with the Secret Intelligence Service proved invaluable. The organising and carrying out of these highly secret operations was removed entirely from the purview of Royal Air Force scrutiny and the work was able to go forward without the publicity involved in the passage through 'official channels'. In order to provide cover against possible incidents, operations were ostensibly and officially training courses for reconnaissance pilots. Since a French airfield near the Belgian frontier - Lille/Seclin - was chosen as a base, there was always a possibility that aircraft might lose their course and find themselves over Belgian territory.

On January 18th, just a week after the return from

/Nancy

N. 3071
 For 'XA'
 sorties see
 Appendix XXN

Nancy after the completion of the Special Survey Flight, the original Spitfire was flown from Heston to Lille/Seclin by F/Lt R.H. Niven, who on the following day opened the series of sorties designed to secure the information needed to rectify the maps required by the British Expeditionary Force against the expected German assault on the Low Countries. It was designed to cover Belgium in a series of strips running mainly north and south in the east but sloping obliquely in the west. A beginning was made in the east on the zone bordering the Maastricht appendage of Holland and extending south of Liège and the survey was extended irregularly westwards to the Channel Coast. The flights were uneventful in the sense that no opposition was encountered, but the pilots had to contend with severe weather.

Between January 19th and March 29th, when the last of the sorties was flown, flying was only possible on twenty-one out of sixty-nine days, owing either to rain, snow or cloud, or to the airfield being unserviceable due to the effects of bad weather. Moreover, although sorties were flown on twenty-one days, owing to adverse conditions it was only on eleven days that photographs could be obtained. In other words, although every effort was made to press forward with the task, it only proved possible to obtain photographs on approximately 16% of the sixty-nine days over which the operation was extended, another illustration of the dependance of high altitude photographic reconnaissance on the weather. Of the thirty-seven sorties flown, nineteen were unsuccessful - fourteen due to adverse weather, mainly cloud; two to engine trouble; one to navigational failure; one to the prevalence of condensation trails between 20/32,000'; and one to the pilot's sickness.

The narrative of operations is thus one mainly of

/vicissitudes

vicissitudes of the weather. A sortie flown the day after the initial successful one of January 19th failed owing to cloud.

No flying was possible on the 21st or 22nd. A sortie flown on the 23rd had to be abandoned owing to cloud, and from January 24th until February 11th operations were at a standstill. On

February 10th a type B Spitfire was flown out by F/Lt Niven to join the original machine and two fresh pilots, F/Lt L.E. Clark and F/O W. Milne, came over to operate them. A brief spell of

less unfavourable weather on February 12th and 13th enabled four successful sorties to be flown. Of the three unsuccessful attempts on the following day, bad weather accounted for one, the windshield being iced over when flying in cloud at 32,000'; the two other attempts with the second machine failed owing to an engine defect.

Thereafter followed a second lengthy period of inactivity, the airfield being rendered unserviceable owing to the thaw which followed heavy snow between the 15/19th. During the first

four days of March conditions were favourable and no less than

eight successful sorties were flown by F/O Milne and F/L L. Pippett, the latter of whom had in the meantime relieved F/L Clark. The

period from March 5th/14th was one of indifferent weather; flying

was restricted to five days, and out of nine sorties only one

was successful, one of the failures being due to the pilot

feeling unwell, and one, that of the 10th, to condensation trails.

Two successful sorties were flown on the 15th and one on the 16th, when two unsuccessful ones were also flown. During the next

week flying was possible only on two days, the 18th and 19th, on

each of which single sorties were flown but abandoned due to

adverse weather. The last successful sortie was that of

March 25th, flown by F/O S.L. Ring, who together with F/O Taylor

and F/O Richmond had joined the flight in the middle of the

month. No flying was possible from the 26th - 28th of March.

/on

On the 29th operations were concluded by a sortie, which failed for navigational reasons; in landing on Laval airfield owing to lack of petrol, F/O Richmond struck a soft patch at the end of the landing run and "went up on the prop". The loss of this Spitfire (N.3117) on the ground was the sole 'casualty' of the operation.

Although all the photographs were small in scale, averaging approximately 1/46,500 or 1/74,500, according as lenses of 8" or 5" focal length were used, they served their main purpose. From them the Geographical Section of the General Staff was able to 'scratch on' details of many of the main changes which had accumulated during the previous thirty years, and so bring their maps up to date in time for the expected campaign. It must have been to this phase of the Unit's work that a War Office letter to the Air Ministry, dated September 4th, 1940, referred, when it recalled that:

See
Appendix
XXIV(b)

S/28981/II/5A

"Some valuable small scale photographs of extensive areas in Belgium were obtained by the P.D.U. and were fully utilized, both for mapping and for general Intelligence purposes".

The photographs were also utilised for air intelligence, in particular for up-to-date information about Belgian airfields, some thirty of which were plotted. By means of the Wild stereograph the Aircraft Operating Company was able to produce plans of the airfields at a scale of 1 : 10,000.*

C. Reconnaissance of the Rhine from Lille-Seclin:
March 18th - 30th, 1940

Expectation of a German invasion of the Low Countries during the Spring also led to attempts to secure advance information of German preparations. On March 16th the Photographic Development Unit was set the task of securing photographs of the Rhine between the Dutch frontier and

/Dusseldorf

* Some of these Wild Plans can still be found mounted in the dossiers of the section of Air Intelligence concerned with enemy and enemy-occupied airfields. (A.I.2(b)).

Dusseldorf with a view to detecting any pontoons or preparations for bridge-building that might exist. The request originated from General Georges, French C.-in-C. of the north-eastern theatre, and reached the Unit by way of the 2nd Mission and H.Q., B.A.F.F. First priority was assigned to the stretch from the Dutch frontier to Wesel and second to that from Wesel to Dusseldorf.

N.3116

A single medium-range (type B) Spitfire and two alternative pilots, F/Os W. Milne and Taylor, were made available for the task, which was to be carried out from Lille/Seclin, the base from which two other Spitfires were still attempting to complete the secret survey of Belgium (Task X) begun in January. The weather was exceptionally unfavourable and flying was possible only on five (March 18th, 19th 22nd, 25th and 29th) of the thirteen days between March 18th - 30th; moreover of the seven sorties flown - on the 19th and 29th F/O Taylor made the attempt as well as F/O Milne - every one was a failure owing to adverse conditions.

D. Secret photographic reconnaissance of the Caucasian oil-fields.

Parliamentary Reply
of Under-Sec. of State,
Foreign Affairs,
July 11th, 1940
Daily Telegraph,
July 12th, 1940

Early in 1940 the French and British governments caused studies to be made as to the most practicable means of destroying the Caucasian oil-fields. The conclusion reached by military experts was that the most effective action would be to attack the main centres of petrol, production, storage and shipment, viz. Baku, Grosni and Batum. At the sixth meeting of the Supreme Council held on March 28th it was agreed that British and French experts should examine practical details of the project. In the meantime the Secret Intelligence Service had been required to obtain the information needed for the planning of the operation. Here again, the Photographic

/Development

Development Unit was available to perform a highly confidential task by unconventional methods.

Appendix
XXV

In view of the distances involved it was decided to use the Secret Intelligence Service Lockheed, which left Heston at 0930 hours on March 23rd and reached Egypt two days later after spending nights at Marseilles and Malta. On instructions from Middle East H.Q. a landing was made at Helwan, in preference to Heliopolis, on the grounds that secrecy could be maintained more easily at the former. However, it was found that Helwan was too small for the Lockheed to take off fully loaded and in the event use had to be made of Heliopolis. On the morning of the 27th the flight was made from Heliopolis to Habbaniyah, Iraq, where the arrival of the aircraft aroused some stir among the airmen, who had to be prevented from photographing her. The removal of the Royal Air Force markings, the following day, caused further comment. After repairs to the oxygen system on the Friday, the aircraft took off from Habbaniyah for Baku at 0730 hours on Saturday, March 30th, with a crew of four². At 17,000 ft. it was found necessary to turn on the oxygen, after which the aircraft continued to climb to 20,000 ft. After crossing snow covered mountains, where a forced landing would have been next to impossible, the coast of the Black Sea was struck at Alan. After continuing about 15 miles out to sea, S/L Macphail steered due north for Baku. Six runs were made over the target, and although the Lockheed was an hour over the objective no signs of enemy air activity or of anti-aircraft fire were observed. After 9 $\frac{1}{4}$ hours flying, the Lockheed landed at Habbaniyah. The following day the films were flown back to Heliopolis and on being plotted were found to give an almost complete vertical cover of Baku.

Sortie
XEA/001

/It

* S/L Macphail, F/O Burton, L.A.C. Bissett and L.A.C. Dickson.

Sortie
XEA/002

It was decided at Heliopolis not to attempt the Grosni sortie, since it was beyond the range of the Lockheed flying from Habbaniyah, but to undertake the reconnaissance of Batum and, if possible, fill in the gap at Baku. The aircraft was flown back to Habbaniyah on April 3rd and on Friday 5th set out for Batum. The oxygen was turned on at 16,000 ft. and height was gained until 20,000 ft. was reached. It had been intended to make four runs over the target area, but half way through the second run anti-aircraft fire was encountered. As successive burst became more accurate, and as there were grounds for thinking that the oblique photographs would give complete cover, the Lockheed was headed straight back to Habbaniyah. The films were flown back to Cairo on the 7th, where they were plotted. On Tuesday, April 16th, the aircraft reached Heston on the conclusion of its mission. From the photographs obtained on these two sorties target maps were prepared by the Wild apparatus at the Wembley premises of the Intelligence Branch of the Photographic Development Unit.

As the opposition encountered on the Batum sortie emphasised at the time, the Russians were well aware of what was going forward. If they were in any doubts as to the implications of the flights, these must have been set at rest by Berlin, for among many other documents recovered from a railway wagon in La Charité station, Paris, on June 9th, 1940, was an expert appreciation of the project for destroying the Caucasian oil-fields, dated February 22nd, as well as a copy of the resolutions agreed by the 6th Session of the Supreme Council on March 28th, among them an agreement for the immediate study by Franco-British experts of the possibility of effectively attacking the

Frankfurter
Zeitung,
July 21st,
1940, S.5.
The Times
Aug. 2nd,
1940

Caucasian oil-fields by air. The wickedness of this project was duly enlarged upon by Herr Hitler in his speech to the Reichstag of July 20th, 1940, and the incident afforded M. Molotov some useful material for bullying the governments of

and Iran. In his speech M. Molotov is reported as saying of Soviet relations with Turkey that -

"It need only be said that the documents recently published in the German White Book throw a disagreeable light on certain aspects of the activities developed in Turkey. The explanations given afterwards by the French Ambassador to Turkey changed nothing of the nature of these documents. In this connexion I must say that early in April the Soviet Government made representations to Turkey concerning a foreign aeroplane coming from Turkish territory which flew over the region of Batum, where there are many oil refineries. At first Turkey denied that any aircraft whatever had emerged from Turkish territory. Later, however, Turkey promised to take measures against such flights in the future. As regards Iran, there is no new important event to report. However, speaking of Iran, too, it is impossible to pass over in silence another incontestable fact. Late in March the region of Baku received a visit from two foreign aeroplanes coming from the direction of Iran. The Iranian Government deemed it necessary to deny this fact. But in this case also the documents of the German White Book throw sufficient light on the incident in question. It must be observed that the repeated despatch of these foreign reconnaissance aircraft could not aim at anything other but a complication of our relations with our neighbours."

One of the stories commonly repeated about the early days of the Photographic Development, later the Photographic Reconnaissance Unit, is that the Wild plan of the Baku and Batum areas, prepared from the photographs obtained by the Lockheed, was circulated without due regard to security and that copies fell into German hands when they occupied Paris.

Die Geheimakten
des Französischen
Generalstabes,
Auswärtiges Amt
1939/41 Nt. 6.
Berlin, 1941.

It this were so, it is curious that no mention is made of this incriminating material in the German White Book, in which many documents bearing on the project (especially documents Nos. 22 and 30) were reproduced in facsimile. As we have seen, the Russians were acquainted with the key documents by the Germans, and had observed, and in the case of the later one, opposed the reconnaissance by anti-aircraft fire.

6. OPERATIONS OF THE PHOTOGRAPHIC DEVELOPMENT UNIT:
APRIL 1ST - MAY 10TH

A. Operations from Heston

Up till the German invasion of the Low Countries, which brings this phase to a close, the objectives of the flight based on Heston continued to be of predominantly naval interest. Among the additional requests from the Admiralty, passed on in Air Ministry Instructions during March, were:-

S/3653
 Phot.Rec.
 Instr.No.1
 (March 12th)

(a) Large scale vertical photographs of Bremen and Bremerhaven with a view to obtaining information about ships in dock, and ship-building with special reference to submarines.

(b) Docks at Hamburg (when long range (type C) Spitfire available).

S/3615/DMC
 (March 23rd)

(c) Submarine base at Neustadt.

Many of the Admiralty requirements, particularly as regards oil refineries at ports, were of equal interest to Bomber Command, whose requirements will be set out under section B, covering the operations of No.212 Squadron from France.

'N' flight, comprising a single Spitfire (type C) and two pilots, was based on Heston, but for the longer sorties it used forward fuelling points in East Anglia, Stradishall and Horsham St.Faith. For all but the last sortie of this period the original long range (type C) Spitfire was used.

P. 9308

After the sortie of May 6th this machine was prepared for taking part in the secret reconnaissance of Italian ports, which began from Le Luc on May 12th, and a new machine was brought into use. F/Lts M.V. Longbottom and E.C. le Mesurier, who later inaugurated the Italian series of sorties, operated the Spitfire up till May 3rd, when they were replaced by F/Os S.L. Ring (from No.212 Squadron) and S.G. Wise. Little use was made during this period of the flight of Hudsons based on

P. 9394

/Heston;

Heston; the only sortie attempted² was that of May 25th, abandoned owing to bad weather and the unserviceability of the artificial horizon.

One of the principal objectives brought within range

For details after delivery of the long range (type C) Spitfire, which was of successful sorties see first used on March 22nd, was the port of Kiel, to which the Appendix

XXVI first two sorties of April were directed. That of April 2nd

was abandoned owing to a combination of engine-trouble and adverse weather; ice accretion took place, when owing to a temporary stoppage of the engine the aircraft descended into cloud at 32,000 ft., and on the engine picking up again the

Sortie HNA/006 pilot made for home. On the morning of April 6th F/Lt Longbottom had to be content with photographs of Sylt, owing to cloud, but

HNA/008 on the 7th he succeeded in obtaining the first photographs taken of Kiel by British aircraft since the outbreak of war: two cameras packed up, as the Holtenau end of the Canal was approached, after the port had been photographed, and the third failed at Brunsbüttel; while flying at 33,000 ft. on the way home an enemy aircraft was sighted at c. 32,000 ft. between Brunsbüttel and Cuxhaven, but turning north-west at full throttle F/Lt Longbottom successfully shook it off and set course for home. Exceptional interest attaches to the photographs obtained on this sortie, because Kiel must have been a principal base for the German invasion of Denmark and Norway, which began only two days afterwards. Had previous photographic covers been available for comparison, it is possible that the quantity of shipping in the fjord and of aircraft on the Holtenau airfield might have given warning of events impending. On the other hand, it is arguable whether at this stage of the war such a warning could have been of much value.

/On

* Hudson N.7336, with F/O D.G.Ross, F/O Walker, A/G Stevens and A.C.Coates as crew.

HNA/007

A.M. Signal
X. 649 7/4

On the afternoon of April 6th F/Lt. Le Mesurier set out to obtain photographs of Wilhelmshaven and secured pictures of Rüstringen, though not of the port. The pilot observed two large ships in the roads, but there was a delay of several hours before this information reached Bomber and Coastal Commands. This prompted Air Ministry to emphasise the urgency of such sightings, and served to draw attention to the importance of any visual reports that pilots might make on photographic sorties.

HNA/009,
010

HNA/011

On April 6th, Air Ministry confirmed by signal that reconnaissance of the Heligoland anchorages remained a requirement of high priority. During April four attempts to cover this objective failed, mainly owing to adverse weather: on the first two occasions, on April 11th and 17th, photographs of Borkum were obtained through breaks in the clouds; the last two, on April 18th and 21st, were fruitless. On May 1st F/Lt. Le Mesurier succeeded in obtaining vertical photographs of Heligoland, and on the same sortie secured pictures of "ships heading N.E. between Borkum and Heligoland". It may be mentioned, as illustrating the close link between the Heston Unit and No. 212 Squadron, that finding his oil pressure gauge registering zero, Le Mesurier landed at Lille (No. 1 base) before returning to the home base. The visual observation and photography of ships at sea was in later years to prove one of the most valuable by-products of photographic reconnaissance from this country. Five more sorties were directed to north-western Germany during this period, on the 3rd, 5th, 6th, 9th and 10th of May: of these, two were totally unsuccessful owing to weather and the rest merely resulted in photographs of Borkum and others of the Friesian Islands.

HNA/012-014

As previously, the fact which stands out from any review of operations is the restrictive influence of the

/weather

weather. Sorties were flown on thirteen days out of the forty, but photographs were obtained only on eight: in other words photographic results were achieved on only 20% of the available days. Further than that, out of the nine 'successful' sorties - two of which were carried out on one day - the primary objective was obtained on only two occasions. The high-light of the period was the successful Kiel sortie of April 7th, which even though too late to influence events marked a definite stage in the extension of the field of reconnaissance.

HNA/008,
011

B. Reconnaissance of German preparations for the invasion of the Low Countries: from Lille/Seclin (March 31st - April 10th) and from Meaux/Villenoy (April 11th - May 9th).

(i) From Lille/Seclin

N. 3116

Task 341

Sortie
HAA/013
(7/4/40)

The Spitfire, used for attempting to photograph the Rhine between Emmerich and Dusseldorf from Lille/Seclin during the period March 18th - 30th, was next employed from the same base on trying to photograph the stretch of the Rhine from Cologne to Mainz. Unsuccessful sorties were flown by F/O Milne on March 31st and April 1st and weather prevented flying on the next five days. Of three sorties flown on the 7th the two flown by F/O S.L. Ring were unsuccessful, one due to cloud and the other to encountering a formation of three ME.109 aircraft with a fourth, possibly a 'decoy', 1,000 ft. below. The third, flown by F/O W. Milne, resulted in photographs of Cologne, Coblenz and Mainz. Weather prevented flying during the next few days. On April 11th 'A' flight moved to Meaux/Villenoy. Altogether from March 18th, when the first attempt was made to obtain photographs of the Rhine from Lille/Seclin, until April 10th, only eight out of the twenty-four days had proved suitable for reconnaissance, while out of the twelve sorties attempted only one was successful.

(ii) From Meaux/Villenoy

Up till the German invasion of the Low Countries on

/May 10th

May 10th strategical reconnaissance from Meaux centred on reconnaissance of the Rhine and of the area behind the Dutch frontier with a view to obtaining the intelligence needed by the French (G.Q.G. N. theatre) and the British (H.Q., B.E.F. and H.Q., B.A.A.F.) to counter the blow. In the course of this period various demands were translated at B.A.F.F. Headquarters into reconnaissance tasks, of which the following were allotted to No. 212 Squadron:-

S/1402/1/
AIR 4

Number	Task	Origin and date of demand
TK 7	Rhine between BONN and MANNHEIM Parts A-C (northern part) D-G (southern part)	
TK 9	CLEVE - GOCH - GELDERN - ALDENKERK - KEMPEN - VIRSEN - VENLO - ROERMOND line: to ascertain German military preparations	Requested by G.Q.G. (Air) on March 28th
TK 14	Certain areas of the Lower Rhine Valley between COLOGNE and DUTCH frontier to fill gaps in French dossiers	ditto
TK 101	Rhine from DUTCH frontier to DUSSELDORF with special attention to WESSEL and KAISERWORTH. To be completed weekly	G.Q.G. April 14th N.B. This is the same task as that origin- ally allott- ed to P.D.U. on March 16th
TK 103	(i) Valley from KESSLING - KALTENBRON (ii) AHR Valley, 4 miles up - and downstream from ALTEWAHR to investigate activity suggested by night reconnaiss- ance by No.52 Wing and by ground reports	H.Q., B.A.F.F. April 14th
TK 104	Completion of task 'X' (secret survey of Belgium) to fill in certain gaps indicated on tracings	G.H.Q., B.E.F., May 1st
TK 105	Strip three miles on each side of the line BOCHOLT - BORKEN - AHAUS - BENTHEIM - LINGEN to detect German military preparations	H.Q., B.A.F.F., May 8th

Of these tasks TK 7 (D-G) was discharged by 'B'
flight from Nancy; TK 14 was accorded too low a priority

/to

to be the object of special sorties; and TK 104 and 105 were allotted too late for action to be taken before the German invasion upset all arrangements. The attention of 'A' flight at Meaux was thus centred on TK 9, 101 and 103, the first two, which were if possible to be combined, being allotted priority over the third. Only one Spitfire was consistently available at Meaux to undertake these tasks, though for two periods in April (20/23rd and 27th) a second machine was active at this base. On May 8th, by which time this latter had for some while been engaged on task 'X' from Lille, two new machines came into operation. The small number of aircraft available, in conjunction with limitations imposed by the weather, entailed serious delays. In the event the only tasks to receive serious attention from Meaux were those of the highest priority, and of these TK 9 was not completed until April 21st, while TK 101 was not discharged with anything approaching the regularity desired.

The first week at Meaux was fruitless owing to persistent bad weather which prevented operations. When at last, on April 19th, conditions made operations possible, an attempt was made to complete the old TK 341, but, while picking up direction by the Rhine, his condensation trail attracted an ME.109; observing the ME. to be climbing steeply in his direction, the pilot, F/O Craxton, made for home by way of Aachen, immediately beyond which he encountered anti-aircraft fire, accurate enough to damage one wing only 3 ft. from the fuselage. Altogether the initial sortie was unfortunate, since the port camera failed after eleven exposures at an early stage of the sortie, while the remaining one brought pictures mainly of Aachen area. Two attempts the following day failed owing to bad weather. April 21st brought the first success and in the course of two sorties F/Lt. Daish and F/O Craxton between them completed TK 9 without incident. The following day a sortie had to be abandoned owing to condensation trails

/and

P.9313

P.9307

P.9331 and
P.9396

Sortie
FAA/002

FAA/003

FAA/005

and on the 23rd owing to adverse weather, which inhibited operations for the next ten days. On May 3rd F/O Craxton, attempting TK 101, secured photographs of Wesel, Duisburg and Düren, the last ones obtained from Meaux prior to the German invasion of the Low Countries. Bad weather prevented flying on May 4th, 7th and 9th and caused the failure of sorties on the 5th and 8th (two: one for TK 101; one for TK 103). Two sorties flown on May 6th had to be abandoned owing to persistent condensation trails, with the added complication in one instance of engine roughness. All in all the chief cause of difficulty during the period at Meaux prior to the invasion was the weather, which reduced flying to nine out of twenty-nine days and accounted for the failure of six out of the thirteen sorties; condensation caused three of the remaining sorties to be abandoned; and of the four which resulted in photographs, only three were really to the point, and the full success of two was impaired by the breakdown of the port camera. Another point to note about this series of sorties is that they involved passage over neutral territory, the normal practice for TK 9 and 101 being to follow the route Meaux - Rheims - Mézières - Namur - Liège - Nijmegen; for TK 341 the same route was followed to Liège when course was set for Koln via Aachen and Düren.

C. Reconnaissance from Nancy (Flight 'B'): April 5th - May 9th, 1940

Strategical reconnaissance by No. 212 Squadron in the area south of Coblenz was carried out by 'B' Flight from Nancy, the base of most of the operations of the Special Survey Flight during the period ending January 10th, 1940. The tasks entrusted to 'B' Flight included, in addition to the more southerly part of TK 7, concerned with possible new bridge construction in the Mainz - Mannheim areas, three special ones demanded by the French in mid-April, viz:

- XF-1 The Brenner pass and surrounding area.
- XF-2 Bridges over rivers in the area bounded by the Moselle, the Luxemburg frontier and the line Prüm - Daun - Whittlich.
- XF-4 (i) The Danube from Bratislava to Regensburg for petroleum and other ports.
(ii) The Ludwig Canal from the Danube to the Main for locks.
(iii) The Main from Bamberg to Mainz.
(iv) The Neckar from Flochingen to Mannheim.

N. 3071 To begin with only one Spitfire was available, the original machine used by the Special Survey Flight and subsequently for the 'XA' sorties from Lille/Seclin. The two pilots, who inaugurated the new tour of operations from Nancy, were F/Lt. L.E. Clark and F/O Taylor, the latter of whom arrived on April 3rd. On April 16th, F/O W. Milne arrived in a Spitfire, previously engaged on reconnaissance of the Rhine from Lille/Seclin, to complete Flight 'B'.

N. 3116 The first sortie, flown on April 5th, was abandoned owing to cloud, which also prevented flying on the following day. Success was not, however, to be delayed for long, because on April 7th, a day of good weather and visibility, the portion of TK 7 allotted to 'B' Flight was satisfactorily discharged. In the morning F/Lt. Clark crossed the frontier at Strassbourg at 33,000 ft. and flying N.N.E., parallel to the Rhine and some distance to the east of it, increased height to 35,000 ft., before starting his cameras at Speyer, carrying on beyond Mannheim to Sandhofen, and turning up the Neckar to the neighbourhood of Heidelberg. Apart from the failure of the 8" vertical camera on the first run, owing to the friction-driver counter in the control box becoming jammed, and to anti-aircraft fire which burst 2,000 ft. below the aircraft a little west of Mannheim, the sortie, which covered parts F and G of TK 7, was without incident. After lunch F/O Taylor took the aircraft up once more and succeeded in the course of four runs in securing photographs of all the southern parts (D - G) of

Sortie
HAA/015

Sortie
HAA/014

/the

the task. Anti-aircraft fire was again encountered over Mannheim, but again it burst considerably below the aircraft. For the next eleven days cloud prevented photographs from being obtained, although two sorties were attempted (April 11th and 13th).

Soon after the arrival of the second Spitfire a period of favourable weather led to a burst of reconnaissance activity. On the 19th and 20th each of the machines flew two sorties, but on both days two of the sorties were failures, owing in the case of those flown on the afternoon of the 19th to the formation of marked condensation trails at operational levels, and in the case of both sorties by one aircraft on

N.3071

Sorties
HAA/016,
017

HAA/016

Sorties
HXF/001,2Sortie
HXF/005

HXF/004

N.3071

HXF/003,6

TK.XF 1

the following day to defective engine performance accompanied by trails. On both the morning sorties of April 19th photographs were secured of part of the Rhine between Basle and Mannheim, but the failure of the starboard camera owing to a blown fuse lessened the value of one of these. On the 20th the two successful sorties between them covered all but the eastern margin of TK.XF 2 without incident apart from anti-aircraft fire encountered on the first one, which as usual was attracted by a condensation trail and fell short by some 2,000 ft. The first attempt on TK.XF 1 was made on the morning of April 21st by F/O Milne, who, owing to unfavourable weather, had to be content with photographing the north shore of Lake Constance on his way back. The same day also saw the first attempts on TK.XF 4, one part of which, the Ludwig canal connecting the Danube and the Main, was successfully photographed by F/O Taylor. Attempting the same task on his second flight of the day, F/O Milne was lost in the original photographic Spitfire, the first casualty sustained by No. 212 Squadron. On the 22nd and 23rd photographs were taken of the Brenner Pass and surrounding country from 33,000 ft.

/Thereafter

Thereafter, adverse weather set in and continued during most of the sixteen days, flying being possible on only four days. Of the four sorties flown, one (April 29th) was abandoned owing to condensation and two due to adverse weather (May 6th and 9th). On May 7th P/Lt. Clark reached the Brenner Pass, only to find the area under cloud, and had to rest content with a few photographs taken through a gap in the Bolzano area. When the German invasion of the Low Countries brought operations at Nancy to an end, photography had been possible only on thirteen out of the thirty-five days, while of the twenty-two sorties only a half, taken on a total of six days, met with any measure of success. Of the failures, five were due primarily to condensation trails, in combination in two cases with engine defects, five to cloud conditions and one to the loss of an aircraft. On the other side of the picture the flight had finished its share of TK 7 on its third day of operations; the greater part of XF-2 was completed within three days of receiving the demand; and substantial parts of the other tasks were discharged, all at the cost of one Spitfire.

HXF/007

7. OPERATIONS OF THE PHOTOGRAPHIC DEVELOPMENT UNIT:
MAY 10TH - JUNE 18TH, 1940

The invasion of the Low Countries by the Germans on May 10th caused the war in the West to enter upon a phase of greatly increased intensity. First and foremost it set in motion a series of military events which led up to our eviction from the continent of Europe, an event of the first magnitude in the history of the war in the air. During the period in question, from May 10th until the completion of the departure of the Royal Air Force from French soil on June 18th, the exercise of British air power was in the main conditioned by the pressing necessities of the rapidly changing military situation. At the same time it is significant that, within a few days of the first shock, long term strategical considerations began to affect the picture: the first attack by the Royal Air Force on German industrial objectives took place on the night of May 15/16th within less than a week of the invasion. Thus, while the main call upon photographic reconnaissance during this period was to supply intelligence needed to bring air-power to bear most effectively on the problem of stemming or delaying the advance, reinforcement and supply of the German ground forces and their air cover, the requirements of the incipient long range strategical bombing offensive had also to be met; it should, however, be emphasised that Bomber Command endeavoured to satisfy its needs as far as possible by using its own Blenheim Squadrons, so that this work fell only comparatively lightly on the Spitfires of the Photographic Development Unit. In addition, the progress of the German conquest of the European sea-board had the effect of progressively extending the range of coastal reconnaissance, as well as intensifying its necessity. Reconnaissance designed to provide intelligence needed for more or less close air support of the army was carried out

at first entirely by No. 212 Squadron from French bases, but from May 18th onwards this was shared to a certain degree by aircraft of the parent unit operating from Heston. Reconnaissance of German-controlled ports and coastal areas continued as before to be carried out from Heston and various forward fuelling-points in Southern England. The rare sorties connected with the long-term Bomber Command offensive were shared by French and British based aircraft. As a matter of convenience reconnaissance from France and Britain will be considered separately, although it is appreciated that in practice there was a certain amount of overlapping. A third subsection will be devoted to the secret reconnaissance of Italian ports, originally undertaken in anticipation of the famous 'stab in the back' of June 10th, precipitated by the disastrous outcome of the Battles of Flanders and France.

A. Operations by No. 212 Squadron (France).

During the final period on the continent the operations of No. 212 Squadron, apart from the Italian sorties described separately, were carried out from one base at a time. The outlying flights were immediately concentrated on Meaux/Villenoy, where 'A' flight had been operating since mid-April, 'B' flight being brought back from Nancy and 'C' from Lille/Seclin. This move was not only wise from the point of view of withdrawing the forward bases from the zone liable to be engulfed in military operations, but the concentration was valuable in itself, especially in view of the proximity of Meaux to B.A.F.F. H.Q. at Coulommiers. The time had arrived when reconnaissance would in all likelihood need to be switched rapidly in accordance with a military

/situation

situation that night, and, in fact, did change overnight.

Meaux remained the base of operations until June 9th, when the German advance towards Paris and the Seine necessitated a move further to the rear. From June 10th until the 14th, when the last sortie was flown, operations were based on Orleans/Bricy. Details of the squadron's withdrawal from France have been difficult to trace owing to lack of records but it appears to have retired from Orleans to La Rochelle by way of Poitiers and Fontenay-le-Comte. During the ten days prior to the move from Meaux one at least of the Spitfires returned to Heston and a second was detached to Corsica for the Italian sorties. The fate of two others cannot be traced. A fifth moved back to Orleans, where it was joined by a new machine sent out from England. Both these were flown back to Heston, one of them on June 14th, when photographs were secured of the Seine between Vernon and Elbeuf on the way home. Two of the other Spitfire pilots who had flown sorties from Orleans, F/Lt. L.D. Wilson and F/O. Blatchford, returned from Poitiers in Fairey Battles, the former bringing with him five aircraftsmen. Two of the intelligence officers attached to the Squadron, P/Os. D.N. Kendall and Wigginton flew to Guernsey and continued by boat. A substantial proportion of the squadron personnel was ferried back to Heston in Hudson and Lockheed aircraft which between them made fifteen return sorties for this purpose between June 11th and 21st. Up till the 14th the Hudsons flew to Orleans, from the 15th to the 17th to Poitiers and on the 18th to La Rochelle. One of the

/Hudsons.

Hudsons actually made return journeys each day from June 11th - 17th (inclusive). The same machine, together with a second Hudson, flew to La Rochelle on the 18th on a final mission. The machines, which were captained respectively by F/Lt. R.E. Baxter and F/O. Burton, did not return until June 21st and so must have been among the last Royal Air Force aircraft to leave France. As a point of interest, it may be recorded that F/Lt. Baxter's Hudson brought Prince Staremberg to England from Cazau airfield, near Arcachon, Gironde. On the same day the remaining air-craftsmen reached England in a collier from Bordeaux. Owing to lack of shipping space the squadron's equipment, including films, petrol and motor-transport had to be burnt at Fontenay le Conte on the evening of June 17th.

Any account of high altitude photographic reconnaissance covering the period May 10th - June 18th must inevitably rest on an accurate appreciation of the rapidly changing military position in so far as it affected the course of the war in the air. For this the reader is referred to the Air Historical Branch Narrative covering 'The Campaign in France and the Low Countries', in which narrative there will also be found an account of the low and medium altitude photographic and visual reconnaissance carried out by aircraft of the Air Component. In the present section attention will be confined to the high altitude photographic reconnaissance with which the future was to lie. Essentially it is a narrative of the operations of the main bulk of No. 212 Squadron - the operations of 'D' flight over Italian territory are dealt with in a following section, although it should again be stressed that this was an entity in name rather than

/fact.

fact. Study of the movements of aircraft and pilots shows that they were interchangeable between Heston and the various continental bases. In practice, more particularly in its later stages, No. 212 Squadron acted as that part of the Photographic Development Unit which operated from French bases. In the Secret Organisation Memorandum, drawn up on May 11th, 1940, to cover the re-organisation of the Photographic Development Unit and No. 212 Squadron, it was even proposed that No. 212 Squadron should in future be known as the Photographic Development Unit (Overseas Section). Although in deference to the wishes of the A.O.C.-in-C., B.A.F.F. this change was not made formally, the proposed new designation would in fact have described the unit more accurately. It may be noted that after the first commanding-officer of No. 212 Squadron - A/SL. Macphail - had been posted back to Heston, the officer in charge was never more than a Flight Lieutenant. On the other hand, W/Cdr. F.S. Cotton was able to devote an increasing amount of his time to the unit in France, now that W/Cdr. G.W. Tuttle was available at Heston.

TK.106

The invasion of the Low Countries wrought a complete change in the programme of reconnaissance. Task Nos. 101, 102, 104 and 105 were cancelled forthwith and Nos. 14 and 103 were suspended, as it turned out, for good. The first new ones to be allotted to No. 212 Squadron had as their object the photography of strips of country, with a view to discovering the enemy's lines of advance and of providing targets for air attack. On the morning of the 10th instructions were given for the photography of two belts of Belgian territory, an outer one extending from Turnhout in the north through Maastricht and Liège to

/Houffalize

Houffalize near the Luxembourg frontier, and an inner one from a point five miles east of Antwerp through Liège to

Namur. In the course of the three sorties flown that day from Meaux, photographs were obtained of the greater part of the territory specified. Enemy aircraft were encountered on two of these: the condensation trail of F/Lt.

L.D. Wilson's Spitfire attracted a couple of enemy fighters, probably ME. 109s, which however he was able to leave behind; and F/O. A.L. Taylor encountered a Dornier 17, which was driven into the clouds by a dummy attack. Meanwhile, reconnaissance by aircraft of the French 3rd Army had established a German mechanised column ten miles in length

advancing on Luxembourg from Echternach. Accordingly a main task for May 11th was photography of the main roads through Luxembourg from a north-easterly to a south-

westerly direction. Early that morning a second task was set for the day, namely photography of roads beyond the Luxembourg frontier in the Ardennes, in order to pick up the advancing column further west. Although two sorties were flown, bad weather caused the failure of both.

Meanwhile the picture on the ground was changing rapidly. By 11.45 hrs. on May 11th the Germans had entered Tongres, having forced the Maas and the Albert Canal in the Maastricht area. Attention was therefore directed to locating bottle-necks in the rear of the advancing columns in order to impede by air attack their reinforcement and supply.

Instructions were therefore given for photographs to be taken of the Meuse bridges between Maastricht and Namur and of the

line of the Albert Canal between Herenthals and Maastricht.

Two sorties were attempted, but, although each secured photographs, cloud prevented the successful carrying out of

/the

the tasks in hand. Bad weather caused the failure of sorties flown on the morning of the 13th; among other difficulties encountered at 34,500 ft. was the freezing of the inside of the port-side of the windshield, a trouble avoided that afternoon by opening the windshield slightly. On one of the two afternoon sorties photographs were obtained through a gap in the clouds of a stretch of the Albert Canal. Photographs of the Meuse bridges were obtained on the morning of the 14th by F/O. Christie, who was followed for between ten minutes and a quarter of an hour by 6 ME. 109s, after passing over Maastricht at 26,000 ft. with only a short exhaust trail. By the 14th it had become apparent that the most menacing enemy thrusts were those in the Ardennes, designed to turn the Maginot line in the area of Sedan, the hinge between the fortified military frontier, prepared at so great a cost by the French behind their common boundary with the Reich, and the allied armies in the Low Countries. Indeed, a decisive event - the German crossing of the Meuse at Houx and in the Sedan area - became known at B.A.F.F. Headquarters on the evening of May 13th. Reconnaissance to cover the German breakthrough was largely in the hands of the French, but on the 14th No. 212 Squadron was instructed to photograph the Meuse between Mézières and Mouzon and the road between Sedan and Paliseuil and on the 15th to cover a line Poix - Terron to Namur by way of the Meuse and back by way of Florennes to Mariembourg. The latter request, made as a matter of urgency at 07.45 hrs. on the 15th, in order to reveal troop movement and any additional bridging, was satisfied within a few hours, the aircraft returning from an uneventful sortie at 11.00 hrs. the same day. /As

TK.115

TK.116

Sortie
FAA/015

As a result of offensive operations by Bomber

TK.113
W.A.16
S/2761

Command, demands began to come in for the photographs needed to assess damage. On the 13th a reconnaissance had been asked for to check the effects of buoyancy mines deposited in the Rhine in accordance with the 'Royal Marine Plan'. The photographs taken the same day showed that the anti-mine barrage appeared to have been partially destroyed at a point $2\frac{1}{2}$ miles west of Karlsruhe. These tasks included photographs of communication centres on the western margin

TK.110
(ii)

of the Ruhr, from Munchen - Gladbach to Cleve, attacked on the night of May 12/13th, and a second series further west, including Aachen, Maseyck and Eindhoven, attacked on the night of the 13/14th. Both tasks were discharged without

Sorties
HAA/014,
018,010

incident in the course of three sorties flown on May 14th, though the scale of the photographs, resulting from high altitude and lenses of small focal length, must have rendered them of small value for assessing bomb damage. Both sorties

Sorties
HAA/020,
021

flown on the 16th were devoted to securing photographs of the Ruhr, presumably in order to obtain data for assessing the results of the Bomber Command operations of the night of May 15th/16th, the first devoted by the Royal Air Force to the bombing of German industry.

Adverse weather caused the failure of the only sortie attempted on the 17th and prevented operations entirely on the 18th, by which date the military position had still further deteriorated, the Germans having passed the Sambre/Oise and Upper Escaut lines with armoured forces wheeling for the Channel ports. On the 19th sorties were flown across the rear of this German push and photographs were obtained without incident.

Sorties
FAA/016/7
TK.119

/The

TK.118
Sortie
FAA/018

The same day the squadron was set the task of photographing a line between Soignies - Malines - Louvain and Namur so as to establish movements of enemy troops through Central Belgium. An attempt to discharge this task on the 20th failed owing to a breakdown in the electrical system, which meant that no photographs were obtained. On 21st the Sambre was photographed between Chauney and Landreocies to verify the state of bridges attacked by Whitleys and Hampdens the previous nights, but cloud again prevented operations on the 22nd and 23rd.

The success of the Germans in reaching the Channel coast near the mouth of the Somme on the 21st marked a definite stage in the campaign, but for a few days there was still an outside chance that the 'Weygand plan', whereby contact might be re-established between the Allied 1st Army Group to the north and the French reserves south of the Somme - Aisne line, could be put into execution. As this hope faded, the task of the Royal Air Force defined itself more definitely as providing support for the withdrawal of the land-forces to Dunkirk. In the field of photographic reconnaissance this involved a watch on enemy movements and the definition of targets for attacks on his lines of communication, particularly bridges, and on dumps and revictualling points, with a view to slowing down his progress and diminishing his pressure on the allied armies, which he was attempting to squeeze into the sea. At the same time it meant that a watch had to be kept on forward airfields which the enemy might attempt to use both for countering the Royal Air Force and for attacking our armies.

/After

Sortie
FAA/021

TK.202,3

TK.201

Sortie
FAA/020

Sortie
FAA/022
TK.204

TK.205

TK.206

Sortie
FAA/027

After the blank days of May 22nd and 23rd, the 24th brought some successes. On an afternoon sortie by no means devoid of incident, F/O. G.P. Christie managed to complete three tasks, two of which were for photographs of supply dumps, required for that day by A.A.S.F. for laying on attacks, the third being a French demand for Guise airfield, also needed for briefing bombing attacks. Near Guise, Christie ran into ten He. 111s, only one of which took much notice, opening up with a front gun; while after passing over the airfield for the second time some Me. 109s started to take off, which gave a clear signal to make for home; and, finally, on the way back the pilot encountered uncomfortably accurate anti-aircraft fire east of Chauny. On the morning of the 24th another pilot secured photographs of the western half of a task set the previous day to ascertain damage inflicted on Belgian airfields in enemy hands in the Charleroi - Liège area and the extent to which they were being used by the German Air Force.

On May 25th photographs were secured of the Meuse between Namur and Montherme, demanded on the previous day to ascertain troop movements, but an attempt to discharge another task, involving the photography of a series of points mainly in woods to ascertain the location of revictualling points, met with failure owing to cloud. On the 26th a fresh task was laid on the squadron by B.A.F.F., the location of two panzer divisions in the Montreuil - Etaples area, wheeling in the direction of Boulogne on the German right flank. An attempt made to secure these photographs the same day was frustrated by clouds, and when on the 27th they were obtained they disclosed no sign of the panzers, which had by

/then

then presumably moved elsewhere. During the next three days the weather was poor; no operations were attempted on the 28th or the 30th and both sorties flown on the 29th had to be abandoned owing to unsuitable weather.

BAFF/S/
1402/110A

TK.204

TK.208

TK.208
Sortie
FAA/025

AHB
IIH2/394
(I.R.
Report)

TK.209

Sortie
FAA/032

TK.111
Sortie
FAA/028

May 31st saw a general reorganisation of the outstanding photographic tasks. The stretch of the river Meuse of which photographs were needed to check the state of bridges, originally from Namur to Montherme, was extended southwards to Mézières. Task 205, on which unsuccessful attempts had been made on May 25th and 29th, was for the most part combined with TK. 207, covering airfields in the Ardennes near Libramont, originally set the previous day though not attempted, to form TK. 209; other items of the TK. 205 were combined with TK. 201 and a number of other airfields to constitute TK. 210. First priority was attached to the Meuse bridges and photographs of these between Givet and Sedan were obtained that same evening: when the photographs were interpreted at B.A.F.F. H.Q. Intelligence, they showed that twenty-eight were destroyed as compared with thirty-four intact or repairable. Weather prevented an attempt on the second priority, airfields in the Ardennes and roads in the Sedan area, until the evening of June 2nd, when both sorties were abandoned owing to ground haze; in the end the task was not carried out until the evening of June 4th. Meanwhile, on June 3rd progress had been made on the third priority - dumps in the Meuse valley and airfields behind the Somme - Aisne line. The same day an attempt to photograph the railway centres at Aachen, Maeseyck and Eindhoven was foiled by cloud. June 4th was the most active day of this period, five sorties being

/flown,

flown, three of them by one aircraft, the first leaving at 06.30 hrs. and the last returning at 20.05 hrs. One sortie, the third flown by Spitfire P.9313 that day, failed owing to engine trouble: of the others, one, as we have seen, discharged parts of TK. 209; another covered the Meuse between Charleville and Fumay; a fourth secured photographs of areas between the Meuse and the Somme in the areas Mézières - Fumay - Avesnes and Guise; and a fifth covered the Rhine between Bingen and Speyer, presumably in connection with the 'Royal Marine Plan'.

Sortie
FAA/032
FAA/030
FAA/031

HAA/041

Sortie
FAA/034

HAA/040

HAA/043

HAA/044

TK.213

Sortie
FAA/035

On the morning of June 5th, the day on which the Germans opened their Somme offensive, three sorties were flown. Two of these were directed to Belgian airfields and to Guise airfield, where numerous German aircraft were observed by the pilot, some of them taking off and landing. The third covered objectives in the Dinant - Fourmies area. No sorties were flown from Meaux on the 6th, but two landed there, one from Heston, the other from Nancy: on the former, the pilot crossed the French coast at Abbeville and flew up the Somme over Amiens and Peronne to the Oise, taking photographs as he went; on the latter, photographs were obtained of Lake Constance and the upper course of the Rhine to Basle. On the morning of June 7th, the day on which the Germans announced the breaking of the Weygand line along its whole length, General Tetu requested photographs of one of the main enemy lines of supply, the railway from Maastricht to Aulnoye by way of Liège, Namur and Maubeuge with, if possible, an extension at the further end to Roermond and Venlo, to check the condition of the track and of any bridges. Photographs of the western half of this task up to Liège were secured during the early afternoon the same day, the pilot returning before the job was completed owing to the cameras stopping. An

/attempt

attempt made to finish the task that afternoon missed fire, due to a mishap to the pilot which excellently illustrates the difficulties of this work arising from the mere factor of high altitude. Setting course from Mézières, after climbing to 30,000 ft., the pilot let his map slip; in grabbing for it his oxygen mask must have pulled away, and when he came to he found himself lost at approximately 8,000 ft. Shortage of petrol and a glycol leak prompted him to land between the obstacles on the obstructed Rheims/Champagne airfield. Subsequent attempts to salvage this aircraft failed. Early on the morning of the 11th several attempts were made to get messages through to the French at Rheims to have the Spitfire burnt, but there is no record to show whether this was in fact done. The railways task required by the French was completed on June 8th: the pilot flew direct to Venlo, where he started his cameras and made upstream to Namur and beyond to Maubeuge and Guise; returning by way of Soissons he noted that the town was burning. In the afternoon photographs were taken of the Bois de Bailleux and the Forêt de St. Gobain in the Chimay - Laon area, where German armoured units were reported to be sheltering and which had been attacked the previous night by Wellingtons of Bomber Command and Battles of A.A.S.F. respectively; according to the pilot no fires were to be seen.

P.9331

Sortie
FAA/036Sortie
FAA/037

Meanwhile the progress of the German advance increased in momentum and on the 9th their armoured columns pressed forward to the Seine between Rouen and Vernon. That day No. 212 Squadron withdrew from Orleans/Bricy. The Seine crossings became the main focus of reconnaissance interest, both for No. 212 Squadron and for the reconnaissance squadrons

TK.215

/of

of the Air Component. On the morning of the 10th the task was set of securing photographs of the Seine between Rouen and Mantes with a view to discovering whether the main bridges had been successfully blown and whether the enemy were throwing their own bridges across the river. Rouen itself was obscured by the smoke issuing from the oil and petrol stores ignited by the French on their withdrawal, but the photographs brought back by the Spitfire, which returned within less than three hours of the receipt of the order, gave cover of the rest of the Seine up to Poissy: examination showed that eighteen out of the twenty-six bridges on the stretch of river photographed were destroyed, the remainder being intact or only slightly damaged. Although the pilot flew at only 19,000 ft. instead of the normal average of approximately 32,000 ft., so as to ensure a reasonable scale for interpretation, he only experienced slight, inaccurate anti-aircraft fire while over Pont de l'Arche. The following day cover of bridges south of Vernon was particularly required. Photographs taken at 13.00 hrs. showed that all the arches of the road bridge and one arch of the rail bridge over the main river, together with a rail-bridge over a stream on the north of the Seine had been destroyed; further, it was evident that the Germans had begun the construction of pontoon bridges from either bank of the river. So as to make sure of getting full details, the sortie was made at a height of only 5,500 ft; anti-aircraft fire was accurate for height, but was considerably behind the aircraft. The scale of the photographs made it possible to detect military activity, including numbers of lorries, some with trailers. Apart from the sortie of the 14th, which ended at Heston and to which reference has

/been

Sortie
FAA/038TK.216
Sortie
FAA/039

HAA/045

been made earlier, this proved to be the last successful photographic sortie by No. 212 Squadron in northern France, those flown on the 12th and 13th having to be abandoned, due either to smoke or cloud.

From the point of view of operational efficiency this last phase of No. 212 Squadron's work in northern France marked a new high level. This was due primarily to the period of exceptionally fine weather chosen by the Germans for their 'blitzkrieg'. During the period of thirty-six days between the invasion of the Low Countries and the final sortie from Orleans/Bricy, sorties were flown on all but seven days, and one of these was occupied by moving the Squadron from Meaux. Again, of the fifty-two sorties flown, forty-two were more or less successful, a proportion of more than 7/10ths. As a result it commonly happened that photographic tasks could be discharged the same day as demanded. This was just as well, because, as the German advance gained ground and momentum, requests for information came more and more to be directed to matters of immediate operational significance. A point to note is that, when during the final stage exact information was required about the Seine bridges, the principle of high-altitude flight was abandoned and the pilots flew low to secure photographs of sufficiently large scale. Despite this the Squadron lost no aircraft on operations, although one had to be abandoned on a forward airfield.

/B.

B. Secret reconnaissance of Italian targets (May 12th - June 15th 1940) *

It need hardly be emphasised that the entry of Italy into the war as a belligerent partner of Germany had long been anticipated before, on June 10th 1940, she declared war on the Allies, and that the role of the Royal Air Force in that event had received due consideration. Already before the German invasion of the Low Countries the Director of Plans at Air Ministry had formulated the three leading priorities in the bombing of Italian targets:

A.H.B.
Narrative on
the campaign
in France.

- | | |
|------------------|---|
| First priority: | Heavy attacks on the four most important industrial centres, viz. Turin-Milan-Genoa-Venice. |
| Second priority: | Dislocation of aircraft airframe and component factories at Turin-Milan-Genoa and Vergiate. |
| Third priority: | Oil targets at Genoa-Leghorn-Trieste-Brescia and Naples. |

Towards the end of the month the Air Ministry was discussing concrete arrangements to implement these plans with Air Marshal Barratt, and on May 31st the Supreme War Council decided that, in the event of an Italian declaration of war against the Allies, offensive air operations should be undertaken at the earliest opportunity against industrial and oil targets in north-western Italy.

On June 3rd the naval and air staffs of Britain and France met in Paris to concert plans and on the same day 71 Wing Headquarters and two servicing flights proceeded to

Ref. Proceed- the south of France to prepare Salon and Le Vallon airfields
ings H.M.S.
Argus(M.020920/ for the reception of "Haddock" force, both of which were
40, 27 May -
7 June), ready for operations by June 10th. Meanwhile on June 1st
cited in
letter from H.M.S. Argus had reached Toulon "intending to form a squadron
Capt. A.C. Dewar
R.N. (Quotations of swordfish to operate against Genoa" - presumably from the
from letter).

* The main documents available are a set of pilots' operational reports, with a few appended notes, together with the photographs (at C.I.U.). In addition information has been obtained orally from Mr. F.S. Cotton. Entries from F/Lt. Longbottom's flying log have also been used.

aircraft based on the Fleet Air Arm training school at Hyères. As described in the Narrative covering the campaign in France, the operations of "Haddock" force were largely thwarted by French opposition based on fear of Italian reprisals. Equally, the Prefet Maritime, having informed the C.O. on June 3rd that he did not want H.M.S. Argus at Toulon, the aircraft carrier left the port on the following day and, after calling at Hyères, reached Gibraltar on June 7th. In the event, British air operations against Italy during the period immediately following the declaration of war consisted of a rather unsuccessful attack by No. 4 Group, Bomber Command, on the night of June 11th/12th, and two small-scale operations by "Haddock" on the nights of June 15th/16th and June 16th/17th.

It is against this background that the photographic reconnaissance undertaken by the Photographic Development Unit between May 12th and June 15th should be viewed. Yet, although the setting is sufficiently clear, official sources are silent on the planning and initiation of the sorties. According to Mr. F.S. Cotton, who during the period in question was acting as Wing Commander in command of the Unit, the initiative was his own, although he broached the project both at Air Ministry and to A.M. Barratt. Since the operations began close on a month before Italy came into the war, it is evident that official responsibility could hardly have been accepted for the enterprise, which would explain the absence of records. No doubt it was convenient to turn a blind eye. At least we know that both Air Ministry and the Admiralty were aware of what was afoot more than a fortnight before the Italian declaration of war, since in a communication from

A.I.8 dated May 26th, 1940, indicating a first priority for reconnaissance, it is stated that the 5th Sea Lord, under whose supervision came the operations of the Fleet Air Arm, was "very pleased with the Genoa job", referring to photographs taken of the port in preparation for the potential operations from H.M.S. Argus.

The photographic reconnaissance of Italian targets began on May 12th, but the first stage ended abruptly on the 14th, presumably an indirect result of the German invasion of the Low Countries, which caused a general withdrawal of Photographic Development Unit machines from the Continent about the middle of the month. The work was not resumed again until May 28th, by which time arrangements were in hand for implementing plans against Italy in the event of her declaring war, and lasted until June 15th. The flight consisted of one or at most two photographic Spitfires with a Hudson for transport. Most of the sorties were flown from Le Luc, which was convenient for Hyères, but forward bases at Ajaccio and Bastia in Corsica were used for more distant objectives. Facilities for processing films were made available by the Officer Commanding the British Naval Detachment at Hyères, base of a Fleet Air Arm Training Squadron. Plots showing the areas photographed, together with rush prints, were forwarded to Wembley, whence in due course an interpretation report was received. From the meagre records available it is evident that about the time of the visit of H.M.S. Argus these reports, together with contact and plots, were supplied to the British Naval Detachment, Hyères, presumably for use in projected Fleet Air Arm operations.

/Taken

Taken as a whole, the operations exemplify in miniature the value of mobility and flexibility in the employment of air power. On May 11th F/Lt. Longbottom flew in Spitfire P.9313 from Heston to Meaux, where he changed over to Spitfire P.9310, in which he continued to Le Luc. Next morning he inaugurated the series from Le Luc by photographing the Italian coast from Genoa to Bordighera. After lunch his colleague, F/L. E.C. le Mesurier, who likewise had won the D.F.C. for his work in the Unit, completed the Gulf of Genoa, apart from Spezzia, by photographing Leghorn and Pisa. May 13th was devoted to covering the Italian approaches to France. F/L Longbottom took off in cloudless weather at 06.35 hours to photograph the Franco-Italian frontier from Mentone to Iarche some fifty miles inland, a sorties which had to be repeated a few hours later owing to the shearing of the port camera drive; finally, later in the morning, the Turin-Modane railway was photographed up to the tunnel at Bardonecchia. On the 14th the series was temporarily brought to an end by two flights: first thing in the morning Le Mesurier took off from Le Luc and flew a course to Constance, Milan, Como, Busto Arzio and Bastia, securing photographs of Milan and Castano; at Bastia Longbottom took over the machine for a flight to Bari via Rome, leaving at 14.35 hours and returning with photographs of the town, port and airfield of Bari taken from a height of 30,000 ft. by 17.35 hours. Thus, in the course of three days two pilots and one Spitfire between them had photographed all but one of the main ports of the Gulf of Genoa, two of the most vital stretches of the Italian approaches to the French frontier, industrial targets in the Milan area, and the port of Bari, where the pilot noted that little shipping was to be seen.

Sortie IXFA/
001
IXFA/002

IXFA/003
and
4

IXFA/005

IXFA/006

IXFA/007

/During

IXFA/008

During the second period, beginning on May 28th, photographs were obtained on thirteen out of eighteen days.

IXFA/009

011

On the first sortie F/L. Le Mesurier completed cover of the ports of the Gulf of Genoa by securing photographs of Spezzia. Rain and violent thunderstorms on the 29th and dense cloud on the 30th prevented operations, but the weather cleared for the mornings of May 31st and June 1st, when photographs were secured of Turin and of various objectives in the Piedmont region of

IXFA/012/
017

north-west Italy. From June 3rd to 4th six sorties were flown over this part of Italy, photographs being obtained of various points in the Mentone, Spezzia, Bergamo, Milan, Aosta area, and on the 5th Leghorn and Florence were covered. Having thus completed reconnaissance of north-west Italy and of the coast from Mentone to Leghorn, attention was directed to regions further south. It was intended that the aircraft which took off from

IXFA/018

Le Luc on June 6th to photograph Madalena and Terranova in north Sardinia should land at Bastia in Corsica, ~~the~~ forward base chosen for more distant sorties. When the pilot attempted to land here, however, he found that the airfield had been rendered unserviceable by the French and so had no choice but to return to Le Luc. Arrangements had hurriedly to be made to operate from Ajaccio as a second best ~~to~~ Bastia, and on 8th photographs were duly taken of the port of Naples and other objectives from this airfield, which continued to be used until the 11th,

IXFA/019-
022

photographs being obtained of the main Sardinian bases, including Cagliari (twice), as well as further ones of Naples and Formia. On June 11th each of the two photographic Spitfires withdrew to Le Luc on completing their missions to Sardinia and Leghorn respectively. One result of covering Naples was that a substantial proportion of the Italian fleet was located on the eve of the declaration of war; the pilot who photographed the port on June 8th reported that between four and five large and five and six medium warships were present in the harbour and that

/another

IXFA/019

IXFA/021

another five large ones were actually entering at the time of photography. On the other hand, on the 10th, two ships, apparently cruisers, were reported as leaving the port and proceeding in line astern in a south-westerly direction.

During the last phase attention was concentrated on the most accessible targets for attack, in ports on the Gulf of Naples, such as Genoa and Spezzia, and inland centres such as Milan and Turin; the latter two were photographed later on the 11th by one of the Spitfires, which had returned to Le Luc after having flown a sortie from Ajaccio earlier in the day. It is indicative of operational urgency that from the 12th to the 15th all returning aircraft landed direct at Hyeres to save time. The pilot, who early on the 14th set out to photograph Genoa, had the thrill of reporting a fleet of seventeen warships about 20 miles south of Impera steaming south-west and accompanied by a fighter patrol. Supposing that he had located the Italian fleet steaming towards France, he set course for Hyeres only to find that what he had in fact seen was the French fleet returning from the bombardment of Naples. To cap the story the film proved to be blank, though whether due to a camera defect or to faulty development has not been established.

The only occasion on which enemy opposition was met with was on June 13th when F/O. G.P. Christie was photographing Genoa. In the pilot's own words:

"While over Genoa a Fiat biplane fighter carried out a quarter attack on my right. So I descended into clouds. While returning to base I observed a twin engine bomber approaching the coast about 30 miles E. of Cannes. It had Italian markings, a rear top turret and front turret. I could not see if it had a dust bin underneath. I carried out 3 attacks almost out of range from the beam,

/then

then as the turrets appeared to be unable to turn through more than 45⁰ I carried out full beam attacks passing over the top very low. After 2 attacks he descended and forced landed on the water. The crew of 5 climbed on to the wing and swam towards the shore. They had no life belts nor dinghy. The machine sank in about 3 minutes nose first."

The point of this story is, of course, that the Spitfire was unarmed.

On June 15th "D" flight was forced to abandon France; the aircraft were flown home, but the ground staff had to return via North Africa by sea.^x It is symptomatic of the value of mobility that the Spitfire, which on June 15th photographed Spezzia, Pisa and Genoa, on the morning of the 18th covered Amsterdam from the home base at Heston.

P. 9385

C. Operations from Heston (May 10th - June 18th)^x

The chief preoccupation of the home base of the Photographic Development Unit continued to be enemy-held coastline, which, as a result of events on the Continent was greatly extended during this phase. Whereas prior to May 10th the field was limited to the coasts of Germany, Denmark and Norway, of which only the parts fronting the North Sea, together with the port of Kiel, were within practicable range, by June 18th it had widened to embrace those of the Low Countries and France, including the vital Channel Ports, not to mention the potential field in the Mediterranean opened up

/by

x F/Lt. Le Mesurier, F/O Sheen, P/O Hornby and ten aircraftsmen reached Heston on July 13th by way of Casablanca and Gibraltar. Heston Form 540.

x Records to cover this period are limited to the Form 540, a set of pilots' reports, a manuscript log book of 'N' Flight, and of course the photographs. The objectives for reconnaissance have had to be inferred from these sources.

by the entry of Italy into the war. In addition to this main defensive task, which grew ever greater in importance, the flight at Heston had to undertake a certain amount of reconnaissance in connection with the struggle raging on the Continent.

The number of photographic Spitfires on hand at Heston varied considerably during the period owing to frequent movement between the home base and the flights overseas.

P. 9394

From May 10th only one machine was available until it crash-landed in a field near Horsham St. Faiths on the 15th.

P. 9308

That same day one of the Spitfires used on the Italian sorties was flown back from Bastia and was thus ready to undertake operations from Heston on the 16th and 17th. By the 18th

N. 3116, P. 9307
and P. 9313

three machines had returned from France, a consequence of the great displacement caused by the German advance from the Meuse to the Channel ports, which had begun on the night of the 15/16th, and by the 19th these had been joined by a fourth.

P. 9331

The second of the aircraft used for the first batch of Italian sorties was also operating from Heston by the 19th, on which date five machines took off on missions. Thereafter the

P. 9308

number declined: one machine was lost on the 19th, one returned to Meaux between the 19th and the 21st and a third to Le Luc between the 20th and the 24th. By the 25th, therefore, the Heston flight was down again to three active Spitfires. Apart from small movements between Heston and Meaux, there was no important change until the photographic Spitfires on the Continent began to come home for good in the middle of June, including two from Orleans and two from Le Luc.

As might be expected, weather conditions for flights from Heston, although better than during the Spring were not quite so favourable as those obtaining on the Continent. If the period is considered as a whole, we find that out of the

forty days involved, thirteen were unsuitable for flying and that all the sorties attempted on five more failed to secure photographs; thus on 45% of the days no photographic reconnaissance was forthcoming. Of the sixty-eight sorties attempted, fifty-three or c.78% obtained photographs. The chief cause of failure was cloud cover, which accounted for four-fifths of the unsuccessful sorties; smoke over the target area and navigational errors each accounted for a single failure, and one aircraft failed to return from its mission, giving a rate of loss of c.1½%. To see these figures in perspective, however, it should be realised that there were in fact periods of exceptionally favourable conditions interrupted by patches of poor weather. Thus, conditions during the first week were poor and, although the need for reconnaissance was pressing, it only proved possible to fly three successful sorties; during the next four days (May 17th - 20th), on the other hand, fourteen sorties were flown, and neither of the two failures were due to weather; from May 21st to June 1st conditions were very poor, photographs being secured on only five out of the twelve days; the succeeding eight days (June 2nd - 9th) were again brilliant, twenty-four sorties being flown, of which all but two were more or less successful; the next eight days were the poorest of the period, seven proving a complete blank, and one of the two sorties flown on the eighth failing to obtain photographs; finally, on the last day of the period, June 18th, photographs were secured on each of the six sorties flown.

(i) May 10th - May 20th

During the first week (May 10th/16th), which was marred by bad weather, attention was directed almost entirely to the Frisian Islands: as a result of the German invasion of the Low Countries, the task had

/extended

Sortie
HNA/014

HNA/045

extended to include the Dutch series from Texel to Schiermonikoog, as well as the German islands. Photographs of the Dutch Islands and of the port of Den Helder were secured on the only sortie flown on May 10th. At a second attempt on the following day, the pilot arrived over Vlieland only to find the rest of the islands were under cloud, so he turned south to photograph Texel and the Dutch coast from Den Helder to Haarlem, noting that Rotterdam was covered by a pall of smoke. More photographs were secured on the 14th, but these again were confined to the Dutch Islands and Den Helder. On the 15th course was set for Cuxhaven, but severe ice conditions were encountered when flying over the port at 34,000 ft. and the cameras refused to work; when attempting to land, the flaps also failed to respond and it was necessary to force land in a field near Horsham St. Faiths.

Sortie
HNA/018

Sorties
HNA/019
020,022

Sorties
HNA/018,021
HAA/023,025

The period from May 17th - 20th, which was more favourable for reconnaissance, saw important progress. On the 17th an attempt was made to extend cover of the Frisians to include the German islands and photographs were in fact secured of Borkum and Norderney, as well as Terschelling. The most striking achievement during the period was the covering on three out of the ten sorties flown on the 18th and 19th of all the major North Sea ports of Germany from Emden to Hamburg. In addition, photographs were obtained during the same period of most of the chief Dutch ports, including

Ijmuiden and Amsterdam, Hook, Rotterdam and Flushing.

The Ruhr provided another target; an attempt on

/the

Sortie
HNA/018

HAA/023

Sorties
HAA/022,
024, 026

the 17th was baulked by cloud, the pilot photographing objectives in the Amsterdam area instead, but on the 19th cover was obtained of Krefeld, Gladbeck and Gelsenkirchen. Three attempts were made to photograph Salzbergen north-west of Rheine, a point on the through line from Berlin to Holland via Hannover and Osnabrück, but on each occasion the pilot had to be content with alternatives.

(ii) May 20th - June 4th

Meanwhile, events moved fast on the continent, and the home-based flight of the Photographic Development Unit was called upon to assist in reconnaissance for the land battle, which was the primary concern of No. 212 Squadron. Accordingly on May 20th a sortie was flown from Heston to the Givet area, where photographs were taken which revealed forest fires in the region, the result of the operations of fire-raising aircraft directed the previous night against enemy dumps. May 21st and 22nd were unsuitable for photography, the single sortie of the 23rd, directed to Rotterdam, failed owing to cloud, and the 24th was again unsuited to operations. By May 25th, when it next became possible to secure photographs from Heston, the retreat on Dunkirk was already in full swing. Of the three sorties flown that day one had to be abandoned owing to cloud, a second secured photographs of Haamstede and a third of Boulogne, which had fallen the previous day, and of the line of the Somme from Abbeville to Amiens, presumably to check enemy movement.

Sortie
HAA/027

Sortie
HAA/028

HAA/029

On May 26th the only operation consisted of a low-flown sortie of the Bruges Canal and the port and mole of

/Zeebrugge

Zeebrugge: photographs taken at between 3,000 and 6,000 ft. showed four sunken ships in and near the mole, although the canal itself was seen to be intact.

The full-scale evacuation from Dunkirk, which begun on the evening of May 26th and ended on June 4th, dominated photographic reconnaissance during this period. The main objectives included enemy troop movements, enemy occupied airfields and the bases in Holland and the Frisian Islands of light enemy naval craft liable to interfere with the evacuation.

Both sorties flown on May 27th were directly concerned with German military operations: one was aimed at detecting troop movements on the Gravelines - St. Omer - Carvin arc and the other at securing photographs of airfields in the Calais - Boulogne - Montreuil area. On the single sortie flown on the 28th only a few exposures were obtained at Rotterdam before the pilot was forced to break off by anti-aircraft fire. Flying was impracticable on the 29th and on the following day cloud caused the abandonment of all four sorties directed to the Channel Coast, Rotterdam and Texel. On May 31st photographs were obtained of Den Helder and, in the course of two sorties, of the Dunkirk perimeter from Nieuport to the neighbourhood of Calais.

No operations were possible on June 1st, but on the 2nd six sorties were flown. Of these, two, directed to the Dunkirk - Calais area, had to be abandoned owing to smoke; two sorties brought back photographs of Dutch naval bases, including Hook, Rotterdam and IJmuiden; one obtained pictures of

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HAA/030

HNA/024

HNA/025

HNA/026

HAA/031
032

HNA/027
028

HAA/034

HAA/033

the coast near Fort Mardick, west of Dunkirk; and a sixth of a line from five miles south of St. Omer to Arras. On June 3rd an attempt to photograph the Frisian Islands was frustrated by cloud, so the pilot pushed on towards the ports of north-west Germany which had not been covered for a fortnight; Emden was cloud-covered, but photographs of Wilhelmshaven were obtained through a hole in the cloud. The

HNA/029

main effort that day was, however, directed to trying to detect the enemy movements, which might be expected to develop when the evacuation of Dunkirk was completed. In the course of two sorties photographs

HAA/035
036

were taken along a line roughly parallel to the Somme from Montreuil to Arras and on to Guise by way of

HAA/037

Cambrai and St. Quentin, while a fourth covered the line of the Somme from Abbeville to Amiens. On the 4th another cross-section of German lines of movement towards the Somme was flown, this time from the Cap Gris Nez area to Guise.

HAA/039

(iii) June 4th - 17th

During this final period, in which the Battle of France was fought and lost, although a few sorties were flown to find targets for attacking enemy rear communications, operations from Heston reverted once more to a primarily naval character.

HAA/038

HNA/030
031

In the course of three sorties, two of which were flown on the 4th and a third on the 5th, most of the chief ports of Belgium and Holland except Antwerp were photographed, including Bruges, Ghent, Hook to Rotterdam, IJmuiden to Amsterdam and Den Helder; in addition the Channel Coast from Calais to Ostend was covered; and, on the other hand, Emden and the

HNA/033

/airfield

HNA/032

airfield at Jever near Wilhelmshaven. On Sortie HNA/030, flown on June 4th, the pilot reported a single-funnel vessel of 6/10,000 tons standing off IJmuiden and another of 10,000 tons off Hook.

HNA/034
and 037

During the next four days, June 6th - 9th, most of the Frisian Islands, including Texel, Terschelling, Ameland, Borkum and Nordeney and beyond them the ports of Emden and Wilhelmshaven were photographed. Again the pilots kept a look out for enemy shipping.

HAA/046
047
HNA/036

and twenty-one small craft were reported on June 6th zig-zagging off Ameland in a generally easterly direction. Good cover was obtained during the same period of the Dutch ports and inland waterways,

HAA/042

including IJmuiden, Amsterdam (twice) and the river

HNA/035

Waal up to Nimwegen. The Channel ports Abbeville,

HAA/045

Boulogne and Calais were covered on the 6th, but

photography of the Lumbres area south-west of

St. Omer, attempted on the 7th, was spoiled by a

camera failure. Three efforts to obtain

HAA/046
047
HNA/036

photographs of communications objectives in the

Munster area met with rather varying success.

Cloud conditions during June 10th - 13th prevented

operations and an attempt to photograph Rotterdam

on the 14th had to be abandoned owing to cloud.

Photographs were obtained of Le Havre on another

sortie that day, but since, owing to engine-trouble,

the pilot had to land in the Channel Islands before

returning to Heston, these did not arrive until the

15th. Cloud again held up operations on the 15th,

16th and 17th.

HNA/038

The last day of the period, which witnessed the final regular operations from French soil, until

/the

the return in 1944, was fine and six sorties were flown, all more or less successful. On five of the sorties the French Channel ports from Le Havre to Dunkirk, the Belgian ports of Ghent and Antwerp and the Dutch coast from Flushing to IJmuiden and from Den Helder to Texel were successfully covered. On the sixth sortie renewed effort was made to cover rail communication centres in the Munster area, photographs being obtained of Munster and Rheine.

HNA/039-
043

Sortie
HAA/049

8. APPRAISAL OF THE OPERATIONS OF THE PHOTOGRAPHIC DEVELOPMENT UNIT: JANUARY - JUNE, 1940.

It would be impossible to do justice to the achievements of the Photographic Development Unit, during the period up till June 18th 1940, without bearing in mind continually the novel and indeed revolutionary character of the tactics employed. In relying upon speed and high altitude in place of armament for the great majority of sorties, the photographic Spitfires broke clean away from tradition. As we have seen the whole development of air-fighting had arisen in origin from attempts to assert and deny to the enemy the advantages of reconnaissance. In view of the experiences of the war of 1914-1918, it is hardly surprising that training between the wars should have proceeded on the assumption that information could only be won by fighting. The correctness of the new doctrine of avoiding conflict and relying solely upon evasion, which it was the task of the Photographic Development Unit to apply in practice, was proved by the costly failure of the old style medium bomber squadrons as well as by the relatively inexpensive success of the handful of Spitfires. If the conception itself was brilliant, the solution of the manifold administrative and technical problems involved in its application were equally worthy of praise; neither should we forget the skill and courage of the early pilots who pioneered the new method in the stern school of war.

The operations of the Unit and of its off-shoot, No. 212 Squadron, fall into three main categories, viz: regular sorties over enemy territory, both from Britain and from France and irregular sorties initiated over neutral territory. Operations from the homeland began on January 18th 1940, within two days of the arrival of the first photographic Spitfire with extra fuel storage (type B). The main objectives of sorties over the North Sea were enemy ports and shipping,

/airfields

airfields and possible bombing targets. Bad weather deferred the first successful naval sortie until February 10th when the historic photographs of the Ems Estuary were obtained. The next developments in naval reconnaissance came with the type C Spitfire, which had sufficient range to reach Kiel. It was unfortunate that, owing to adverse weather, more than a fortnight elapsed before photographs of the port were secured on April 7th, since it is possible that had previous cover been available clearer warning of the impending attack on Norway might have been given. Thereafter, the only important extensions of coastal sorties were those brought about by the progress of the German victories on land, which made it necessary to photograph the ports first of the Low Countries and then of the Channel ports to Le Havre. At no time in this period did the range of reconnaissance extend either to Scandinavia or to the Baltic coast of Germany beyond Kiel. As for airfields and bombing targets photographed from Heston, these were situated mainly in north-west Germany. The mosaic of the Ruhr photographed on March 2nd did as much as anything else to convince doubters of the value of the new methods.

Operations from France were concerned primarily with reconnaissance of the preparations for and of the progress of the German conquests of the Low Countries and Northern France. They differed markedly in character from those undertaken from Britain. Speaking generally, they were linked with the progress of campaigns on land more intimately than with the war in the air and they were not at all concerned with the war at sea, which occupied so much of the attentions of the home-based flights.

The 'irregular' operations of the Photographic Development Unit and of No. 212 Squadron are interesting historically, since they reflect clearly the very important part played by the Secret Intelligence Service in origins of

the "new model" in photographic reconnaissance. The Belgian sorties, flown between January 19th and March 29th, helped to prepare the way for the allied advance into that unhappy country to assist in defence against the German aggressor, while those over Italy proved a legitimate insurance against the declaration of war which came before they were completed. Even more irregular in many respects was the photography of the Caucasian oil-fields at the end of March and early in April, for which one of the Lockheeds originally employed by the Secretary Intelligence Service was used.

The aircraft available for the work were almost ludicrously few, only four Spitfires being established for Heston and six for France; moreover, since the Heston machines had to provide for training as well as for operations, the number actually available was usually lower. The Heston establishment also allowed for a flight of four Hudsons for cloud photography, but in fact these did not all materialise. The situation on the eve of the German "blitzkrieg" appears to have been that eight photographic Spitfires and eleven pilots were "completely ready for operations", together with a single Hudson and one trained crew. Since, in addition to maintaining sorties, mainly of coastal objectives from England, operations were conducted for a period from three bases in northern France, and for a period from one in Southern France or Corsica, it was only through careful re-arrangement and rapid inter-change that the small force of substantially less than one squadron sufficed for the manifold tasks in hand.

During the period up till the withdrawal from France, the photographic Spitfires of the Photographic Development Unit, including No. 212 Squadron, flew a total of 273 operational sorties, in the course of which only three machines and their pilots were lost. This loss rate of slightly more than

1% compares with an average of approximately 18% for the Blenheim squadrons operating during the opening months of the war, a fact which was in itself a main justification for the new method. On the other hand, only a small proportion of sorties achieved full success. Of those flown, rather more than a third (101 or 37%) failed to achieve any success, and of those which resulted in photographs only comparatively few discharged their tasks completely. Also it commonly happened that, owing to cloud cover or other causes, it was necessary to photograph alternative objectives, or again that for various reasons the required area or points were not covered in their entirety.

The main causes of entirely blank sorties were as follows:-

	Cloud; mist	Con- densation	Engine	Elec- trical System	Smoke over Target	Navi- gation	Physical Mishap to Pilot	Enemy action	Loss	Total
<u>Jan. 18/ March 31st</u>										
Heston	12	-	-	-	-	-	-	-	1	13
N. France	22	1	2	-	-	1	1	-	-	27
<u>April 1st/ May 10th</u>										
Heston	4	-	1	-	-	-	-	-	-	5
N. France	14	9	-	-	-	-	-	1	1	25
<u>May 10th/ June 18th</u>										
Heston	12	-	-	-	1	1	-	-	1	15
N. France	12	-	1	1	1	-	1	-	-	16
Total	76	10	4	1	2	2	2	1	3	101

It will be seen that the weather was by far the largest cause of failure, cloud cover and mist accounting for three quarters of the blank sorties. Next in importance was condensation, a product of certain atmospheric conditions, which drew unwelcome attention to the unarmed Spitfires and sometimes led to the abandonment of sorties: although accounting for as much as a tenth of all

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the blank sorties, it will be noted that nine out of ten cases occurred within a single phase of the activities in France. Mechanical, electrical and navigational failure between them only accounted for some 7%. Even smaller was the proportion due to accident, sickness, or lack of judgment on the part of pilots, which together amounted to approximately 4%. The two cases of the target being too obscured by smoke to be photographed both belong to the period when the Channel ports were burning, and in any case were outside the control of the Unit. Enemy interference, including losses, only accounted for some 4% of failures, although abandonment due to condensation trails could of course be regarded as a measure of precaution against enemy activity. By contrast with the early experience of the Blenheims, camera failure in no case led to the total failure of sorties, due to the precautions taken to avoid condensation and the consequent freezing up, although in a certain number of instances camera defects prevented full success.

As we have seen, the weather was the predominant cause of the failure of sorties. Even greater was its influence, particularly during winter and spring, in preventing sorties being flown at all. The restricting influence of the weather is well brought out by the following table:-

1940	Days No flying mainly due to weather	Days with all sorties U/S, due mainly to weather	Days on which photos taken	
<u>Jan. 18th - March 31st</u>				
(a) From Heston	74	61	8	5 (7%)
(b) From Lille	73	51	11	11 (15%)
<u>April 1st - May 10th</u>				
(a) From Heston	40	27	5	8 (20%)
(b) From Lille	21	16	4	1 (5%)
(c) From Meaux	29	20	6	26 (10%)
(d) From Nancy	35	22	7	29 (10%)
<u>May 10th - June 18th</u>				
(a) From Heston	40	13	5	22 (55%)
(b) From Meaux, Orleans	36	7	6	23 (64%)
(c) From La Luc, Corsica	22	6	-	16 (73%)

In interpreting these figures, it must be remembered that at all times there were substantial numbers of tasks waiting to be discharged and that normally the only reason for not undertaking operations was that weather conditions made them either impracticable or foredoomed to failure: with some reservation on account of factors other than the weather, for example unserviceability of machines or airfields, the proportion of days on which no flying was undertaken gives some indication of the restricting influence of the weather. To gauge the full effect of the weather one should also take into account that on many days every sortie attempted had to be abandoned, due mainly to cloud or mist. More positively, the position can best be assessed by considering the proportion of days on which photographs were in fact obtained. The very low percentage of days on which photographs were obtained prior to May 10th meant in effect that, except by grace of the weather, a delay of several days was liable to elapse before tasks could be discharged, even if given the highest priority. As for requests for low priority, so long as the number of aircraft available remained so restricted, these were only liable to be satisfied during prolonged spells of good weather. As it happens the zones, in which the bulk of operations were carried out, are peculiarly liable to cloudy conditions. It is notable that, even during the good weather period, the figures for operations undertaken from southern France and Corsica were substantially better than for other zones, and it is probable that in fact the weather exercised even less influence there than would appear, the blank days being occupied in movements and rest. This restricting influence of weather which, particularly in north western Europe, applies to a great or less extent to all air operations, was the chief factor limiting reconnaissance by the Photographic Development Unit. The failure of the Spitfire, based on Lille for the express purpose between

/March 18th -

March 18th - 30th, to secure a single photograph of the Rhine between the Dutch frontiers and Dusseldorf, required by General Georges, is a good case in point.

It should, however, be recognised that this drawback was far more serious for short-term than for long-term work; lengthy delays in the case of tasks connected with the progress of a land-battle, such as spotting enemy movement, meant in effect that requests were sometimes out of date before they could be attempted; on the other hand, where it was a matter of maintaining a general observation of shipping activity in enemy ports or of accumulating detailed target information for planning bomber offensives in the future, the gaps in reconnaissance caused by adverse weather were of smaller import. Enemy interference had to a large extent been eliminated by flying fast and high, and many of the problems incidental to the new technique, such as the danger of camera freezing, had been mastered by experiment.

Certain very serious limitations of a technical character remained, however, before the new method of high-altitude photographic reconnaissance could contribute its maximum quota of intelligence: the scale of the photographs obtained from the heights at which the Spitfires normally operated was too small to give anything like all the detail required for interpretation, and the fuel capacity of the aircraft available was still inadequate, Norway and the Baltic, for example, still being outside effective range.

PART III

FROM THE FALL OF FRANCE TO THE END OF THE
BATTLE OF BRITAIN

I. INTRODUCTION

The effect of the entry of Italy into the war and of the fall of France was enormously to increase both the scope and the urgency of photographic reconnaissance. The most immediate threat was the invasion of Britain, and it is with this that the present section will be primarily concerned.

Towards the end of May 1940, when it became evident that a British withdrawal from the Continent could not long be delayed, the Joint Intelligence Sub-Committee of the Committee of Imperial Defence reviewed the means by which it might be possible to obtain the earliest warning of German preparations for the invasion of this country. In their report dated May 30th, the Committee began by pointing out how numerous were the areas, from which a seaborne expedition or expeditions might be launched against these islands, and by emphasising the difficulty of obtaining adequate information. The Committee was constrained to point "the general lack of surface craft available for patrolling" the European coast-line from Trondheim to the Pyrenees, and to the possibility "that the Germans might launch a seaborne expedition with no naval protection, relying solely on protection from the air, and on cover of darkness", a problem which "our intelligence system has not been designed to tackle". Finally, there was the crucial fact that in leaving the Continent, we perforce cut ourselves off from some of the most fruitful sources of information about German intentions at the very moment when knowledge of these was most vital; no wonder that the Committee should have been impressed with "the difficulty of getting information out of occupied territories".

In considering the information likely to be available regarding the impending invasion, the Committee stated that it was unlikely that reports from agents in enemy countries would be received in time. Other sources included:-

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(40) 88.
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1940.

- (a) wireless intelligence sources;
- (b) the behaviour of enemy agents in the United Kingdom acquainted with the impending invasion;
- (c) shipping preparations and other activities in enemy ports;
- (d) military preparations and concentrations in the vicinity of ports of embarkation; and
- (e) the actual sailing of the expedition.

To obtain information of the last three, it was recognised that air reconnaissance would be essential. The feeling of the Sub-Committee was that "regular and systematic air reconnaissance, over all areas in which the seaborne expedition might be prepared, and from which it might sail, will be vital". It was also suggested that "reconnoitring aircraft should contain a proportion of naval observers" and that preparations for organising the reconnaissance should be put in hand at once.

In view of the possible shortness of the warning likely to be forthcoming it was vital that information should be collected, collated and assessed with the minimum of delay. Further, it seemed clear to the Sub-Committee that, since information might be expected from a wide range of sources, including the three Service Ministries, the Secret Service, Foreign Office, outside sources and the Press, it was clear that "the Intelligence Organisation to deal with this information should.....be of an Inter-Service nature". Since it was "vital that properly digested information should be in the hands of those who have to take action with the least possible delay", it was considered evident that the day to day handling of the information could hardly be taken on by the Joint Intelligence Sub-Committee. Accordingly, it was recommended as an interim measure that an Inter-Service

sub-section should be set up to collect and collate all information tending to show that an invasion was impending, and that it should be a responsibility of this sub-section to warn the appropriate executive authority when it was considered that invasion was imminent. Actually, as was noted at the end of the Report, a small sub-section, comprising single representatives from the Admiralty, War Office and Air Ministry was already located in the Operational Intelligence Centre in the Admiralty.

N.I.D.0934

The functions of the sub-section[§] were agreed as:-

- "(a) To consider all intelligence matters appertaining to Invasion, whether already embodied in Intelligence Summaries or otherwise brought to notice.
- (b) To co-relate the Naval, Military and Air Force aspects of such information.
- (c) To formulate and submit to higher authority, including Home Defence, daily and whenever necessary, appreciations of the general situation or any particular aspect thereof".

N.I.D.0934

On the heading of its first report, issued at noon on May 31st, 1940, this body entitled itself The Invasion Warning Sub-Committee of the Joint Intelligence Committee, but report No. 2 of June 1st went out under the revised heading of the Combined Intelligence Committee. The series of daily reports issued by the Combined Intelligence Committee, in conjunction with the photographic interpretation reports of the Photographic Interpretation Unit, give an excellent insight into role of photographic reconnaissance as a principal source of intelligence during the era of acute anxiety concluded by the victorious outcome of the Battle of Britain.

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§ The original members comprised:-
 Commander C.E. Colpoys, R.N.
 Pay Lt. Cdr. Denning, R.N.
 W/Cdr. Walker, R.A.F.
 Capt. Sanderson, R.E.

2. ORGANISATION

C.C.Air (Plans)
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At a meeting held at the Air Ministry on June 10th, 1940, attended by Naval as well as Air Force officers, an attempt was made to define the scope of the air reconnaissance required and to allot responsibility for carrying it out. It was agreed that reconnaissance was needed of certain specified ports and airfields in South-west Norway, Jutland, North-west Germany, the Low Countries and such of the north French coastal region as was already in German hands. So far as ports were concerned, it was concluded that photographic reconnaissance was needed of the majority, but that visual reconnaissance might be carried out as an alternative over Jutland, the Frisian Islands, the channels between and Scheldt and the Maas, and the French Channel ports. It was considered that the assembly of an expedition would be indicated either by:

- " (i) the concentration of a large number of small craft or;
- (ii) by a small number of large vessels which would carry amphibious tanks."

The position of the Combined Intelligence Committee as "the only authority asking for and giving priority to requests for reconnaissances required in connection with invasion" was recognised by the meeting, which recommended that the Committee should co-ordinate requests for reconnaissance and "decide at each day's meeting what reconnaissances were required during the next 24 hours and give a degree of priority to them". Although reaching no clear decision about the way in which the necessary reconnaissance would actually be organised, it is significant that the conference was of the opinion that "high altitude photographic reconnaissance was by far the best method". As a corollary, it was decided that "the P.D.U. should be organised so that they could take over from Coastal Command as

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soon as possible the reconnaissance of the coast from the Low Countries to Denmark." On further consideration the Air Staff decided to place responsibility for reconnaissance of enemy ports squarely on the shoulders of the Commander-in-Chief, Coastal Command, although stipulating that "intelligence from the reconnaissance reports and other sources will be collated by the C.I.C., who from the information available will indicate to the C.-in-C., Coastal Command each day the ports which should be reconnoitred in order of priority." The Commander-in-Chief was expected to use the resources of his own Command, but in addition he was to have first call on the resources of the Unit, to whom he was empowered to pass orders for this purpose direct. Broadly speaking the General Reconnaissance squadrons would be responsible for visual reconnaissance, while tasks requiring photographic reconnaissance would fall to the Photographic Development Unit.

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Although it was recognised that reliance would have to be placed in the main on photographic or visual reconnaissance by day, the possibility of obtaining information about enemy preparations for invasion by means of night photography was not overlooked. The matter was broached by the Deputy Chief of Air Staff on June 7th, and was considered at the Air Ministry Conference of June 10th. The policy laid down by the Air Staff for Coastal Command provided that the "facilities available in Bomber Command for night photographic reconnaissance (were) also to be made use of to supplement daylight reconnaissance". At the same time it was intimated that "it was not intended that special night photographic reconnaissance should be undertaken by Bomber Command". Instead, it was laid down that if the Commander-in-Chief, Coastal Command, "will indicate to Bomber Command the ports of which night photographic reconnaissance is required",

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13 and 14

Bomber Command will "if possible route aircraft on night sorties so as to include the ports indicated, provided this can be done without prejudice to the primary task of the sorties". Meanwhile, the Assistant Chief of Air Staff (G) pressed for the policy of equipping the Photographic Development Unit to take night-photographs on its own account, and to this end tentative arrangements were made on June 16th for Bomber Command to hand over a modified camera with twenty 8" flashes and to loan an officer to advise the Unit on their use. In the event Bomber Command temporised, owing to the great shortage of flashes which were urgently required for bombing operations. In an official letter dated June 18th, Bomber Command drew attention to this shortage, and pointed out that pilots would need training before they could undertake night photography, suggesting that there should be no transfer of the flashes or the special camera until the Unit had become "proficient in night flying, night navigation and training in the use of bomb sight(s)". Further efforts to equip the Unit to take night photographs were made during the first week of July, but once again these met with failure owing to the shortage of flashes, all of which were required for bombing operations. In point of fact the Photographic Reconnaissance Unit passed through the invasion crisis of the summer and autumn without having any facilities for night photography, nor does it appear that the procedure suggested by the Deputy Chief of Air Staff resulted in the taking of night photographs of invasion ports by aircraft of Bomber Command.

As a logical consequence of this policy the Heston Unit was transferred from the control of the Director of Intelligence, Air Ministry, whose special section (A.I.8.) came to an end, to that of the Commander-in-Chief, Coastal Command, with effect from June 18th. At the same time the opportunity was taken to appoint a regular R.A.F. officer,

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Wing Commander G.W. Tuttle, D.F.C., who had for some months been mainly responsible for operations from Heston, to command the Unit. In informing Wing Commander F.S. Cotton of this fact, in a letter dated June 16th, the Air Council set on record their indebtedness for "the great gifts of imagination and inventive thought which (he had) brought to bear on the development of the technique of photography in the Royal Air Force." So long as the Unit remained in an experimental stage the Air Staff deliberately accepted the many inconveniences⁷ which followed from the employment of a dynamic individualist as Commanding Officer. By the middle of June, 1940, however, the Unit, thanks largely to Wing Commander Cotton's energy and drive, had proved itself sufficiently to be taken over on a strictly operational basis. At this point the smooth working of the Unit demanded first and foremost the qualities of command and organisation too seldom associated with the qualities of imagination and initiative needed in the initial stages. Both measures, the transference of the Photographic Development Unit to the control of an operational command and the replacement of its commanding officer by a regular Royal Air Force officer, were recognitions of the gravity of the situation and of the importance and immediacy of the role which photographic reconnaissance was expected to play.

The transference of the Photographic Development Unit to Coastal Command raised the problem of how other users should pass their requests for reconnaissance and who should determine priorities as between competing claims.

- Since it was agreed on all sides that the first requirement
/was

⁷ See A.C.A.S. (G) folder 70C/1/18 for examples.

was for intelligence bearing on the threat of invasion, the question really referred only to the disposal of the residue after the overriding claims of the Combined Intelligence Committee had been met and in practice this was for some months of relatively minor importance. Nevertheless Bomber Command was sufficiently aware of the superiority of the methods perfected by the Unit over those of its own medium bomber squadrons to wish to share its services. Accordingly, the Air Staff decided that Bomber Command should communicate their requirements direct to Coastal Command indicating the degree of urgency, it being clearly recognised that "at present first priority is for reconnaissance of enemy ports which might be used to assemble an expedition". A few days later (June 24th) it was ruled by the Deputy Chief of Air Staff that all demands for special photographic reconnaissance, other than those originating from Coastal Command or from Bomber Command, would be dealt with by the Director of Naval Operations who would pass them to Coastal Command. From this it will be seen that, although the recommendations of the Combined Intelligence Committee enjoyed absolute priority, Bomber Command was placed in a privileged position in relation to other users.

Meanwhile, the organisation for photographic reconnaissance was pressed forward within Coastal Command. The Photographic Development Unit, Heston, was established on July 8th as the Photographic Reconnaissance Unit and the Interpretation Unit at Wembley was renamed the Photographic Interpretation Unit. The reconnaissance unit came directly under Headquarters Coastal Command for operations, but was administered by No. 16 Group. The Interpretation Unit which continued to be commanded by W/Cdr. H. Hemming, A.F.C., Managing Director of the Aircraft Operating Company, and to comprise a mixture of civilian and service personnel, also came directly

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under Headquarters for operations, but under the Photographic Reconnaissance Unit for administration. Air Ministry relinquished direct control of photographic reconnaissance and the special section (A.I.8.) ceased to exist, but S/Ldr. G.C. Maxwell, M.C., D.F.C., A.F.C. who had served in it, was appointed Liaison Officer for Headquarters, Coastal Command, for all matters connected with the two Units.

Of the factors which had to be considered when estimating the establishment needed by the Photographic Reconnaissance Unit one of the chief was the weather. So urgent was the requirement and so limited was the weather favourable to high-altitude photography that it was thought essential to provide a sufficient number of aircraft to photograph the main enemy invasion bases simultaneously. One answer to the problem of the weather was to employ Hudson aircraft at low altitudes under conditions of low cloud for coastal and port reconnaissance, in the manner previously demonstrated. This meant that Hudson aircraft had to be provided as well as Spitfires. To the aircraft needed for Combined Intelligence Committee work had to be added those required to satisfy the demands of Bomber Command, and it had to be assumed that these also would have no occasion to operate at the same time as those photographing the ports. Allowance had also to be made for a certain wastage of aircraft. Another factor was the extra strain imposed by high altitude flying, which necessitated a large surplus of pilots. Again, owing to the extent of coast-line to be watched and the limited range of the aircraft available, it was necessary to operate detached flights in the north (Wick) and south-west (St. Eval), which involved the

/provision

provision of communication aircraft (Tiger Moths) and also of more numerous ground staffs. Finally, it has to be remembered that the nucleus of the Unit, the Secret Intelligence Service flight, had still to be housed at Heston.

S/57848/54A

The original Photographic Reconnaissance Unit establishment (WAR/CC/248) of July 8th provided for four flights (A - D), each with four Spitfires (3 I.E. and 1 I.R.) and one Hudson, the two detached flights^x having in addition a Tiger Moth each. In addition there were the special (Experimental) Flight, comprising two extra long range Spitfires, 2 armed Spitfires, 1 Spitfire fitted with oblique cameras and 2 Wellingtons, and a Training and Communication Flight including 2 Spitfires and an assortment of Secret Intelligence Service aircraft. Each of the four Operational Flights was allotted eight commissioned pilots. Owing to the special and still partly experimental nature of the work, the workshop establishment was substantial. There was also a large Intelligence Section, including 19 officers. Station Defence, also a vital requirement at that time, required 173 men. All told, the establishment provided for 752 personnel, including two civilians. Towards the end of the month an additional Flight (E), comprising eight Spitfires (6 I.E.; 2 I.R.), was added to the establishment for photographing German occupied airfields.

See WAR/CC/148
Establishment
for
details

S/57848/61A
64A

The effectiveness with which the Unit could discharge its primary function at this period, that of photographing the bases likely to be used by the Germans for invading this country, was determined as much by range as by the number of aircraft available. The position on July 20th, 1940, was that eight medium (type B) and three long range (type C) Spitfires were actually in use. By means of the long range type it was just possible under favourable conditions to reach Kiel from Benson, while from Wick the south-west portion of
/Norway

CC/S.7010/
26/18A

^xFlight A (Wick); Flight B (St.Eval).

Norway, including Bergen, Stavanger and Christiansand (s), and from St. Eval the coast of France down to the Gironde estuary could be covered. Two super long range Spitfires (type F), fitted with extra tanks for 90 gallons of petrol, were ready for use towards the end of July, but these only increased the radius of action by 100 miles, which left the Baltic still substantially beyond reach.

J.I.C.
Report No.42.

The lack of information regarding the position of Stettin and other German Baltic ports, commented on by the Joint Intelligence Committee in their report of June 17th,

C.I.C. Report
Nos.85 (Annexe
A), 93 (Annexe A),
99 and 100.

and frequently by the Combined Intelligence Committee, was more than once emphasised in discussions at the War Cabinet,

which body specially invited the attention of the Chiefs of Staff to the matter on June 29th. Only July 3rd the Chief of Air Staff had to admit that "Stettin was beyond the range of our reconnaissance aircraft, but he undertook to do everything possible to obtain this reconnaissance", adding that "the fitting of a special aircraft was being actively examined".

187th
Conclusions
War Cabinet
Meeting
June 29th

The aircraft designed to meet this requirement was the extra super long range Spitfire (type D), fitted like types B, C, and F, with an extra 30 gallon tank, but also with tanks on the leading edges of the wings with capacity for another 115 gallons. With its 145 gallons of extra fuel the type D photographic Spitfire was designed for a safe range of 1700/1800 miles, more than sufficient to reach Trondheim, Stettin and Marseilles and capable of reaching Toulon and Genoa. Unfortunately the type D Spitfire, although

A.C.A.S. (G)
Folder
70B/1/16

originally ordered in October, 1939, did not become available until the main invasion peril had been dispelled by the winning of the Battle of Britain - and, when on October 29th, 1940, the port of Stettin was photographed by the Photographic Reconnaissance Unit for the first time, the

/general

C.I.C.
Report No. 153

A.C.A.S. (G)
Folder
70B/1/16

A.C.A.S. (G)
Folder
70L/1

general impression given was of nothing more sinister than "lively commercial activity". Following the War Cabinet's invitation of June 29th, the Air Staff went closely into the supply position of the type D Spitfire only to find that both the machines on order had been taken off the priority list and that no further work was being done on them. It took the best part of a month to get the type put on an equal priority with standard Spitfires and it was winter before the first machine became available. There were many reasons for this unfortunate delay. To begin with, whereas types B, C and F were essentially conversions from type A, type D involved a radically new construction of a peculiarly difficult nature. Again, the construction of the special wings with petrol tanks in their leading edge clashed with the Fighter Command requirement for special cannon wings. In the event a prototype became available in time to photograph Stettin at the end of October, but normal deliveries did not begin until four months later and then very slowly. During the greater part of the period under review, therefore, the zone of photographic reconnaissance was limited, so far as Spitfires were concerned, by the range of type F, which at cruising speed gave a maximum radius of 650 miles. As a rule F.24 cameras with 8" lenses were used, but a few cameras were already fitted with the 20" lens needed to secure photographs of a scale sufficiently large to meet the requirements of Bomber Command.

The provision of suitable pilots for training on Spitfires at Heston was another urgent requirement. In a demi-official letter of June 29th to the Director of Postings, the Commander-in-Chief, Coastal Command emphasised the need for exceptional care in selection and stressed the importance of experience, navigational ability and a high standard of common

/scuse

A.C.A.S. (G)
Folder
70B/1/15

sense as qualifications, suggesting that "pilots are obtained from bomber or army co-operation squadrons, but not from fighter squadrons, in view of the fighter pilots' limited navigational practice". All pilots were commissioned.

No less important than the taking of the photographs was their interpretation, and we must now pause and consider the arrangements made to decipher the photographs brought home by the reconnaissance aircraft and to distribute the information so obtained. Broadly speaking, the Interpretation Unit acted as the complement of the Reconnaissance Unit, being primarily responsible for the interpretation of photographs obtained by that unit, the interpretation of target, strike, and damage assessment photographs secured by aircraft of Bomber Command continuing to fall to the Photographic Interpretation Section at Headquarters, Bomber Command. Although there was some overlapping, the cause of latent and at times open friction², the spheres were tolerably well defined: whereas, the Photographic Interpretation Section was designed to meet the domestic requirements of Bomber Command, the responsibilities of the Photographic Interpretation Unit extended to all the users of the Photographic Reconnaissance Unit, including the Combined Intelligence Committee, various branches of the Air Ministry, the Royal Air Force Commands, the Admiralty and the War Office. As described in a previous section of this narrative the Photographic Interpretation Unit developed around the nucleus of a commercial organisation, the Aircraft Operating Company, whose services were secured by the Air Ministry by an agreement dated April 1st, 1940. The Managing Director continued to preside as an Honorary Wing Commander, the

/company's

²P.I.S. Bomber Command was naturally especially sensitive on questions of bomb damage assessment, and resented any encroachment in this field. See BC/S.20443/120A.

company's plant at Wembley was taken over for use, and the staff, apart from the executives, who were granted honorary commissions, passed into the service of the Air Ministry as civilians. To this commercial nucleus was added the small Air Ministry Interpretation Section (A.I.1(h)), under Wing Commander Heath, which remained with the Unit after the departure of its chief. A further, and very valuable infusion of service experience came with the transference in June of Squadron Leader Riddell from the Bomber Command Section. Again, the Unit was reinforced by the return of the interpreters who dealt with the photographs taken by No. 212 squadron in France.

Thus, by the beginning of the Invasion Phase the organisation at Wembley had already attracted a considerable body of service interpreters. Nor were these for long confined to the Royal Air Force. Already, since the famous Ems sortie of February, 1940, naval officers had attended informally at Wembley to assist in the interpretation of naval units; indeed, it was in close co-operation with Lt.Cdr. C.Denning R.N., of the Naval Intelligence Division that Mr. (later Hon. Flight Lieutenant) M. Spender evolved his technique of interpreting ships from vertical photographs of small scale. When with the fall of France the threat of invasion developed, it was natural that the Admiralty should wish to maintain contact of a more official nature with an organisation, upon which they had to depend for vital information. Accordingly an officer serving in the Naval Intelligence Division at the Admiralty was designated Naval Liaison Officer to the Photographic Development Unit. Within a few weeks, on July 25th the War

/Office

CC/S.7010/
26/4A

■ The first Naval Liaison Officer, Lt.Cdr.G.B.Kingdom, a pilot of the Fleet Air Arm, was already active on July 2nd, 1940, when the Admiralty sought and in due course obtained permission for him to fly P.D.U. Spitfires. Lt.Cdr.Kingdom crashed and was killed when flying a P.R.U. Spitfire on August 1st, 1940. He was succeeded as N.L.O. by Cdr. A.J. Garland R.N.(Retd.).

Office attached Captain W.A. Venour, back from the campaign in France in which he had been engaged on photographic interpretation, to Wembley for the ultimate purpose of forming an Army Section in the Photographic Interpretation Unit. In these two attachments we may see the beginnings of an inter-service unit, but further development in this direction was very slow. Moreover, it should not be forgotten that despite large infusions from the Royal Air Force there was still a large though declining civilian element in the unit; at the time of the Wembley visit of the Establishments Sub-Committee on May 24th, 1940, civilians accounted for some 40% of the photographic interpreters, a proportion which had fallen to about 30% by the end of January, 1941.

S.61233/
42A/encl.1C
/106A/App.F.

The primary purpose of the Photographic Interpretation Unit was to interpret the photographs taken, processed and plotted by the Photographic Reconnaissance Unit and to ensure that the information obtained therefrom reached the proper quarters. In addition the unit was responsible for reproducing photographs needed to illustrate its reports and for the production of mosaics and plans. Interpretation was carried out in three main phases:-

- (i) The first phase or rush interpretation, which was designed to extract information on outstanding activity, such as movements of large ships, was sent out by teleprinter on a Form White to Coastal and Bomber Commands, Air Ministry and Admiralty.
- (ii) The second phase or preliminary report, giving a more detailed statement of activity, was typed and sent out on a wider distribution, including Coastal Command (3), P.R.U. Heston, War Office (M.I.14(c)), Admiralty (O.I.C.) and various Air
/Ministry

Ministry branches and directorates (A.I. of country concerned, A.I.3 (H.D.), A.I.1(c), Plans and Naval Operations).

- (iii) The third phase or detailed reports, which were also typed and had the same distribution as the preliminary reports, were concerned with specialised detail mainly of a static character.

In practice, during the invasion crisis attention was concentrated on first and second phase interpretation, and from July 8th day and night watches were kept in order to reduce the interval between the taking of photographs and the issue of interpretation reports. In the case of photographs taken from Heston, the airfield was sufficiently close to make it possible, to begin with, for the first, as well as later stages of interpretation, to be undertaken at Wembley. Such was obviously impracticable in the case of photographs taken by the detached flights operating from Wick and St. Eval, and, as a result of discussions held in June between the Assistant Chief of Air Staff (G), Commander-in-Chief, Coastal Command, and the Senior Air Staff Officer, Bomber Command, "it was arranged that an interpretation officer would be made available at distant stations from which reconnaissance were conducted". What in fact happened, owing primarily to the shortage of trained interpreters, was that the responsibility of issuing Forms White devolved on the Station Intelligence Officers at Wick and St. Eval, an arrangement which did not give the best results.

During the first half of September, 1940, when the invasion crisis rose to a climax, the necessity of speeding up interpretation for the Forms White became more urgent, and it was suggested by Coastal Command that time might be saved if three trained interpreters, sufficient to maintain a permanent watch, were sent to Heston. In his reply of September 14th,

/opposing

BC/S.20443/
121A

CC/S.7010/
69A
74A
77B

opposing this suggestion, the Officer Commanding the Photographic Interpretation Unit insisted that the Forms White should "not represent the views of an individual but of an organisation consisting of a number of specialists, backed by a complete library of information, including photographs of previous sorties all properly set out, an Intelligence Section and with scientific instruments available to assist the interpretation" - a piece of 'company prospectus' which entirely begged the main issue, the necessity of issuing Forms White with the bare minimum of delay. Secondly, on the score that it was important for the processing and Form White sections to be located together, he urged that the Heston processing section should be moved to Wembley, yet, as was argued by the W/Cdr. Photos, Coastal Command, since it was quite as vital to keep the processing section as close as possible to the airmen responsible for taking the photographs, this was really only another argument for moving From White interpretation to Heston. Finally, against the reminder that Forms White were already issued from Wick and St.Eval, Hemming urged the defects of these reports as another argument against setting up a Form White section at Heston. In point of fact, the occasional failure of the Forms White from the detached flights was due to the fact that they were issued by Station Intelligence Officers without special training in photographic interpretation, other than coaching by S/Ldr. Heath, late of A.I.1(h) and P.D.U.I., and then of Coastal Command, and was in reality a strong argument for opening up proper interpretation sections at Wick and St.Eval.

It is only too evident that the Officer Commanding the Photographic Interpretation Unit was at bottom actuated by a desire to maintain intact the organisation at

/Wembley.

/74A

Wembley. As Managing Director of the Aircraft Operating Company, it had been Major Hemming's main preoccupation since the Munich 'crisis' of 1938 to preserve his company and nurse it through the coming war, whether in or out of uniform. This desire continued to colour his attitude as Commanding Officer, even though it was inevitable that his organisation must progressively sink its identity in the Royal Air Force. The same day that he wrote opposing the suggestion, the Officer Commanding the Photographic Reconnaissance Unit was instructed by signal to attach three Intelligence Officers to Wembley for training, a single Photographic Interpreter to be supplied to Heston in the meanwhile by the Interpretation Unit. By the end of December trained Photographic Interpreters were stationed at Benson and St. Eval, and early in February, 1941, at Wick.

3. TACTICAL EMPLOYMENT OF P.D.U. AND P.R.U. AIRCRAFT.

The great majority of sorties by Spitfires during this period were flown from a high altitude, between 27,000 and 35,000', averaging around 30,000', or in other words from nearly twice the height commonly flown on reconnaissance by the Blenheims of Bomber Command earlier in the war. This is only what might have been expected, since it was of the essence of the new technique of using unarmed machines for photographic reconnaissance to fly high as well as fast. On the other hand a certain elasticity in respect of altitude was essential, if the limitations imposed by weather were to be kept in check: by flying at lower altitudes and taking advantage of cloud cover it was frequently possible to obtain photographs which could not have been secured from a higher altitude. The device of using Hudsons under conditions when low cloud precluded high altitude photography, already adopted during the spring, was continued throughout the period under review, both from Heston and from the out-stations at Wick and St. Eval: out of a total of 681 sorties undertaken during this period by the unit, 31 or c.4.6% were flown by Hudsons, whose range extended from south-western Norway to the Gironde. Spitfires were also used for low and medium flying, some 10% of the successful sorties by these machines during the period mid-June to October having been flown at low (50 to 10,000 ft.) and 2% at medium (16,000 to 21,000 ft.) altitudes. Almost all the low altitude photographs were taken from an oblique angle.

See Appendix
XXXII

See Appendix
XXXIII

Another departure from the formula of high altitude flying by unarmed machines is provided by the moderately frequent use of armed Spitfires (type G), two of which were included in the establishment of the experimental flight at Heston, for low-flown sorties: although since these were only fitted with extra fuel capacity of 30 gallons their range was

/virtually

virtually restricted to the strip of coast from the Low

P.D.U.
Sortie
HAA/048

Countries to the Cherbourg peninsula. Armed Spitfires had occasionally been employed during the previous period, as on June 14th when the pilot reported encountering an Me.109 between Louviers and St.Aubin: after firing a short burst, he observed the enemy machine disappearing into cloud. On June 29th the same Spitfire (P.9453), in the pilot's own words, "ground strafed a Junkers W.34 at Querqueville aerodrome west of Cherbourg"; the pilot "made three attacks and saw bullets enter the machine", the A.A. fire being "very slow in opening up".

P.D.U.
Sortie
HNA/056
Pilot's
Report

On the whole reconnaissance during this period was favoured by the weather and the operational efficiency of the aircraft was high. As a result of this and of the tactical measures described above, there were comparatively few days on which reconnaissance proved impossible from Heston and St.Eval. In the following table the operational effectiveness of the Unit is expressed in terms of the proportion of days on which reconnaissance was carried out by Spitfires:-

	<u>Days on which sorties were flown</u>	<u>Total days between June 19th and October 31st</u>	<u>Percentage</u>
Heston	123	135	c.92%
		<u>July 1st and October 31st</u>	
St. Eval	97	123	c.80%
Wick	52	123	c.42%

Of the sorties flown a very creditable number yielded photographs, viz. 74% of all the Spitfire sorties and 42% of those flown by Hudson aircraft.

Finally, it should be recorded that losses were kept at an extremely low level, only 7 Spitfires being

/lost

lost as against 650 sorties flown, a rate of only slightly more than 1%; of these one was shot down in flames over Kent by an Me.109 (October 8th), another was lost over Kiel the same day; a third failed to return from Bremen and Hamburg (June 19th); a fourth and fifth were missing on sorties sent to the Ruhr on successive days (August 16th and 17th); and a sixth and seventh, again on two successive days (September 14th and 15th), in attempts to secure low altitude photographs over the Belgian coast. In addition, 2 Hudsons were lost, one each on missions to Cuxhaven (August 27th) and the Scheldt Estuary (October 26th). From this it will be seen that four out of the nine losses were sustained on low altitude missions, which formed only a small fraction of the whole.

4. SOURCES OF AIR PHOTOGRAPHS OTHER THAN P.D.U. AND P.R.U.

The main source of the photographs interpreted at the Photographic Interpretation Unit during this period was the Photographic Development Unit, later the Photographic Reconnaissance Unit, but rather more than an eighth of all reports were based on photographs taken by G.R. squadrons of Coastal Command; only exceptionally did the Unit handle photographs taken by Bomber Command, which retained its own Photographic Interpretation Section at Command Headquarters. As shown in the following table, the proportions remained remarkably constant throughout the period under review, except that in the latter half the proportion from Bomber Command aircraft declined to a lower figure than previously:-

	<u>Bomber</u>	<u>Coastal</u>	<u>PDU-PRU</u>
Mid June-to end of August	3%	13%	84%
September and October	1%	13%	86%

In reality, however, photographs supplied from sources other than the Photographic Development and Reconnaissance Units played an even more significant role, since, whereas the normal photographic reconnaissance often covered several runs over a series of objectives, the photographs submitted by Coastal Command normally comprised only a handful of photographs, often only of a single target. Again, the photographs taken by General Reconnaissance squadrons were normally obliques, often taken from a distance with lenses of small focal length and capable of yielding only very limited information. Furthermore, the system of delivery to the Interpretation Unit appears to have been seriously deficient; photographs were normally at least three days old when they reached Wembley and were sometimes as many weeks out of date. Nevertheless, the Coastal Command photographs filled certain gaps, notably in the north,

/where

where the Photographic Reconnaissance Unit range at this period hardly extended beyond Bergen; during the period under review the General Reconnaissance squadrons supplied ten oblique covers of Trondheim or the Roads, and in mid-October ranged still further north to Namsos. The chief information contributed by Bomber Command photographs concerned airfields, mainly in the Low Countries, but large scale (1/10,000) photographs taken of Antwerp on September 21st were important for giving the first clear view of prototypes of what later came to be known as Siebel Ferries.

5. ENEMY AIR ATTACK ON THE HOME BASES OF THE PHOTOGRAPHIC RECONNAISSANCE AND INTERPRETATION UNITS

It is important to remember that, in addition to meeting with opposition from enemy fighters and anti-aircraft fire while actually in the air, the Photographic Reconnaissance Unit was also attacked on its home bases in the course of the Battle of Britain, itself a preliminary to that very invasion, of which it was the prime function of photographic reconnaissance at this period to unmask the preparations. Equally liable to attack was the Photographic Interpretation Unit at Wembley, situated in a vulnerable zone in the factory area at Wembley on the outskirts of London.

For details
see Appendix
XXXIV

The attacks began shortly after the opening on August 19th of the second phase of the Battle of Britain, when the German Air Force began their systematic assault on inland airfields. St. Eval was attacked on August 21st, 22nd and 23rd, though with little effect on the Reconnaissance Unit beyond damage to the airscrew and wing of a Hudson aircraft. Next came Heston's turn. Light bombs were dropped close to the airfield on August 26th, breaking window glass in the Cranford billets, and on September 12th an anti-aircraft shell passed through the meteorological office and another damaged aircraft in the main hangar, but it was not until later in September that the attacks became serious. These began on the 17th of the month with a stick of bombs across the airfield which caused only slight damage, followed on the 18th by between 50 and 100 incendiaries on the eastern half of the airfield the fires from which were only prevented from spreading over the dry grass to dispersed aircraft by the prompt action with blankets and spades of airmen and Air Raid Precaution workers. More serious was the magnetic mine dropped by parachute late in the evening of the 19th; although no casualties were suffered, the main hangar

Heston
Form 540

/was

was demolished and seventeen aircraft were damaged, including five Spitfires, a Wellington, a Hudson and ten others. Four of the five Spitfires damaged on this occasion were operational, a serious proportion of the limited resources of the Photographic Reconnaissance Unit, but it appears that the machines were not in fact kept out of service for more than a few days.* The Photographic Interpretation Unit was first attacked early in the morning of October 2nd, when a single aircraft dropped two or three oil-bombs, destroying the hut used as a Photographic Interpretation School and killing one of the Station Police. Later in October, on the evening of the 17th, the Unit was again attacked and the premises were so severely damaged that an early move was rendered imperative. During October, also, St. Eval was attacked three times, though with little effect so far as the Unit was concerned, and Heston no less than eight times, in the course of which the Photographic, Photographic Intelligence, Map and Equipment sections were damaged, as well as a Spitfire and a Hudson aircraft, the former severely.

* In a minute addressed to the C.A.S. by D.N.O., Air Ministry, on September 24th it was stated that all four operational Spitfires were estimated to be serviceable again in a week's time. D. of Ops. (N.C.) folder N.59 (A.H.B.IIK/36/5901/31)

6. PREPARATIONS FOR INVASION AS REVEAIED BY PHOTOGRAPHIC RECONNAISSANCE.

The period between the evacuation of France by the Royal Air Force and the end of the Battle of Britain falls into three main phases, so far as photographic reconnaissance of enemy preparations for invasion is concerned. During the first phase (June 18th - August 31st 1940) the photographs gave a largely neutral picture and failed to confirm the reports and rumours of German intentions to invade this country; the intermediate phase, during the first half of September, on the other hand, witnessed the rapid development of a visible threat of invasion by sea at a time when the air struggle was at its height; during the third and last phase the tempo of visible preparations slowed down, until the successful outcome of the Battle of Britain and the advance of winter brought about the postponement of the projected invasion.

(a) Phase 1

Controlling, as they did, the entire sea-board of Europe from the Spanish frontier to northern Norway, and possessing in the Baltic a potential base for the assembly of an invasion fleet, as yet beyond the range of photographic reconnaissance, the Germans were well placed to spring a surprise against this country. Of their many possible bases of operations, suspicion attached first of all to Denmark and Norway. For example, on June 10th the Combined Intelligence Committee cited a report from the Military Attaché at Stockholm to the effect that the Germans were continuing to reinforce Norway on a formidable scale with troopships entering Oslo Fjord at the rate of three a day, and quoted a sighting by Coastal Command of a strong naval force anchored off Trondheim. The Committee expressed the view that there was "a strong indication that a seaborne expedition leaving from Norway may be contemplated...."

C.I.C.
Report No.10

One moral of this and similar reports was that, as the Combined Intelligence Committee had recommended on June 9th, photographic reconnaissance of South Norway and Denmark (specifically Aalborg) was urgently needed.

Sortie
HNN/001

The first photographic reconnaissance sortie to cover part of Norway was that flown by a Hudson from Leuchars on the morning of June 30th, 1940, when oblique photographs were obtained in very hazy weather in the areas of Bergen, Haugesund and Stavanger, none of which were very informative. On July 4th and 6th respectively photographs were obtained of Sogne Fjord by Spitfires flying from Wick, and on the latter date photographic reconnaissance of Bergen was reported to show "no notable concentration of ships in Bergen", nor was there any significant concentration or movement of small craft. Photographs taken by Coastal Command on July 2nd of Aalborg and reported on by the Interpretation Unit on July 6th, showed, it is true, a certain quayside activity and three ships, one of 400' and lacking a funnel, were reckoned to be of suspicious appearance, while further cover of this port obtained by Bomber Command on July 8th showed activity which appeared to be "greater than normal". Again, photographs taken of Stavanger/Forus on July 8th showed that the aerodrome was being constructed "apparently following the layout of the newest type of German aerodrome", and oblique photographs secured by Coastal Command the same day showed naval units, including at least two cruisers, at anchor in Trondheim Roads. Yet, it can hardly be said that reconnaissance photographs confirmed very strikingly the impression produced by the reports of various kinds which reached London in considerable numbers. In their daily report of July 18th the Combined Intelligence Committee admitted that "undue importance may be given to preparations

Sortie
N/1 and 2

Sortie N/3
P.I.U.
Inter Rep.
No.119

I.Rep.
No.109

I.R. No.147
N/4 I.R.122

C.I.C.
Rep.No.49

/in

in Norway due to the increased volume of reports coming from this area".

During the second and third weeks of July the weather caused a longish break in photographic cover of the ports of south-western Norway, but photographs taken during the last ten days of the month confirmed that conditions in the ports were normal. Coastal Command photographs taken on the 21st revealed "no significant grouping of shipping and comparatively little movement" in the port of Bergen and a Photographic Reconnaissance Unit sortie of the 25th showed no apparent change. The shipping seen on photographs of the 23rd at Stavanger and Haugesund showed a reduction in both cases, though constructional activity continued at Stavanger/Forus A/D and some 40 aircraft were seen on the Stavanger/Sola A/D, the runway system of which was complete. Photographs of Christiansand (S) on August 1st showed no significant indications in that port, even the concentrations of floating timber remaining undisturbed. As to these latter it is unfortunate that Forms White teleprinted from Wick on several occasions referred to them as agglomerations of small boats, a type of report to which intelligence circles were at this time peculiarly sensitive. While it was recognised that the timber was a normal feature of Norwegian economic life, the possibility that it might provide raft sections for more sinister purposes was kept in mind; tows of such timbers, presumably imported from Norway, were photographed in the North Sea Canal and in the Merwede Canal, Amsterdam, on August 15th and 26th respectively. On August 6th Oslo was reached for the first time, but Trondheim continued to be beyond the range of the Unit. Oblique photographs taken by Coastal Command on August 22nd and 28th, however, failed to reveal any striking activity in or around the port.

/Meanwhile,

P.I.U.
I.R.No.181

Sortie N/7;
I.R.No.186
Sortie N/6;
I.R.No.182

Sortie N/10

e.g.
I.R.No.293

Sorties
H/99 and
H/124

I.R.Nos.
360, 383

Meanwhile, attention had been directed nearer home to the coasts of the Low Countries and of Northern France.

C.I.C.
Rep.No.23

Commenting on a reconnaissance report of June 21st, the Combined Intelligence Committee remarked that the number of barges observed between Rotterdam and Maasluis and in the estuary of the Scheldt appeared to be in excess of trade requirements and should be considered a threat. A few days later, in summarising the features of barge movements in the Low Countries which appeared not to tally with normal commercial use, the Committee claimed:

C.I.C.
Rep.No.28

- (a) that many of the barges appeared to be moving off their normal peacetime routes;
- (b) that the barges were seen in groups, mainly moving south;
- (c) that they appeared to be moving faster than usual;
- and (d) that some bore German patrol markings, comprising a white strip across the bow on the deck.

The concentration observed at Nicuport was correlated with the salvage of material from Dunkirk. Concentrations of coasters in the neighbourhood of Walcheren and Vlieland were, however, accounted suspicious.

P.I.U.
I.R.106

Yet, on the whole, the photographs received and interpreted at the Interpretation Unit during the period prior to September 1st 1940 lent remarkably little colour to the view that preparations for invasion were far advanced in the ports of the Low Countries. During the latter half of June a careful watch was maintained on barge concentrations and at the end of the month a plan of those at Rotterdam, the largest in the Low Countries, was circulated by the Photographic Interpretation Unit, but no movements of significance were noted. Summarising the position a fortnight later, the Combined Intelligence Committee recalled in their

P.I.U.
Int.Rep.
No.90 of
June 30th

Rep.43.
Annexe B

/report

report of July 12th that "barges in the Dutch and Belgian canals have been under constant air observation and have been bombed, as secondary targets, when opportunity offered", and went on to state that there was "no evidence that barges are being prepared for invasion". This conclusion was strikingly borne out by photographic reconnaissance that same day: a Photographic

Sortie H/13

I.R.No.133

Sortie H/14

I.R.No.136

DET.120

12/7

I.R.No.143

Development Unit sortie flown to examine the mouth of the Scheldt for barge movement brought back photographs which revealed 'negligible' barge and shipping activity; a second sortie by the same unit showed that barge activity between Sluis and Calais was nil or negligible; and photographs secured by Coastal Command revealed no apparent change in the concentration at Bruges. It was also appreciated by the Combined Intelligence Committee that there were in fact several explanations for unusual movements and concentrations of barges, quite unconnected with the invasion of Britain: thus concentrations in the Bruges - Ostend - Calais area might have been due to the fact that large numbers of barges attempting to escape during the German invasion of the Low Countries were overtaken near the Franco-Belgian frontier; again, the general dislocation of transport arrangements due to the overrunning of the country and the break-down of normal trade might well have been expected to have brought about abnormal movements and agglomerations of barges. The general conclusion reached in the report for July 14th was that "the picture of barge movements presented by periodical air reconnaissance of portions of the enormous area covered by the canals is not complete enough in itself to indicate the purposes for which barges are being used".

C.I.C.
Rep.45,
Annexe

During the second week in August there was a noticeable increase in reports of preparations for invasion - for example a report that embarkation practice with small craft was taking

/place

Rep. 71
Annexe A

e.g.
Sortie H/77
P.I.U.
I.R.No. 261

C.I.C.
Rep.No. 78
Annexe B

C.I.C.
Rep.No. 85,
Annexe A

place at Ymuiden and Rotterdam was quoted in the Combined Intelligence Committee Report of August 9th. Although this was not confirmed by photographic reconnaissance, photographs taken that day reveal signs of increased barge activity, for example in the ports between Bruges and Gravelines. Noting the increased activity of the previous week, the Combined Intelligence Committee Report of August 16th ascribed this in part to a resumption of normal trade, suggesting that the German administration might even have turned to barge traffic for civil requirements in order to free road and rail communications for military purposes. In their report of August 23rd the Committee further noted the absence of any shipping concentrations and concluded that "no serious threat of invasion yet exists from Netherlands, France or S.W. Norwegian coasts". The situation remained substantially unaltered so far as photographic reconnaissance was concerned up till the end of the month.

Meanwhile observation of the remainder of the German occupied coast-line within the range of the Reconnaissance Unit, although patiently maintained, revealed little evidence bearing on invasion. This might, indeed, have been anticipated for the Biscay Coast, although it is conceivable that this might have sheltered any expedition prepared for the occupation of Eire or the south-western ports. On the other hand, it was significant that remarkably little of a suspicious nature was seen in the ports of north-western Germany from Emden to Kiel. Numerous fluctuations were noted at Emden as the following table shows:-

/Date

<u>Date</u>	<u>Sortie No.</u>	<u>Remarks</u>
July 14th	H/16	Abnormal assembly of merchant shipping
" 28th	H/42	Barges increased from 50/80 to 180.
Aug. 2nd	H/59	Reduction in merchant shipping
" 5th	H/70	Increase in merchant shipping (total 31 M/Vs); barges reduced to c.100.
" 15th	H/105	Decrease in merchant shipping (total 12 M/Vs)
" 28th	H/132	Increase in merchant shipping (total 29 M/Vs); very great increase in small craft.
" 30th	H/141	Decrease in and some redistribution of small craft.

Such changes as these, if we may judge from later experience, merely reflected the arrival and departure of convoys, marking the normal ebb and flow of trade. Since it was suspected that the invasion armada would in all probability fit out in the Baltic, particular attention was paid to the shipping at Kiel, which at that time lay at extreme range of photography, and to the Kiel Canal. No doubt it was due to the tension existing at this time that so much interest was taken in the small timber units seen off Stickenhorn on the occasion of the first successful sortie over Kiel on April 7th. When on photographs taken on July 15th many of the units were seen to have disappeared, it was presumed that they had been distributed elsewhere and suspected that they were in some way connected with enemy plans for invasion. The suggestion made at this time that the so-called 'Stickenhorn Units' might have been mechanically propelled pontoons for bridging the span between ship and shore was one which, embellished in a variety of ways, was destined to figure in intelligence reports of different categories for some time to come. There can be no doubt that these units which were later found to fill comparatively minor roles as booms and target floats, owed their notoriety to

P.I.U.
I.R.No.146

/their

their appearance at a time when intelligence circles were peculiarly open to suggestion in respect of invasion craft.

(b) Phase 2

C.I.C.
Rep.No.92
Annexe A

C.I.C.
Rep.No.93
Annexe A

At the end of August the Combined Intelligence Committee noted a renewal of the German campaign threatening the invasion of the United Kingdom, timed on this occasion for early September. Since, as the Committee stated in the Annexe to their report on August 31st, the information at its disposal depended "so greatly upon air reconnaissance", it will be convenient at this point to recapitulate the position as it existed on the eve of the invasion crisis:-

- (a) Daily reconnaissance was carried out so far as weather permitted of the coastal area from Texel to Cherbourg and of the exit from the Skaggorak, the former being photographic as well as visual.
- (b) Periodical reconnaissance, as required, was carried out of:-
 - (i) Cherbourg - Brest - Bordeaux area
 - (ii) North-west German ports from Emden to Kiel
 - (iii) Coast of Norway south of Bergen.
- (c) Other areas were for various reasons not covered sufficiently frequently to be satisfactory, viz:
 - (i) Oslo
 - (ii) Coast of Norway north of Bergen
 - (iii) Denmark, including Aalborg,

and (d) Stettin and the Baltic still lay outside the range of the Royal Air Force reconnaissance.

During the phase to be examined in this section the information available is fairly detailed, since the stretch of coast concerned fell within the sphere of daily photographic reconnaissance.

The most striking feature revealed was the south-

/ward

P.R.U.
Sortie
No.H/145
P.I.U.
I.R.
No.377

ward and west-ward movement of barges from Holland to the Channel Ports. Photographs taken on September 1st gave the first decisive indications, disclosing striking movements through the South Beveland and Terneuzen - Ghent Canals; although only the southernmost four miles of the former were photographed some 71 barges were seen, of which every one of the 23 in movement was heading southwards, while at the southern extremity 80 barges were moored in the harbour of Hansweert, others being towed outside; in the fourteen miles of the Terneuzen - Ghent canal covered, an increase of c.200 barges was noted since the middle of August, and of these 50 were moving, all in a southerly direction. The following day only 5 barges were photographed in the northern eight miles of the Terneuzen - Ghent canal, but 95 were seen in its tidal mouth and another 70 in waterways around Terneuzen itself. The South Beveland Canal and the port of Hansweert, on the other hand, showed a notable increase, even on the high level of the previous day, no less than 245 barges being counted. During the course of the next few days the numbers of barges seen in the two canals and their terminal ports declined precipitately as shown by the following table:-

<u>Date</u>	<u>Sortie No:</u>	<u>South Beveland Canal</u>	<u>Terneuzen - Ghent Canal</u>
Sept. 2nd	H/147	245	165.
" 4th	H/151	-	110
" 5th	H/162	40	50
" 6th	H/164	29	23.

Meanwhile there was evidence that some at least of the barges which passed through the canals on the first days of September had begun to accumulate at ports on the Channel Coast. Particularly striking was the build-up at Ostend, as

/shown

P.R.U.
Sortie
No.H/147
P.I.U.
I.R.
No.381

shown in the following table:-

<u>Date</u>	<u>P.R.U. Sortie No.</u>	<u>P.I.U. Report No.</u>	<u>Number of barges</u>
Aug. 28th	H/134	358	0
" 31st	H/143	372	18
Sept. 2nd	H/147	381	70
" 4th	H/151	389	115
" 6th	H/163	402	205
" 7th a.m.	H/167	406	270
7th p.m.	H/168	408	298

Sortie
H/167
I.R. 406

Photographs taken on the morning of the 7th showed clearly enough that the barges were reaching Ostend in tows of 3 - 6 by means of the Bruges - Ostend Canal. It appeared that Ostend was thus the marshalling point for the barges previously seen moving south through the South Beveland and Terneuzen - Ghent Canals. From Ostend the barges passed in convoys down the coast to the Channel Ports.

P.I.U.
I.R. Nos.
393 and
407

Approximately 100 barges were seen on September 4th to have arrived at Flushing since August 31st, a number which had risen to 120/130 by the 7th. During this week, also, convoys of barges were photographed proceeding westwards towards the nearer Channel ports of Dunkirk, Calais or Boulogne, at each of which concentrations began to form.

Sorties
H/151 and
H/155

Thus, on the morning of the 4th some 50 self-propelled barges were photographed off Cap Gris Nez and by the afternoon these were seen to have arrived in the port, where they were again photographed next day. On September 6th "processions of barges and large motor-boats of E-Boat type" were observed "moving south-west in trains of small groups travelling in line astern, to some extent accompanied by large shipping". 31 barges, part of a convoy, were seen

Sortie
H/160
I.R. No. 399

I.R.
No. 402
Sortie
No. H/163

/proceeding

proceeding west in line ahead, approximately $\frac{1}{2}$ mile off Dunkirk, where it was noted that an additional 34 barges had arrived since September 4th; again, at Calais it was noted that 53 barges, the majority between 120 and 180 feet had arrived since the same date.

In the face of these and similar barge movements recorded on photographs obtained by the Photographic Reconnaissance Unit, the Combined Intelligence Committee adopted a watchful, if cautious attitude. While recognising the potential military significance of the trend, the Committee gave full weight to the alternative explanation that the movements were in fact due to the resumption of normal commercial activities; even the apparently abnormal increase at Ostend, they considered, "might be accounted for by the removal of obstructions in the canal system". Again, on the 6th of September, they concluded "there is little evidence other than the movement of small craft towards the Channel Ports to show that preparations for invasion or raids by sea on U.K. are more advanced than they have been for some time". On the other hand, the absence of reconnaissance over the Baltic always made it possible that an expedition was being held in readiness against a successful outcome of the air battles over Britain, and it might be that the assembled barges would be used to handle supplies for the projected invasion rather than actually to take part in that operation. The striking results of photographic reconnaissance that same day, however, led to the Combined Intelligence Committee taking a more serious view in their Report of September 7th. "The movement of large numbers of self-propelled barges and small ships to the westward into Ostend, Dunkirk, Calais, Boulogne and Le Havre" suggested, in the Committee's opinion, "a very early date for invasion, since these barges would not be moored

/unnecessarily

C.I.C.
Rep.No.96

C.I.C.
Rep.No.99
Annexe A

C.I.C.
Rep.No.100

unnecessarily early to positions so exposed to our bombing attack". That night (September 7/8th) it is significant that the main weight of Bomber Command's attack was directed to barges and shipping in the four Channel ports between Ostend and Calais.

On September 8th meteorological conditions were considered suitable, and this, together with the switching two days earlier of the daylight attacks of the German Air Force from inland aerodromes to the London area, reported activities in North German ports, and the movements of barges revealed by Photographic Reconnaissance during the first week of the month, made immediate operations appear likely. The danger was now indeed at its height and the day to day activities on the invasion coast, recorded by the Photographic Reconnaissance Unit and deciphered at the Photographic Interpretation Unit, were followed with anxiety by all responsible for the defence of Britain. It was, indeed, during this tense period that the machinery for gaining intelligence from air photographs received its first real test, and it was the sense of urgency engendered during these weeks that served to inspire the organisation during the long period that was to elapse between the passing of the first crisis of invasion and the resumption of the offensive on a large scale.

The movement of barges and towing-craft continued to be one of the main features of enemy preparations recorded by air-photography. Although some at least of the barges could be seen from their wakes to be self-propelled, they were commonly photographed in groups, each comprising two barges and one towing-vessel, suggesting that tugs were used for their assembly. On September 9th, indeed, "a procession of about 35

e.g.
Sortie H/172
P.I.U.
I.R.No.413

/assorted

Sortie
H/174
P.I.U.
I.R.No.417

Sortie
H/197
P.I.U.
I.R.No.445

Sortie
H/208
P.I.U.
I.R.No.457

Sortie
H/213
P.I.U.
I.R.No.463

assorted tugs, trawlers and small coasters" was observed "eastward bound from Dunkirk to Ostend", and it was suggested at the time that these were possibly intended to tow more barges westwards to the Channel Ports. Again, on the 12th, seven groups, each of 1 tug and 2 barges, and nine groups, each of 1 tug and 1 barge, were photographed heading towards Dunkirk. It was not, however, until the third week in September that any crucial change was observed in the disposition of barges. Photographs taken of the coast between Flushing and Le Havre on the 15th gave clear indication that barges were in course of being distributed from the former port to others on the Channel coast. No photographs were secured of the Channel Ports by Spitfires on the 16th, but a series of obliques of the coast between Cap Gris Nez and Knocke le Zoute taken from a Hudson at approximately 50 feet showed clearly enough that the redistribution of barges was in full progress. On the 17th it was found that the barges at Boulogne had increased to 150 from 102 on the 15th, while at Calais the increase was from 136 on the 13th to 266. The peak was reached on the 18th, when over a thousand barges were counted in the five main ports from Flushing to Boulogne, as follows:-

Flushing	140
Ostend	227
Dunkirk	192 (112 in the port; 80 in waterways)
Calais	255
Boulogne	230
TOTAL	<u>1,004</u>

The extent to which the Germans had modified the barges for the purpose of loading or unloading equipment at this period remains uncertain. On September 8th the Combined

/Intelligence

C.I.C.
Rep.
No. 101

Intelligence Committee quoted a report from the Dutch Naval Attaché to the effect that yards along the Maas were employed in altering bows to facilitate the embarkation of guns and

tanks and that trials with barges so laden were being held.

Owing to the small scale of the great majority of photographs taken at this time it was difficult to obtain visual

confirmation of such reports, but close study of photographs

of a scale of 1/7000, taken on a strike by No. 82 Squadron,

No. 2 Group, Bomber Command, on September 19th, revealed that

at least six of the barges at Dunkirk had gangways 7 feet

wide connecting with the quayside as well as broader ramps

inside the barges themselves. On the whole, however, it

would appear that the Germans relied substantially on the

commercial barges available, modified as little as possible.

A new feature noted during this phase was the

evidence of concerted movement of merchant shipping, accumu-

lations of which were observed taking up stations on either

flank of the barge concentration. Merchant shipping tonnage

in the ports of north-west Germany showed a pronounced

decline; thus, on September 9th it was already deduced from

photographs of Hamburg, obscured though these were by cloud,

that there had been a considerable decrease in shipping since

the 4th of the month, a decrease fully confirmed for Hamburg

by photographs taken on the 11th, which also revealed a

reduction at Bremen from sixty-three merchant vessels on the

4th to a mere seventeen. On the other hand, during this

period convoys of merchant shipping were several times seen

off the Channel coast moving on a westerly or south-westerly

course. Thus, on September 9th, a convoy of seven vessels

was photographed five miles west of Gravelines, moving in the

direction of Calais, and on the following day a convoy of

eight merchant vessels escorted by four motor boats, probably

/E-boats,

P.I.U.
I.R.No.477

Sortie
H/181
P.I.U.
I.R.No.424

Sortie
H/189
P.I.U.
I.R.No.435

Sortie
H/182
P.I.U.
I.R.No.426

Sortie
H/183
P.I.U.
I.R.No.427

Sortie
H/186
P.I.U.
I.R.No.435

Sortie
H/190
P.I.U.
I.R.No.440

Sortie
H/194
P.I.U.
I.R.No.442
Sortie
H/217
P.I.U.
I.R.No.467
Sortie
H/197
P.I.U.
I.R.No.445

P.I.U.
I.R.No.459

P.I.U.
I.R.No.467

E-boats, was photographed rounding Cap Gris Nez. A sortie flown over Flushing on the 11th gave further confirmation of the westward movement of shipping: the pilot reported a concentration of large ships 15 miles west of the port, which at 07.30 hours were stationary, but which ten minutes later were observed moving westwards; the photographs disclosed 14 merchant ships of approximately 5,000 tons each stationary, another 10 of similar size in motion and, in addition, 2 large ships of about 10,000 tons and 10 smaller vessels outside Flushing. Later that day a convoy of 12 merchant vessels, ranging in length from 170 to 470 feet, was photographed in line astern on a south-westerly course five miles south-west of Boulogne and accompanied by 4 probable E-boats. On September 12th it was noted that the merchant vessels at Le Havre had increased from 2 on the previous day to 11, a number which by the 17th had risen to no less than 52. An impressive increase had previously been observed at Antwerp where the number of merchant vessels rose by 28 between August 31st and September 12th and the barges by 220 to reach a total of 625. Another indication of enemy activity was the 400 foot merchant vessel photographed alongside at the Hook by aircraft of No.105 Squadron, Bomber Command, on the 14th and seen to be "loaded with what (were) almost certainly 16 small motorboats on deck". Again the concentration of merchant vessels noted on Le Havre on the 17th was accompanied by the arrival of three torpedo-boats, probably of the Wolf Class, and six motor torpedo-boats, as well as by a doubling of rolling stock.

By the middle of the third week of September, therefore, the position revealed by air-photography on the Channel Coast was that the Germans were ready to strike: over 1,000 barges were concentrated in ports between Flushing and

/Boulogne,

cf. C.I.C.'s
Rep. No. 111

C.I.C.
Rep. No. 112

Boulogne, together with over 600 in the port of Antwerp, while on either flank substantial tonnages of merchant vessels were assembled. It was estimated by the Combined Intelligence Committee in their report of September 19th that between Delfzijl and Brest there were assembled some 240 merchant vessels with a maximum carrying capacity of 400,000 tons together with a potential barge capacity of 500,000 tons.

(c) Phase 3.

Between September 19th and 22nd photographic cover of the Channel Ports was incomplete, but by the 23rd there were signs that the immediate crisis was past, and that although the threat remained the danger was less pressing than it had been. No doubt the main reason for the change in the Germans' plans was their failure to secure air supremacy over southern England, but the break in the weather in the middle of the month must also have had its effect. In their survey of the evidence for invasion preparations between June, 1940, and January, 1941, the Combined Intelligence Committee recalled that "on the 14th September the weather deteriorated and the feeling on the 15th September was that expeditions would be launched as soon as weather conditions were favourable for both sea and air operations". As the season grew more advanced the possibility of favourable conditions for an expedition progressively decreased, while in the skies overhead the Battle of Britain was being pressed to a conclusion which rendered the entire project obsolete at least without a period of elaborate preparation.

The most striking indication of reduced tension was the shifting of naval strength from Cherbourg to Brest: thus, the half dozen destroyers and the single torpedo-boat photographed in the Darse Transatlantique, Cherbourg, on the 18th were all seen to have left the port by the 20th; on the other hand, whereas no destroyers were seen at Brest on the

Sorties
W/74 and
W/77 P.I.U.
I.R. Nos.
473 and
482
C.C. photos
and

/17th,

Sorties
W/83 and
W/88 P.I.U.
I.R. Nos.
489, 498
and 506

17th, two had arrived by the 21st, another three by the 23rd and a sixth and seventh by the 25th. Secondly, the concentration of barges in the Channel Ports between Flushing and Boulogne decreased by nearly one third.

Sortie
H/264
P.I.U.
I.R.No.519

It may be that to some extent the dispersal was undertaken as a measure against bombing. Thus, although only 45 barges remained in the port of Flushing, twice as many were dispersed close by in the Middleburg Canal. On the other hand there is some evidence that barges were being definitely dispersed, presumably to clear the ports and for use elsewhere: for example, barges were actually photographed passing southwards down the Canal from Ostend in the direction of Bruges. What is certain is that in the course of October the number of barges in the five ports declined to a figure well below half of that at the peak period. The salient facts can best be expressed in the form of a table:-

	<u>Sept. 18th</u>	<u>Last week of September</u>	<u>Last week of October</u>
Flushing	140	45	52
Ostend	227	85	55
Dunkirk	192	250	130
Calais	255	134	110
Boulogne	<u>230</u>	<u>177</u>	<u>101</u>
Total	<u>1004</u>	<u>691</u>	<u>448</u>

If by the end of October it had become fairly evident that the immediate threat of invasion was lifted for a season, this was not to say that throughout the period the Germans ceased to make active preparations for a project which remained essential for winning the war. Evidence accumulated, for example, at Boulogne, Ostend and Gravelines, that the Germans were adopting ramps or gangways to ease the loading and unloading of barges. Again, it was noted from successive photographs of Antwerp that they were experimenting with prototypes of what later became known as 'floating-ports' and 'Siebel-ferries', comprising pairs of parallel

e.g.
Sortie
H/297
P.I.U.
I.R.No.563

barges of equal length joined by intermediate decking. The first indication was noted on photographs of large scale (1/10,000) taken by aircraft of Nos. 114 and 139 Squadrons in the course of offensive operations on September 21st, although opinions differed at the time as to the correct interpretation: at Bomber Command it was considered that the device might have intended to mount a winch as an additional means for loading other barges, while the Photographic Interpretation Unit suggested that they "might be used to disembark heavy units from merchant vessels. unable to approach the shore because of low water".

Photographs taken on October 15th, disclosed three pairs of barges in the Bassin du Kattendijk at Antwerp with platforms having superstructures of a type unlike any noticed before, clear indication that experiments with the craft were still being continued.

In addition photographic reconnaissance revealed the extent of German preparations for continuing and intensifying the air war against this country, both in the construction and extension of airfields and of wireless facilities. The degree of enemy activity in these respects grew progressively more evident with the passage of time, as it became possible to compare more and more successive photographs of the same sites. Thus in a report issued on October 1st it was observed that during the previous two months "very considerable constructional activity" had occurred on Dutch airfields, including Valkenburg, Soesterberg, Eindhoven, Gilze-Rijen; in addition constructional activity had at different times been noted on many other Dutch airfields, including Leeuwarden, Schipol and Ypenburg. Enemy airfield activity was also noted along the coastal zone to Brittany on the west and Norway in the north. Further, the positions of many enemy wireless installations

P.I.S.,
B.C.
Rep.No.420

P.I.U.
I.R.No.485

Sortie
H/332
P.I.U.
I.R.No.600

Sorties
H/275,285
P.I.U.
I.R.Nos.
533,549

within the coastal zone were noted, though as yet interpretation of these was not very far developed.

In conclusion it may be recalled that throughout the invasion crisis anxiety had been expressed by the Combined Intelligence Committee lest an expedition might be prepared in the Baltic ports beyond the range of photographic reconnaissance. These fears were alleviated on October 29th when, using the new D type Spitfire, photographs were secured of the ports of Stettin, Swinemunde and Warnemunde, as well as part of Rostock and several of the ports of north-west Germany. The results were in general reassuring. At Stettin the only naval vessels of importance were the target battleship 'Zahringen' and three probable M-class minesweepers, while the merchant shipping was sufficient to indicate a "fairly lively economic activity" but showed "little to suggest preparation for an overseas expedition"; moreover Swinemunde could show nothing more sinister than 21 Stickenhorn units, some ammunition dumps and railway activity.

7. OTHER INFORMATION DERIVED FROM PHOTOGRAPHIC RECONNAISSANCE.

While it is true that during the period when Britain was most closely menaced by invasion, reconnaissance like other war activity was dominated by this overriding circumstance, it is yet permissible to detect motives other than those narrowly concerned with the problem of invasion. Foremost among these was the desire to secure the information needed to keep open our life-lines across the sea. Since enemy ports were a cardinal objective of anti-invasion reconnaissance, cover of naval bases within the existing range of the Photographic Reconnaissance Unit was in general adequate, and the technical difficulties inherent in identifying naval units had already been mastered within the limits imposed by the small scale of the photographs during the period of apprenticeship since the early spring of 1940.

The possibilities of the method, but also its grave deficiencies when range is restricted, can be illustrated by considering what was learnt of the whereabouts of the larger units of the German fleet during this period. Of the battleships, 'Tirpitz' remained throughout under construction at Wilhelmshaven, although she was seen to have changed position more than once; between September 18th and 28th she was observed to have moved from her berth in the Bauhafen to the floating dock in the Scheerhafen and to have returned again to her former position probably by the 10th and certainly by the 21st October. 'Bismarck' on the other hand, which was at a more advanced stage of preparation, was seen to have moved from the Blohm and Voss Yard, Hamburg, to Kiel between September 11th and 23rd; by the 28th she had left the great naval base and was not photographed again during this period, having steamed out of range. Both the battle-cruisers 'Scharnhorst' and

Sorties
H/221,265,
309,344

P.I.U. I.R.
Nos.471,520
574,610

Sorties
H/191,238,
265

P.I.U. I.R.
Nos.438,
488,520

Sortie
H/238
P.I.U. I.R.
No.488

'Gneisenau', which were to occupy the Photographic Reconnaissance Unit so fully in the months to come, remained at Kiel throughout the period, though the former was seen temporarily to have left her usual berth in the South Floating Dock for the Dockyard Wharf, where she was photographed on September 23rd only to return a few days later. On the other hand, only the 'Luetzow' of the pocket-battleships and the 'Seydlitz' of the Hipper class cruisers, fitting out at Kiel and Bremen respectively, were located, while the 'Graf Zeppelin' aircraft carrier was last photographed on July 3rd at Kiel.

e.g.
Sorties
H/92, 95
P.I.U. I.R.
Nos. 283, 291

The value of the small number of army officers attached to the Photographic Interpretation Unit was reflected most obviously in the precision they were able to bring to assessments of shore activity in relation to possible invasion preparations, through the observation of rolling-stock and railway facilities, motor-transport, stores, and dumps. In addition, they were able to lend authority to the interpretation as long range gun emplacements of the widespread activities revealed by photography in the Cap Gris Nez area during the summer.

So far as the war in the air was concerned, the targets provided by photographic reconnaissance at this time were mainly concerned with the enemy's preparations for invasion, notably the concentrations of barges in the Channel ports, with naval preoccupations, such as the presence of major naval units in bases within bombing range, or with aircraft on the airfields used by the Germans in the course of the Battle of Britain. On the other hand, much was learnt about airfield construction in Germany or German-occupied territories, as well as about the disposition of the German air force, which was of general long-term value. In addition, a beginning was made with

the location of hazards to offensive air operations, such as flak and balloons. During this period, also, a number of wireless stations were accurately plotted and a limited amount learnt of their characteristics.

It should be appreciated that at this stage there were several factors which limited the information derived from photographic reconnaissance. The most important of these was the preoccupation with invasion, which virtually limited reconnaissance of enemy territory to a comparatively shallow coastal strip. Another powerful factor was the small scale at which most of the photographs were taken, due to the small focal lengths of lenses in combination with high altitudes, a drawback which was only offset to a limited extent by low-flown sorties. Thirdly, there was the highly important fact that photographic interpretation was still in a comparatively early stage of development and that the number of experts was too small to allow of the specialisation requisite for detailed interpretation, especially at a time when the calls for immediate reports bearing on invasion preparations were so insistent. Some idea of the type of information extracted from photographic reconnaissance at the end of the period can be had from considering the first sortie over Stettin, flown on October 29th. In addition to detailed information concerning shipping at Stettin, Swinemunde, Rostock, Warnemunde, Brunsbüttel, Cuxhaven, Wilhelmshaven, Emden and Delfzijl, the sortie threw the first light on military and other activity in certain of the Baltic ports, yielded the first photographs of four aerodromes and three sea-plane bases in the same area, located six flak batteries, two wireless stations, and two groups of oil installations, and recorded the contemporary state of two sets of balloon defences.

Sortie
H/380
P.L.U. I.R.
Nos. 651,
651(a),
651(b),
651(c),
651(d) and
651(e)

PHOTOGRAPHIC RECONNAISSANCE
BY THE ROYAL AIR FORCE
IN THE WAR OF 1939-1945.

PART IV
FROM NOVEMBER 1st, 1940 to
APRIL 30th, 1941.

1. REORGANISATION.(a) Introductory.

The rapidity with which events moved in the summer of 1940 made it necessary to adapt the machinery available for the provision of photographic reconnaissance without giving it the full consideration which it would normally have received. Yet the onset of the crisis served one useful purpose in that it brought to a head a situation which might otherwise have taken longer to develop. Faced with imminent possibility of invasion, the Air Staff showed no hesitation in confiding the task of securing photographic evidence of enemy preparations to the Photographic Development Unit, which during the previous six months had been nursed from a single experimental Spitfire to an organisation fitted to undertake a task of vital responsibility.

In due course it was inevitable that consideration would have to be given to fit the Reconnaissance Unit for its role, when a greatly expanded air force should take the offensive against Germany on a large scale, a task for which resources were no longer adequate after the requirements of the Combined Intelligence Committee had been met: the preoccupation with anti-invasion reconnaissance meant that the needs of Bomber Command had generally to go unsatisfied. Moreover, there were other pressing requirements, due to the entry of Italy into the war, to anxieties concerning the fate of the French fleet and overseas bases and to doubts on the possible attitude of Russia.

Accordingly, while the Battle of Britain was at its height, the planners were busy devising a scheme for organising a specialised photographic reconnaissance service of sufficient size to meet the requirements of all the services. Briefly, it was proposed to form a Photographic Reconnaissance Group to direct and supervise all photographic activities

/throughout

Proposals
for the
formation of
a Reconnaissance Group prepared by Plans 2
(27/9/40)
Coastal Command
S/7010/26/6/1B

throughout the Royal Air Force, "to advise on all matters affecting photographic operations, training, equipment, maintenance, development and inspection". The proposed Group, which for administrative purposes was to be placed under Coastal Command, was designed to function as a co-ordinating agency. Operations were to be carried out by a number of small specialised Photographic Reconnaissance Units attached to and under the direct operational control of Bomber and Coastal Commands; the only operational units working directly under the Group would be a special strategical reconnaissance and survey flight. Information of immediate operational interest would be extracted from the photographs by small Interpretation Units attached to each of the Reconnaissance Units, but a Central Interpretation Unit, working in close touch with the Intelligence branches of the three Services, would be responsible for such detailed interpretation of the photographs obtained by the Bomber and Coastal Command Units as was required by the Service Ministries, as well as dealing with the intake from the Strategical Flight and acting as general consultant to the units working under Bomber and Coastal Commands. It was claimed for this Group that it would "provide for the first time in Royal Air Force history a form of direction and supervision of all photographic activities". Further, it was represented as likely that "by centralising photographic reconnaissance principally under one organisation, there (would) be enormous savings in expenditure on apparatus and economy in personnel".

When, on October 2nd, 1940, the proposal to form a Photographic Reconnaissance Group came before a meeting at the Air Ministry, presided over by the Vice-Chief of Air Staff, it met with opposition from several quarters and was rejected. The only enthusiastic support for the scheme came, as might have been expected, from Coastal Command, which even suggested

/that the

that the Group should be operational. In this event the Group would itself judge the priority of tasks and allot these to the various flights, which would be administered on a lodger basis. On the other hand the scheme was strongly opposed by Bomber Command, whose representative contended that air-photography was an integral part of the work of his command and that, so far from securing economy, the scheme would lead to overlapping and conflict. Although the Deputy Director of Plans (Military Co-operation) supported the idea of setting up a Strategical Reconnaissance Unit, independent of the Commands, for the purpose of acquiring intelligence, Air Ministry spokesmen as a body were antagonistic to the scheme. The Air Member for Supply and Organisation condemned the proposed Group as a hybrid, cutting "across the whole principle of the organisation of Commands and of the organisation of the Air Ministry": agreeing that the case for Photographic Reconnaissance Flights was made out, he thought that these should be controlled by the Commands, while to meet the need for more specialised photography, he suggested that a Co-ordinating Committee might be formed in the Air Ministry on which personnel, training and equipment should be represented.

The recommendations of the Conference, which in effect determined the lines on which reorganisation in the metropolitan area was carried out during the winter of 1940/1, were as follows:-

- (1) A Central Interpretation Unit was essential, and photographs obtained by Bomber Command, as well as those secured by the Coastal Command reconnaissance units, should be referred to it.
- (2) The short term requirements of Bomber Command should be met by their own Reconnaissance Flights, and Damage Assessment should continue to be undertaken by the Command's own Photographic Interpretation

pretation Section.

- (3) Coastal Command should continue as before with its own reconnaissance duties "and should co-ordinate the special requirements regarding the invasion threat with those of Home Forces and of the Admiralty".
- (4) A Directorate should be established in the Air Ministry to administer photography in its application to reconnaissance.
- (5) A Standing Advisory Co-ordinating Committee should be set up under the new Directorate.

In short, the conception of a Photographic Reconnaissance Group was rejected in favour of operational control by Coastal and Bomber Commands tempered by Air Ministry co-ordination on a technical level.

(b) Photographic Reconnaissance Units (Nos.1,2 and 3)

If, as we have already seen, the events of the Spring and Summer of 1940 enormously enlarged the area of reconnaissance in western and northern Europe, they also had implications only less immediate in more distant areas. The fate of the French fleet and the entry of Italy into the war were two of our main preoccupations over and above the invasion of our own shores, and both involved photographic reconnaissance. The Admiralty, in particular, as intimated in letters dated August 22nd and subsequently, was vitally interested in reconnaissance of the Mediterranean ports of France, Italy and Italian North Africa, as well as of the Dodecanese. In addition it was desired to watch the French West African ports and, at the other extreme, the North Russian port of Murmansk. Unfortunately it proved impossible to meet these requirements, urgent though they were, until the Battle of Britain had been fought and won. In practice it was several months before

/adequate

Admiralty
letter M/N.
I.D. Q2836/
40 S.6136.

11th
Meeting
E.R.P.
Committee

adequate steps could be taken to improve the position even on a reduced scale. For the Mediterranean area it was proposed to strengthen the unit of Glen Martins already stationed at Malta and to establish a No.2 Photographic Reconnaissance Unit based on Egypt. The formation of the latter was approved by the E.R.P. Committee as early as September 13th, but in December, 1940 it was still in process of formation and did not begin operations until 1941. As will be shown, the Mediterranean ports of France were first reached and photographed from Heston.

S/6549

S/6549/12B

/24A

At home the main problem was to arrange for Bomber Command to obtain adequate service. To this end it was decided at a conference presided over by the Vice Chief of the Air Staff on October 2nd 1940, to establish a photographic reconnaissance flight within Bomber Command for the primary purpose of bomb damage assessment. The establishment approved by the Air Member for Supply and Organisation on October 29th provided for six Spitfires,² two Wellingtons, a commanding officer, an intelligence officer, eleven pilots, photographers and appropriate ground crews. Arrangements were made to draw upon the experience of the original Photographic Reconnaissance Unit at Heston, where aircraft were to be modified and aircrews trained for the special work on hand. In order to distinguish it from the original (No.1) Unit and from that sanctioned in the Autumn for the Middle East (No.2), the new organisation was known as No.3 Photographic Reconnaissance Unit.

It should be explained that the Wellington aircraft were those originally allotted to No.1. Photographic Reconnaissance Unit, but later transferred from Coastal to Bomber Command as the one most concerned with the develop-
/ment

/25A ment of night-photography, for which they were intended. When in February, 1941, the question was raised whether the retention of these aircraft and their crews could be justified, it was successfully contended by Bomber Command that they were serving a useful purpose by assisting the development of night photography, likely to prove of direct value to the conduct of night bombing operations.

/10A The daylight reconnaissance was to be undertaken by the specially modified Spitfires flying at high altitudes. Since for the purpose of assessing bomb damage large scale photographs were vital, it was necessary to instal lenses of long focal length. Initially the F.8 cameras were fitted with lenses of 20" focal length, but it was arranged that these should be replaced as soon as possible by Fairchild cameras with lenses of 24" focal length, the minimum needed to secure the smallest scale (1/15,000) required for bomb damage assessment from a height of 30,000 feet.

/20A When in mid-November two German telephoto lenses of 30" focal length became available it was decided to fit one of these to an F.8 camera for use by the Bomber Command Flight.

/15A.
/16A.
17A. No.3 Photographic Reconnaissance Unit was formed at Oakington on November 16th under the administrative and operational control of No.3 Group. Instructions for sorties were passed in the normal manner from Command through Group Headquarters, a list of targets being supplied in the first instance, arranged in order of priority for routine use. Films were processed at Oakington, the negatives and two contact prints being forwarded with a minimum of delay to Command Headquarters. In order to reduce the time between the taking of the photographs and their scrutiny by the Command Photographic Interpretation Section, it was arranged that they should be flown from Oakington to Command Headquarters and dropped at the message dropping point.

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The main function of the No.1 Photographic Reconnaissance Unit continued to be anti-invasion reconnaissance in conformity with the programme of the Combined Intelligence Committee. The establishment of the Unit remained substantially unchanged except for certain modifications as regards aircraft: the two Wellingtons were transferred to No.3 Photographic Development Unit, and Blenheims^{*} were substituted for the Hudsons for low altitude cloud flying, the latter being urgently needed for other purposes. An important development during this period was the change in location. Prevalence of fog during the winter months, lack of runways and above all vulnerability to enemy attack made Heston undesirable for a specialised unit of such great potential importance, and already during September a move had come under discussion. As a result of a meeting at the Air Ministry held on October 2nd, Coastal Command was invited to submit detailed requirements regarding accommodation and early steps were taken to select a new location. It was necessary to choose an airfield favourably placed for operations throughout the year, within easy reach of London and of Coastal Command Headquarters and yet as secure as possible from air attack. After various alternatives had been considered, it was decided to transfer the unit to Benson, where its status was defined as a lodger on the station which remained in the partial occupation of No.12 operational Training Unit. On December 12th the Training Flight was transferred from Heston to Benson to discover any local difficulties, and operations were timed to begin from the new base on December 27th. Detached flights continued to operate from Wick and St. Eval for the northern and

/western

C.C./S.7010
26/6/46A-50A

* The revised establishment dated 30/11/40 allowed for eight Blenheim aircraft (5I.E. 3 I.R.).

western zones of metropolitan reconnaissance.

(c) The Central Interpretation Unit.

The need to keep the two units within easy reach of one another meant that the move of the Reconnaissance Unit from Heston to Benson involved also a move for the Interpretation Unit. Following the bombing in the early hours of October 2nd, the matter of new accommodation was raised at the Air Ministry meeting later in the day, and Coastal Command was invited to submit detailed requirements. The attack on the 17th of the month rendered the main building structurally unsafe and only served to point the urgency of action. In practice the move was not easily accomplished, partly due to the need to secure premises of adequate size within reason of Benson and London, and partly owing to the scramble for buildings at this time by several ministries, civil as well as military. A drastic increase in the projected establishment only served to complicate negotiations in progress. In the event accommodation was secured at Medmenham on the Marlow-Henley Road, but it was not until April, 1st, 1941, that the Central Interpretation Unit, as it had then become, moved into what was to remain its home throughout the war.

For details
see S/6847,
S/6867, S/6970
and CC/S.7010/
26/6/Pt.I.

BC/S.20595/1

Following a conference held at Air Ministry on November 29th, 1940, the Central Interpretation Unit was formed on January 7th, 1941, as a self-contained and self-accounting unit, absorbing the Photographic Interpretation Section at Wembley, which had been administered by the Photographic Reconnaissance Unit, and the Modelling Section at the Royal Aircraft Establishment. For normal administration the unit was placed directly under Headquarters, Coastal Command, but technical control was vested in the hands of the Assistant Chief of Air Staff (G), acting through the Deputy Directorate of Photography. The primary function of

/the Unit

the Unit was to act as a central clearing-house to which air-photographs from all sources should be submitted for interpretation and from which interpretation reports should be issued to the various ministries and service formations concerned. The main source of photographs was of course No.1 Photographic Reconnaissance Unit, but it had been agreed at the Air Ministry conference of October 2nd that photographs taken by reconnaissance units of Bomber Command (i.e. No.3 P.R.U.) should also be referred to the Unit. According to the Organisation Memorandum on the setting up of the Central Interpretation Unit, Bomber Command was to retain responsibility "for the interpretation of photographs taken by No.3 P.R.U.", provided that "such photographs will be forwarded to the C.I.U. within 24 hours for detailed examination for other subjects", the implication being that the Interpretation Section at Bomber Command should confine itself to bomb damage assessment. The sub-division of functions between the Interpretation Section and the Central Interpretation Unit was further defined at a conference held at Bomber Command on January 28th, 1941, when it was agreed that on photographs by No.3 P.R.U. the former should report in detail on all damage, but only in general on major activity to the Central Interpretation Unit; on photographs by No.1 P.R.U., on the other hand, the latter should deal primarily with major activity, making only general statements concerning bomb damage leaving detailed comment under this head to the Bomber Command Section. Probably this was the best compromise which could have been aimed at under the circumstances, although overlaps and consequent scope for friction were bound to remain until Nos. 1 and 3 Photographic Reconnaissance Units were amalgamated in the summer and responsibility for bomb damage assessment was transferred to the Central Interpretation Unit in

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/September, 1941.

September, 1941. Meanwhile, in order to implement the agreement, arrangements were made for the mutual supply of photographs taken by Nos. 1 and 3 Photographic Reconnaissance Units. Immediate or First Phase interpretation continued to be carried out at the points to which the aircraft returned, namely, Benson, St. Eval and Wick.

In addition to the interpretation of photographs and the distribution of reports to interested parties, the function of the Central Unit included the training of the interpreters needed to fill the establishment and to provide a pool, mainly for supplying overseas units. This was discharged partly by providing an initial school for the training of officers specially selected from civil life or recruited from the service, and partly by the practical training of those who had passed an instructional course. The need of providing practical guidance over a period of several months was proved as a matter of experience. This advanced training was not the least of the services rendered by the Central Unit in the years that followed.

The Unit was also entrusted with the task of maintaining a central library of air-photographs from all sources, from which it was expected to meet demands from many quarters. This in turn entailed a large photographic section. The production of accurate plans and charts from air-photographs, aided by the Wild stereograph and its staff, was another important function of the Unit. Closely associated with this was the production of scale models from air-photographs, for which purpose the modelling section of the Royal Aircraft Establishment was transferred from Farnborough.

The initial establishment of the Central Interpretation Unit allowed for a total of 114 individuals of officer status, of whom 104 were allotted to photographic interpretation duties, and 117 of other ranks, making a total of 231,

/excluding

excluding the projected pool of interpreters and attachments from the other services. It was provided that the establishment should be made up of W.A.A.F. in lieu of R.A.F. personnel up to a ratio of approximately one in four: allowance was made for 18 W.A.A.F. officers for interpretation in place of a like number of R.A.F. officers, and for 46 W.A.A.F. other ranks to make up for 41 airmen, an additional W.A.A.F. officer and 17 other ranks being provided for administration. A further point to be noted is that 27 of the officer posts and 64 of the other ranks were allocated to civilian employees of the Aircraft Operating Company. In practice the number of Royal Air Force interpreters available remained for some months far below establishment, pending the training of new recruits; thus on February 4th, 1941, there were only 13 out of an established total of 64. The civilian interpreters together with the full strength of W.A.A.Fs, however, brought the total number of interpreters at this time up to about half the established strength.

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A.C.A.S.(G)
folder 70D/1

The formation of the Central Interpretation Unit raised anew the question of the status of the Aircraft Operating Company and its employees. The fact that the Interpretation Unit was made self-accounting and independent of No.1 Reconnaissance Unit increased the responsibility of the Commanding Officer to a point at which it was desirable that a regular officer should be appointed to command. This involved the removal, or at least supplanting as Commanding Officer, of Wing Commander Hemming, Managing Director of the Aircraft Operating Company, whose commission was honorary. Again, although for the moment the male element in the body of interpreters was predominantly made up by employees of the Company, it was evident that, as training proceeded and the establishment was filled, the

/civilian

civilian element would sink into numerical insignificance. It was further felt by Coastal Command that, for reasons of security and discipline it was undesirable that employees of the Company should be retained in a civilian capacity. In the outcome the decision was taken on the insistence of the Commander-in-Chief, Coastal Command, to replace Wing Commander Henning by a regular officer and to terminate the contract between the Air Ministry and the Aircraft Operating Company. Accordingly the Unit settled in at Medmenham under the new Commanding Officer (Wing Commander Carter O.B.E.). The ending of the contract later in April meant that the honorary commissions held by Wing Commander Henning and two of the former executives of the Company were rendered void. It was also necessary to regularise the position of the rank and file of the civilian staff, who were offered appropriate service ranks. Opportunity was taken in the case of interpreters to eliminate the few who failed to come up to requirements, but it is fair to say that as a body the civilian interpreters formerly employed by the Company more than pulled their weight in the Unit, embodying as they did unique experience of the work.

(d) Air Ministry Control.

The functions and organisation of the Deputy Directorate within the Air Staff, which it had been decided to set up "to direct policy and co-ordinate the activities of the photographic service throughout the Royal Air Force," were discussed at a meeting in the Air Ministry on October 4th, 1940, presided over by the Deputy Chief of Air Staff. It was then determined that the new Deputy Directorate should be termed the Deputy Directorate of Photography and should operate under the Assistant Chief of Air Staff(G). The officer appointed to fill this post was G/C F.C.V. Laws

ACAS(G)
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/10 also CC/S
7010/26/6/13B.

/O.B.E.

O.B.E. (1) whose functions as Deputy Director were defined as:-

- (a) Direction of "photographic policy in the service"
- (b) Co-ordination of the various branches dealing with photography (D.D.Photos; E.5; R.M.7; T. Photos; A.I.D.).
Note: O.R.4 was incorporated in the Deputy Directorate.
- (c) Representation of "Air Staff requirements in specialised aircraft, cameras and photographic equipment for reconnaissance purposes".
- (d) Advice "on the organisation and function" of the projected Central Interpretation Unit, and on "requirements in photographic training both operationally and technically."

It will be noted that the role of the Deputy Directorate was essentially to direct, co-ordinate and advise on a technical photographic level. After considerable discussion the meeting decided explicitly "that the Deputy Directorate should not have a reconnaissance responsibility." This decision followed logically from that taken at the meeting of October 2nd, at which the conception of a unified organisation was rejected. The responsibility for anti-invasion reconnaissance rested squarely on Coastal Command, prompted by the Combined Intelligence Committee, and was discharged by No.1 P.R.U. In conformity with the policy defined on October 2nd, Bomber Command, as we have seen, organised its own reconnaissance unit (No.3 P.R.U.) As for

/other

(1) G/C Laws' experience of air-photography was unrivalled and extended back to the days before the First World War. His record included service in France, a spell as first Commandant of the School of Photography (Nov.1915-Aug.1916), service on the Rhine, a period in the Directorate-General of Supply and Research at Air Ministry (1919-1924), a second and much longer term as Commandant School of Photography (1924-1930), a period in Iraq, and a third spell of the School of Photography (1933), from which he retired from the service with the rank of Wing Commander. After carrying out commercial air survey, he returned to the service and proceeded to France. His experience was fully drawn upon at the Air Ministry Conference held early in 1940, and in March of that year he was posted to the Directorate of Operational Requirements at Air Ministry (O.R.4), where he remained until selected as first Deputy Director of Photography in the late Autumn of 1940, a post in which he continued throughout the war.

other users, the Director of Naval Operations served as a channel of communication through Air Ministry to Coastal Command. In effect, therefore, direct Air Ministry control was confined to the technical sphere assigned to the Deputy Directorate of Photography.

From a technical point of view the system operated well enough and the minutes of the meetings of the standing Advisory Co-ordinating Committee on Photography, ⁽¹⁾ set up under the chairmanship of the Deputy Director of Photography, reveal clearly enough the benefits which accrued. On the other hand, the lack of central co-ordination in the sphere of intelligence was bound to make itself felt so soon as the immediate and overriding pressure of invasion was lightened. Already, at the conclusion of an Air Ministry conference held on November 29th, 1940, under the chairmanship of the Assistant Chief of Air Staff (G) to discuss the re-organisation of the Photographic Intelligence Unit and the formation of a Central Interpretation Unit, two fundamental questions were raised, viz. the manner of the co-ordination of requests for photography and the duplication of effort liable to be involved where two Photographic Reconnaissance Units were operating under separate commands. On the first point the Chairman ruled that the existing system, whereby requests were passed through the Directorate of Naval Operations to Coastal Command should continue, and that in the event of a clash of priorities the matter should be decided by the Deputy Chief of Air Staff, or, if necessary, by the Chiefs of Staff. On the second he stated that the proper solution lay in adequate liaison between the Commands, liaison which was in fact already maintained at Coastal Command by W/C Maxwell.

A.C.A.S. (G)
Folder
70E/1/14.

/Early

(1) e.g. 1st meeting, Dec. 18th, 1940. 2nd meeting, Jan. 22nd, 1941. D.D.Photos. Conference Folder.

A.C.A.S.(G)
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70C/1/47

Early in the new year, however, it was recognised that some machinery would have to be devised to co-ordinate demands for photographic reconnaissance, since it was clear that the demand would always exceed the possibilities of supply. The need for an order of priority in the execution of tasks was obvious and had in practice been exercised by Coastal Command. In a memorandum dated January 27th, 1941, the Assistant Chief of Air Staff expressed the view that priorities ought to be assigned by the interdepartmental intelligence authorities, who, alone, were in a position to assess the relative urgency of demands coming from numerous and diverse quarters. When approached by the Director of Intelligence, Air Ministry, the Joint Intelligence Committee invited the attendance at their bi-weekly meetings of a Staff Officer competent to "advise from the technical and operational point of view" with regard to photographic reconnaissance. It was intended by the Assistant Chief of Air Staff (G) that the officer concerned should be a representative of the Deputy Directorate of Photography. Further, it was seen to be important that demands for photographic reconnaissance should be filtered through an Air Ministry Branch staffed by officers with a knowledge of the technical factors involved, so that the time and effort involved in the attempted execution of impracticable tasks might be saved. At the same time the Director of Intelligence, Air Ministry, set up a small section⁽¹⁾ in his Directorate to analyse demands for photography from the Royal Air Force above Command level, and from outside users, such as the Admiralty and War Office. It was intended that this section should "perform the clerical functions in

/connection

(1) Known as A.I.1(h) and, as from Feb. 1st, 1941, as the Photographic Interpretation Section. The section was abolished on the formation of the Assistant Directorate of Photographic Intelligence, (A.D.I.Ph.), in April, 1941.

connection with the proposed co-ordination and so far as this is concerned (would) be responsible to the officer appointed to advise the Committee."

Meanwhile, discussion was carried to a higher level, when the Vice-Chiefs of Staff at their 55th Meeting on February 14th, 1941, considered a memorandum on photographic reconnaissance from the Joint Intelligence Committee dated February 10th, 1941, which complained among other things of the lack of photographs of the hinterland of the European seaboard, from which indications of enemy invasion plans might be obtained, a deficiency due in their submission to the "many conflicting demands and other claims on our aircraft." One outcome of their deliberations was that the Air Ministry was invited "to consider the amalgamation and centralised control of the various photographic reconnaissance units." The main criticism of the existing organisation was the absence of any central body controlling priorities and the risk of overlapping between No.1 and 3 Photographic Reconnaissance Units. In submitting proposals for the amalgamation and centralised control of the units concerned with photographic reconnaissance, the Assistant Chief of Air Staff (G) detailed the main requirements as :-

- (i) "An organisation at the top for collecting all reconnaissance requirements and passing them on to their units in an order of priority framed suitably as operational instructions for reconnaissance.
- (ii) A Headquarters for controlling all P.R. units and detached flights which will receive these instructions and allocate sorties."

The former would comprise the section already adumbrated, which would settle priorities according to a general directive and issue operational instructions to the Reconnaissance Headquarters. In order to ensure that the utmost intelligence value was obtained close liaison would be maintained

/with

with the Joint and Combined Intelligence Committees. The section would come under the Deputy Chief of Air Staff, upon whom would devolve the responsibility for settling, or referring to higher authority, any clashes that might arise on priorities. The proposed Headquarters was to "translate the instructions issued by the Air Staff Section into co-ordinated sorties, and allocate the tasks" to the photographic reconnaissance units. This organisation involved the loss by Bomber and Coastal Commands of their 'private' Photographic Reconnaissance Units, and it was contemplated that when the Central Interpretation Unit, which was to be controlled by the Photographic Reconnaissance Headquarters, was installed at Marlow, it should incorporate a section to assess bomb damage, an aspect of interpretation which Bomber Command had endeavoured to retain under its own wing.

It was at first contemplated that the organisation should be administered by Bomber Command, but it was intended to render it operationally independent of any command and subject to control by the Air Staff. As the Deputy Chief of Air Staff commented at the time,⁽¹⁾ the effect of these proposals would be to reconcentrate the organisation of Photographic Reconnaissance and so reverse the policy followed since the removal of W/C Cotton. There was, however, one not unimportant difference: whereas previously the organisation had been concentrated in the hands of one unorthodox individual, it was now proposed to control it through a section of the Air Staff in liaison with the

/Joint

A.C.A.S. (G)
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70/K/1.
Minute dated
25/2/41.

(1)....."this takes us full circle. Originally P.R.U. was the "Cotton Club" - and a law unto itself. This was unsatisfactory, so it went to Coastal Command - and was a law unto Coastal Command. Then Bomber Command naturally demanded a better share and got a 2nd P.R.U. of its own. Now the proposal is to concentrate it again. A laborious process to rid ourselves of Cotton. But very probably the only way! "

Joint Intelligence Committee. It was not specifically stated in the proposals, under which Directorate in the Air Ministry the new section was to come, but from the memorandum of January 27th it would appear that it was intended by the Assistant Chief of Air Staff (G) to fall within the control of the Deputy Directorate of Photography. On the other hand it was urged by the Director of Plans that, since the object of photographic reconnaissance was to obtain intelligence, the control of this activity ought rather to fall to the Director of Intelligence. This was, indeed, a crucial point. It was vital that the aim of photographic reconnaissance should be kept clearly in view. The provision of technical means was well met under existing arrangements, but this was no argument for assigning to the Deputy Directorate of Photography the quite distinct task of ensuring that the aim of photographic reconnaissance was adequately realised: the one task was technical, the other of a strictly intelligence order.

Minute to
V.C.A.S.
27/2/41.

A.C.A.S. (G)
Folder 70K/1

The key decision was taken at a meeting between the Vice and Deputy Chiefs of Air Staff and the Assistant Chief of Air Staff (G) on March 1st, when "it was agreed that the control of the four P.R. Units at Benson, Wick, St. Eval and Oakington, together with the C.I.U., ~~should~~ be centralised in the Air Ministry under A.C.A.S. (I)". In effect, therefore, the views of the Director of Plans prevailed, and the Assistant Directorate of Intelligence (Photographic) was established under the Assistant Chief of Air Staff (I) to co-ordinate the work of photographic reconnaissance and interpretation and to control the priorities of requests made by the various commands and defence departments. The first Assistant Director was G/C P.G. Stewart. (1)

/Lt. Col.

(1) W/C P.G. Stewart had previously been in charge of the Air Ministry War Room.

S.70556.

Minute of
V.C.A.S.
Mar. 20th '41.
A.C.A.S. (G)
Folder 7OK/1

Lt. Col. T.B.L. Churchill, M.C., mentioned previously in this Narrative as instructor in photographic interpretation at the School of Photography in the days of tension in the Mediterranean, was appointed A.S.O.I. The role of Deputy Director of Photography (G/C F.C.V.Laws) was specifically defined as that of technical advisor to the new Assistant Directorate.

The amalgamation of Nos. 1 and 3 Photographic Reconnaissance Units was not, however, achieved so easily and did not in fact take effect until June 16th, 1941. When the amalgamation did occur, moreover, the combined unit was not placed under the operational control of the Assistant Chief of Air Staff (I) or the administrative control of Bomber Command; instead it was "placed under the operational and administrative control of Headquarters, Coastal Command". The position outlined in the Air Council letter communicating this to Coastal Command was that requests for photographic intelligence from Bomber and Fighter Commands should be made direct to Headquarters, Coastal Command, with the proviso that the Assistant Director of Intelligence (Photographic) should be kept informed of the general programme. Requests from other quarters, apart from the Admiralty, which also had direct access to Coastal Command on a similar understanding, were to be passed through the Assistant Director of Intelligence, on whom rested responsibility for co-ordinating requests as a whole, except "in a case of extreme urgency". The Assistant Director was also responsible for "ensuring that the information obtained is passed as rapidly as possible from the Central Interpretation Unit to the department concerned." In this latter connection he was made the sole channel of supply for copies of reconnaissance photographs. Finally, it was again made clear that "matters of general policy affecting the Photographic Reconnaissance Units" would be handled by

/the Assistant

the Assistant Chief of Air Staff(I). The Deputy Director of Photography was restricted to:

- (a) "Questions of requirements in specialised aircraft, cameras and photographic equipment for reconnaissance purposes" and,
- (b) "the co-ordination and direction of Royal Air Force photographic policy from the technical aspect"

for all of which he was responsible to the Director of Operational Requirements.

B. Operations

(a) Introductory.

During the six months under review photographic reconnaissance continued to be directed to defensive purposes. Despite the lessening of tension which followed the victorious outcome of the Battle of Britain, and the influence of the winter season, a good proportion of the sorties flown during the period as a whole were to obtain intelligence for the Combined Intelligence Committee on the progress of enemy preparations for invasion. One consequence of the dimming of their prospects for an immediate invasion was, however, that the Germans decided to concentrate on the war at sea, hoping by this means to sever the life lines without which we could not for long have continued the war. To this end they decided to employ major naval units as commerce raiders, as well as to develop air attack on home ports and air reconnaissance of shipping routes, and to lay down a large programme of U boats for future use. It was essential to obtain as much information as possible about such activities and preparations, not only for future plans, but also, and especially in the case of surface commerce raiders, for immediate operational purposes. In the present section some indication will be given of how photographic reconnaissance helped to provide this information so vital to our survival.

/(b)

(b) 'Scharnhorst' and 'Gneisenau'

Two ships on which the Germans placed great hopes were the so-called 'battle-cruisers' 'Scharnhorst' and 'Gneisenau', specifically designed to pursue and destroy merchant shipping and any small naval vessels with which they might come into contact in the course of their piracy. The two units kept in close company from the time they were photographed in the floating docks at Kiel on October 15th and 21st, 1940, down to their passage of the Straits of Dover on the unhappy February 12th, 1942. Although still present in the floating docks at Kiel on December 21st, 1940, they were no longer to be seen on January 9th, 1941, when the port was completely photographed apart from Wik and Holtenau. A clue to their whereabouts was given by a sighting on December 29th, of two big ships, escorted by destroyers and aircraft, on a northern course between Kristiansand (S) and Skagen. Although reported as 8" cruisers of the 'Hipper' class, photographic evidence of the dispositions of two out of the three vessels of this class showed this to be incorrect: 'Seydlitz' was still fitting out at Bremen and a second was photographed at Brest on January 2nd, 1941, after having been engaged by Berwick and Bonaventure some 700 miles west of Cape Finisterre on Christmas Day, 1940. Almost certainly the sighting referred to 'Scharnhorst' and 'Gneisenau'. An excellent source (Admiralty grading A.2) reported two large ships, believed to be the battle-cruisers, as having passed through the Great Belt northward bound on January 23rd. Another source (B.2) reported that both 'Scharnhorst' and 'Gneisenau' had left Oslo Fjord during the first week in February and had neither returned, nor passed southward through the Belts up to February 20th.

In fact the pair had broken out into the North Atlantic.

/ On March

On March 8th they were reported by H.M.S. "Malaya" north-east of Cape Verde Islands at $21^{\circ} 37' \text{ N. } 20^{\circ} 20' \text{ W.}$ steaming at 20 knots on a course 245° . On March 15th and 16th they are known to have been operating south-east of Newfoundland. On the 20th they were sighted by aircraft from H.M.S. "Ark Royal" about 550 miles W.N.W. of Cape Finisterre at $46^{\circ} 50' \text{ N. } 21^{\circ} 25' \text{ W.}$ Next day they were sighted by Coastal Command aircraft nearer home, steering east at 20 knots approximately 125 miles W.S.W. of Brest at $47^{\circ} 17' \text{ N. } 7^{\circ} 13' \text{ W.}$ Photographic reconnaissance of the Atlantic ports of France was impracticable on March 22nd owing to the weather. Photographs taken on the 23rd showed that neither ship was present at St. Nazaire, Lorient, La Pallice, Le Verdon, Royan, or Pauillac. On March 28th both were photographed at Brest, 'Gneisenau' in Dry Dock No.9 and 'Scharnhorst' alongside the Torpedo Boat Station. Here, apart from a brief excursion to La Pallice by 'Scharnhorst' between July 21st or 22nd and 26th, they remained for nearly a year, watched intently by the Royal Air Force. During the period March 28th - April 30th, Brest formed the objective of more than one third of all sorties flown by No. 1 Photographic Reconnaissance Unit, namely of 87 sorties out of a total of 233. Only one day during this period was allowed to pass without the attempt being made, although during periods of indifferent weather the proportion of sorties even partially successful was low: for example during the second week of April only 3 out of 15 attempts yielded any photographs, and for the last week of the month only 6 out of 27.

(c) U-boat Construction

In the months and years to come the accurate forecasting and assessment of German U-boat construction was to be one of the most outstanding services rendered to naval

/intelligence

intelligence by photographic reconnaissance. It was not, however, until near the end of the period under review that sufficient photographic cover of the main German building-yards became available of a definition and scale sufficient to permit of detailed study of the methods employed in U-boat construction. Moreover, if the methods, and above all the rate of production, were to be accurately calculated, it was necessary to have not one but a succession of covers of the individual yards, taken if possible at more or less equal intervals. Not until March, 1941, were photographs available in sufficient numbers and of sufficient quality to make feasible a reliable estimate of the state of U-boat building. Above all it was the large scale photographs of Kiel taken on March 12th and 13th, 1941, that made a definite interpretation possible. Once the appearance of U-boats under construction had been verified at one port, it was a comparatively simple matter to interpret photographs of building-yards in other ports, even if of smaller scale or inferior quality.

C.I.U.
Report
Nos. RD.39
(21/3/41)
& A.40.
(25/9/41)

The difficulty lay in the methods used in building the U-boats. The first step was to lay down keel plates, when the work resembled the initial stage in the construction of an M-class minesweeper. Next, a staging or cradle, apparently covered as a rule by regularly-spaced cross-planks, easily moved to enable cranes to work at any particular point, was erected over the hull. The cradle was started before the hull was completed and lengthened as it grew. When the inner hull was complete the cradle extended beyond bow and stern. The effect of the cradle was to screen the U-boat hull and make it difficult at most periods to detect, particularly on small scale or indifferent photographs. Nor did the U-boat come into the light of day when launched from the slips, though immediately prior

/to this

to this they were sometimes exposed for a short time in the open. While fitting out, U-boats launched from open slips were concealed by another cradle made at a lower level so that the conning-tower protruded. Whether the cradles were intended deliberately as a method of concealing U-boat construction is perhaps a matter for argument, but that this was the case was definitely the opinion formed by photographic interpreters. In any event it added greatly to the problems of interpretation in the initial stages, although, on the other hand, once recognised for what it was, the cradle, as an easily recognisable feature, actually assisted the accurate counting of U-boats under construction. It may be significant that at the Blohm and Voss yard at Hamburg, which were covered by overhead gantries, no building cradles were fitted. Moreover, at certain yards, where the U-boats were covered by screens built out from the quay-side, no cradles were provided for the fitting-out period. This argues that the cradles really were intended as a species of camouflage and reflected the anxiety of the enemy to conceal the scale of his projected U-boat attack. That he was deprived of springing a surprise in the battle of the Atlantic was due to the vigilance of the Royal Air Force.

The first detailed report on ship-building in German yards, based on air-photographs, was issued in March, 1941. It revealed comparatively slight activity in the construction of surface warships or merchant shipping, but a "vast drive in submarine construction which began in the latter half of 1940". In point of fact it gave the first precise indication of the character of the initial programme of U-boat construction, which was still in a comparatively early stage of development. Since the area photographed extended no further east than Stettin, the early reports could not be assumed to give a complete picture. This

/only

P.R.U.
Sortie
H/816
(8/4/41)

P.R.U.
Report No.
R.D.57
(9/4/41)

This only made more impressive the number of U-boats seen under construction up to mid-March, no less than 118, including a dozen fitting-out. Particularly clear photographs of Hamburg, taken three weeks later, made it possible to detect a number more hulls under construction at the Blohm and Voss yard, Hamburg, and this, combined with the laying down of extra hulls, brought the figure up to 144. By September, 1941, the total had risen to 211, of which 53 were fitting-out, even though the yards at Danzig were still beyond reach.

One result of unveiling the stages in the life history of U-boats from keel-laying to launching was that it was possible to observe with some accuracy the time taken in their construction. Already in the first report it had been possible to estimate the period of building at eight months, through analysing the position on the ships at Bremen revealed by photographs taken on eight occasions at approximately monthly intervals between August, 1940, and March, 1941. Once the number of U-boats under construction and the time needed for the construction of each had been established, it was possible to forecast with some certainty the probable number of launchings for seven months or so ahead. It only remained to establish the period needed for fitting-out to assess accurately the monthly reinforcement of the U-boat fleet. This in turn enabled the Naval and Air Staffs to plan ahead and make arrangements to combat the menace commensurate with its scale at any particular time. Detailed examination of photographs also made it possible to distinguish various types of U-boat. This in turn meant that any change of emphasis in the building programme, with its implications for future operational policy, could early be detected. In identifying the various types close liaison was maintained with the Naval

Intelligence Division, which ensured that technical knowledge as well as other sources of secret information were brought to bear on the problem.

The first group of U-boats seen under construction were a batch of ten small trainers of 250 tons visible at the Deutsche Werke, Kiel, when the port was first photographed in April, 1940, all of which had been launched by December of that year. By June 29th the first 500 ton operational U-boats were laid down, a type which formed approximately three quarters of the German production up till September, 1941. Rather larger U-boats (740/750 tons) formed approximately a fifth of the total number completed. During the same period only one of the 1000/1200 tons type was produced, although by September, 1941, twelve were seen on the slips of the Deschunag Yard, Bremen.

(d) Focke-Wolf Condors

The contribution of air photography to intelligence concerning the German effort in the air continued to comprise in the main the identification of aircraft on airfields in the coastal belt from the Franco-Spanish frontier to Norway, together with observation of the state of preparedness of the airfields themselves. An instance, which may be singled out, was the identification of Focke-Wolf Condors on Marignac Airfield on photographs taken on December, 10th, 1940.

(e) Wireless

During the period under review a new field of research bearing on the air war was opened up by photographs taken on 22nd November, 1940, which disclosed two very small circular objects (0.4 mm on photo), the nature of which was somewhat puzzling. Whilst they bore some similarity in size and shape to light flak, their relative nearness to each other and lack of the usual track activity ruled out this

/solution.

P.R.U.
Sortie
W/225

P.R.U.
Sortie
H/548
No.402.

See also
ACAS(G)
Folder 70M/1

1 battleship of the 'Dunkerque' class,
presumably the 'Strasbourg'
2 obsolete battleships: 'L'Ocean'
and 'Condorcet'
1 aviation transport: 'Commandant Teste'

3 8-inch and 3 6-inch cruisers

21 Contre-torpilleurs

10 destroyers.

and 22 submarines.

In this way the Admiralty was provided with a valuable check on the naval units present at the principal naval base on the Mediterranean coast of France. In addition detailed interpretations were made concerning boom defences, battery positions, seaplane bases and oil-storage and refinery installations.

Other new areas of importance were covered from Wick, including Oslo on December 9th, and Trondheim on December 7th and again on the 21st of the month.

No.P.9552.

When at length, after a delay of many months, the first routine D-type photographic Spitfire, carrying 145 extra gallons of petrol, became available, it was put to early use. Its initial operational sortie flown on April 5th, 1941, was aimed at the ports from Den Helder to Kiel, but owing to adverse weather conditions only localities in Northern Holland were photographed. A more ambitious sortie to Stettin, Swinemunde and Politz on April 8th was, however, successful and on the 10th Copenhagen and Malmo were photographed for the first time. On April 14th Sergt. W. Morgan, who had flown the machine on its initial operational trip, made a record sortie for a Spitfire of 7 hours 10 mins, during which he secured photographs of Genoa and Spezzia. Sergt. Morgan, who was decorated with the D.F.M. for his feat, was compelled to land on his return flight in a field near Hawkinge, Kent, with only 2 gallons of petrol left in his tanks. On April 22nd another

/notable

notable flight was made to the Franco-Spanish frontier and on the 26th the range of photographic reconnaissance was extended in the north by F/O Leavitt flying the same machine from Wick as far afield as Namsos.

In the course of the six months' period some 842 sorties were flown, for all but 14 of which Spitfires were used. The decision to replace Hudsons by Blenheims for low cloud sorties had been taken in the previous period, but four sorties, all unsuccessful, were flown by Hudson aircraft during November. The last Hudson sortie, and the only one of the month, was flown from St. Eval on December 11th, when photographs were obtained of Bordeaux. The first Blenheim flown by the Photographic Reconnaissance Unit on operations secured photographs of the estuary of the river Trieux on February 1st, 1941, and the second brought back photographs of Bordeaux, La Pallice and the river Gironde to the same station on March 26th. In April seven sorties were flown by Blenheims, three from Wick and four from Benson, six of which yielded photographs of shipping or coastal areas. With these insignificant exceptions, however, sorties were flown by the various types of Spitfire; the armed G-type was used for objectives within a limited range, of which particularly large scale or low flown oblique photographs were needed, and the types C, F and D for high altitude sorties of progressively longer range.

The overall picture of operational activity is most easily conveyed in the form of a table:

P.R.U. Operations: November 1940 - April 1941.

	<u>Sorties</u>	<u>Sorties on which photographs obtained</u>	<u>Losses</u>
Nov. 1940	138 (4 Hudson)	77 (56%)	1
Dec.	98 (1 Hudson)	67 (68%)	1
Jan. 1941	93	71 (76%)	2
Feb.	134 (1 Blenheim)	82 (61%)	2
March	164 (1 Blenheim)	97 (59%)	1
April	215 (7 Blenheim)	143 (66.5%)	3

/Totals

271.

Totals	842 (including 5 Hudson and 9 Blenheim sorties)	537 (av. 64%)	10 (av. 1.2%)
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It will be noted that approximately two-thirds of the total number of sorties flown yielded photographs, while the loss rate was little more than one per cent.

APPENDICES AND MAPS

APPENDIX I

THE NILE SURVEY, 1920-1922

The aerial photographic surveys of the river Nile carried out by aircraft of the Middle East Command at the request of the Egyptian government during the years 1920-2 provided valuable training at no cost to the country, the entire expense being met by the Egyptians. The objects of the survey were admirably set out in the Report on the 3rd Nile Aerial Photographic Survey rendered by the A.O.C. Middle East Area:

A.M. File
No. 107192/13A

"This aerial survey is undertaken at the request of the Egyptian Government, who bears the whole cost thereof, and is carried out annually in the spring, when the Nile is at its lowest stage. It was also repeated in the autumn of last year, for comparative purposes, during the highest stage of the river.

The main object of the survey is to provide the Irrigation Department of the Public Works Ministry with hydrological records of the behaviour of the Nile with respect to the ever-changing sand banks, the erosion of the river banks, and the effect of the annual flood on the protection works.

The comparison of each annual survey thus enables the Irrigation Department to take the protective measures necessary to ensure that the irrigation of the country, on which the prosperity of Egypt depends, and which is effected wholly by correct regulation of the river barrages and the canal offtakes, is carried out efficiently, speedily, and economically.

X X X X X

Another object of the survey is to provide the Antiquities Department with aerial photographs of areas in which excavation work is in progress or contemplated, and as these areas are always in close proximity to the river, this photography incurs very little additional expense. On aerial photographs, the outlines of ancient walls, canals and embankments, now covered by the sands of centuries, can be traced, whereas from ground inspection no trace thereof is visible....."

Surveys were made of the 618 mile stretch from Aswan to the Delta Barrage in the autumn of 1920 (September 2nd to October 5th) when the Nile was at its highest level, the spring of 1921 at its lowest level and again in the autumn of 1921 at "High Nile". The spring survey of 1922 was extended to the sea so as to cover both the Rosetta and Damietta Branches, a total of 850 miles. On this occasion, the 3rd Nile Aerial Photographic Survey, the task was divided into two parts, a North Survey from the Delta Barrage to the sea, carried out in the normal course of work by No. 208 Squadron (Bristol Fighters) from its base at Ismailia, and a South Survey by No. 47 Squadron (D.H.9s) using as bases Luxor (Aswan to Sohag), Assuit (Sohag to Minia) and Helwan (Minia to Delta Barrage). The surveys were made with 6" F.L. lenses from a height of 14,000 ft., giving a scale of 1/28,000. The cost of the 3rd Nile Survey to the Egyptian Government was £1583/13/5. It is interesting to note that the officer in charge of the South Survey was F/O Bussey, Technical Photographic

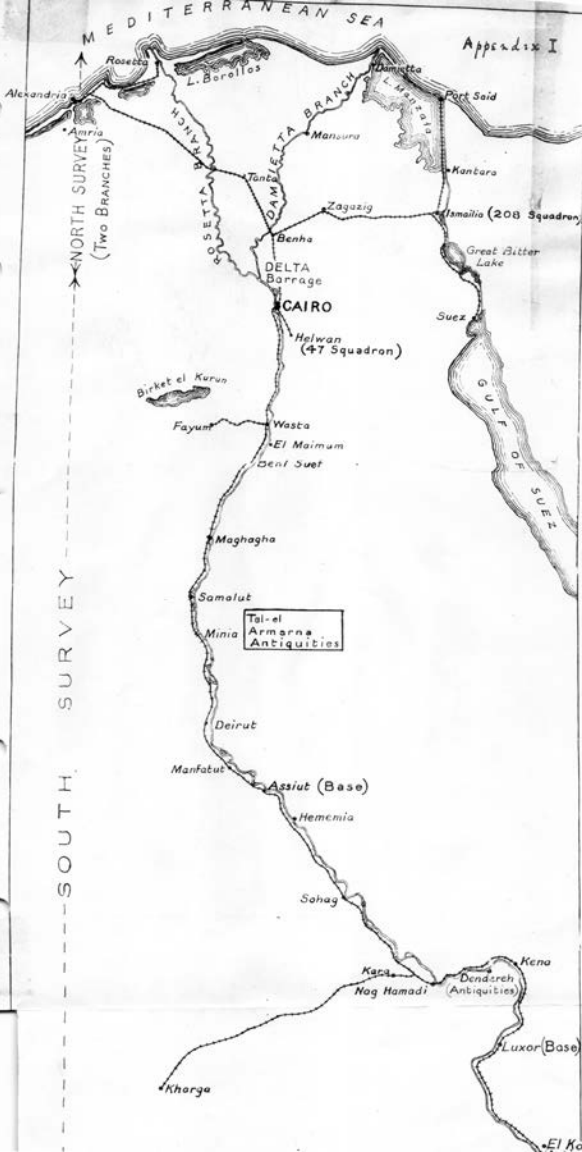
/Officer,

Officer, No.4 F.T.S., who early in 1940 was co-ordinating Air Ministry photographic control as Wing-Commander Photography in the Directorate of Operational Research.

From a training point of view a number of important lessons were learnt from these flights, quite apart from the impetus given to service photography generally. The fact that the task had to be carried through with definite time periods added to the operational value of the training.

The main lessons were as follows:-

- (a) Flying
 - (i) The alertness of the pilot was tested by the bends in the river which made it a matter of difficulty to make sure of obtaining complete cover. This difficulty was enhanced at times by strong side winds.
 - (ii) From a purely survey point of view it brought into the limelight the question of tilt and its possible elimination.
- (b) Technical
 - (i) Experience was gained in the effects of temperature on the development of plates.
 - (ii) Camera jams caused by cracked plates led to the devising of special rubber sponge-lined cases for the transport of loaded plate magazines over rough country.
 - (iii) Entry of sand grains into the camera caused many double exposures. This led to the prosecution of much research and the adoption of special precautions and care in maintenance. Thus experiments were put in hand to perfect a system of ventilation whereby sand could be eliminated from the fuselage. During the ascent the camera was covered by a sand-proof bag and it was recommended that the flex drive and the propeller ball-races should be syringed out and re-oiled for each flight.



APPENDIX II

ROYAL AIR FORCE SCHOOL OF PHOTOGRAPHY, FARNBOROUGH

A. List of Commandants:

Nov. 1915 - Aug. 1916	2nd Lieut. F.C.V. Laws
Aug. 1916 - Nov. 1917	Lieut. C. Porri
Nov. 1917 - Nov. 1920	Major P.R. Burchall
Nov. 1920 - Aug. 1922	S/L. A.R. Cooper
Aug. 1922 - Nov. 1924	S/L. W.J.Y. Guilfoyle O.B.E., M.C.
Nov. 1924 - Oct. 1930	S/L. F.C.V. Laws O.B.E. (W/C* 31.12.26)
Oct. 1930 - Feb. 1932	W/C. A.H.S. Steele-Perkins O.B.E.
Feb. 1932 - July 1932	W/C. H.M. Probyn D.S.O.
July 1932 - Jan. 1933	W/C. R.H.G. Neville O.B.E., M.C.
Jan. 1933 - Oct. 1933	W/C. F.C.V. Laws O.B.E.
Oct. 1933 - Aug. 1934	W/C. G.H. Bowman D.S.O., M.C., D.F.C.
Aug. 1934 - Apr. 1936	W/C. M.L. Taylor A.F.C.
Apr. 1936 - Oct. 1938	W/C. C. Porri
Oct. 1938 - Feb. 1939	S/L. J. Silvester, (W/C. 1.1.39)
Feb. 1939 - July 1940	S/L. R.C. Sturgiss
July 1940 - Dec. 1940	W/C. H.G. Wheeler
Dec. 1940 - July 1941	W/C. J.B. Barrett
July 1941 - Nov. 1941	W/C. J.B. Newman
Nov. 1941 - 19	W/C. A.E. Taylor
194	W/C. P.R. Burchall

* Up-graded in April, 1926.

B. Summary of courses held at the School of Photography up to 1938.

(i) Airmen's course.

The basic function of the school was the training of airmen to man unit photographic sections. This training was continuous from the war of 1914-18. A flight of aircraft* was maintained to expose film for processing by this and other courses.

(ii) Boys' course.

In order to keep pace with the expansion of the Royal Air Force training was instituted for boy entrants, the first batch (twenty) of whom arrived in September, 1934. With effect from April 1st, 1936 numbers rose, under expansion scheme 'C' to sixty-four: by the end of January, 1937, eighty-one boys were under training and by 1938 one hundred and three.

(iii) Short course for officers

Designed for officers who wished, while continuing primarily as flying officers, to possess "a working knowledge of one or more technical /subjects".

* Up till April 1st 1934, when it was transferred to R.A.F. Station, Farnborough, this formed a flight of No. 4 Army Co-operation Squadron.

subjects". The course was instituted in 1924 in conformity with the recommendation in the Trenchard Memorandum that after five years' service officers would be required to specialise. It lasted three months and was attended by an average of approximately five Royal Air Force officers, with, in addition, a few naval and foreign officers. Officers who passed the course might opt to take the Long Course or alternatively return to their squadrons and supervise their photographic sections in addition to routine flying duties. The course was discontinued, after 24 sessions, in 1932 in accordance with a change of policy in relation to the duties and training of General Duties Officers as a class, according to which it was decided to concentrate attention on flying duties instead of "attempting to combine in the same individual a knowledge of flying duties and of those minor technical duties taught in the short armament, signals and photographic courses".

A.M.W.O.
676/1930

(iv) Warrant Officers' and Senior N.C.Os' course.

In accordance with the new policy it was decided to train warrant officers, flight sergeants and sergeants of the trade of photographer as squadron 'photographic instructors' in place of officers. The first session of the new course, which, since the personnel concerned had already passed through the airman's course, lasted only four weeks, began in May, 1932.

A.M.O.
A.116/1931
A.M.O.
A.93/1932

(v) Naval Officers' course

Abolition of the short course for officers entailed separate provision for naval officers. The courses, which were of nine weeks' duration and were primarily designed to fit observer officers to take charge of fleet air arm photographic sections on aircraft carriers, began in September 1932.

(vi) Long Officers' course

The Long Course, of nine months' duration, intended for those who in the words of the Trenchard Memorandum "wish to become really expert in a particular branch", was recruited from graduates of the Short Course and was designed to train officers to fill specialist photographic posts. The first course began in August 1924 and by 1929 had settled down into an annual event starting in January of each year; the last course finished in time for the outbreak of war. The attendance, approximately three Royal Air Force officers a year, was more than sufficient to fill the posts available, but this was only in accordance with the policy that periods of specialist should be alternated with periods of general employment. The extra strength of trained specialists involved in this policy was to prove its value when the time came for rapid expansion. It should be stressed that the course was severely

A.M.O.
A.426/1928

technical, and it is significant that in so far as the application of photography was considered this lay exclusively in the fields of survey and Army Co-operation.

(viii) Courses for Army officers in the military uses of Air-photography.

The only course concerned with the ultimate use of photographs for providing intelligence was given by army lecturers attached to the School to classes of army officers. Since 1924 eight courses were held annually.

C. Courses of Instruction in Photographic Interpretation for R.A.F. Intelligence Officers, 1938-39 (S.O.P. Form 540):

(1) Senior Intelligence Officers, Bomber Command:

<u>Dates</u>	<u>Name</u>	<u>Unit</u>
24.1.38 - 5.2.38	S/L. J.W. Colquhoun	H.Q. Bomber Command
	S/L. F.S. Hodder	H.Q. No. 1 Bomber Group
	S/L. L. Dalton-Morris	H.Q. No. 2 Bomber Group
	S/L. M.P. Ommanney	H.Q. No. 4 Bomber Group

(2) Station Intelligence Officers:

<u>Dates</u>	<u>Personnel</u>
June 1938	1 regular R.A.F. officer and 8 'retired officers'
Sept. 1938	1 regular R.A.F. officer and 16 'retired officers'
Jan. 1939	2 squadron-leaders R.A.F. 4 retired colonels Indian Army and 1 flight-lieutenant R.A.F.O.
Jan-Feb. 1939	3 squadron-leaders R.A.F., 4 'retired officers', and 3 'serving army officers'
Mar. 1939	8 'officers'.

APPENDIX III

DISTANT PHOTOGRAPHY OF ITALIAN TERRITORIES: 1935-1939

Date	Sqdn	A/C	Crew	Areas photographed	Remarks
Sept. '35	47			Libyan coast: Tobruk	(S.43029/2)
				Survey of Gash river, Sudan	Form 540
March '36	47			Eritrean border between Umbrega and Kassala	Form 540
May '36	47			River Rahad, Sudan	Form 540
18.6.36				East coast of Sicily: Catania to C.Passero	Photographs taken at the end of the Abyssinian crisis of 1935/6 and forwarded to A.M. by H.Q. Med. in September 1937 for compari- son with those of July and August 1937. (S.40886/44A)
22.6.36				South coast of Sicily: Licata to C.Scaramia	
Aug. '36	47			Boma Plateau and line overlap of Kuron River	Form 540
25.5.37	202 F.B.	K.4196	P/O Farrar and Sgt.Otter with W/C. Grenfell (H.Q. Med.)	Pantellaria	A.M. request. To check with intelligence reports of aero- drome construc- tion. Poor photography and negative results. (S.40886/5A, 20A, B C and 30B)
	202 F.B.	K.7304	F/L Bower and F/L Atkinson with F/L. P.Broad (H.Q. Med.)		
Between 3 and 7.7.37	8 D.			Red Sea: Dumeirah I. and neighbour- hood.	To verify reports of Italian military works. (S.41438, 22A) Taken from 10,500' with F.L.14" lens.
15.7.37	202 F.B.	K.4195	F/Os Crosbie and Mason	Pantellaria	To check sortie of 25.7.37. Excellent photo confirmed air- field construc- tion. (S.40886/25 and 37A).

Date	Sqdn	A/C	Crew	Areas photographed	Remarks
9.8.37	202 F.B.	K.7304	F/L Bower and P/O Burges	Sicily: Augusta and Syracuse	Request of Naval C.-in- C. Med. to cover any concentra- tions of Naval shipping prior to manoeuvres in Sicily. (S.42860).
1.10.37	8 D.			Red Sea: Dumeirah I. and neighbour- hood.	To improve on the photographs of 3/7.7.37 (S.41438,44A) Taken from 6,000' with F.L.14" lens
16.11.37 18.11.37	202 F.B.	K.6932	F/L Bower and P/O Burges with A.O.C.Med. A/Cdre.P.C.Maltby	Pantellaria	Taken on out- ward and return flights.
3.1.38	202 F.B.	K.6932 K.9682	F/Os Mason and Case F/O Crosbie and P/O Burges	Libyan coast: Tobruk Bardia, Derna	Taken on their return journey by aircraft used to convey Inspector General and his S.O. to Alexandria. A.M. request prompted by D.N.I.'s desire to obtain information on coast defences and the lay- out of the port of Tobruk. (S.43029/1A- 12A).
7.4.38	202 F.B.			Pantellaria	To check progress. (S.40886/63A)
21.6.38	202 F.B.			Pantellaria Lampedusa and Linosa	To check progress. (S.40886/64A)
13.10.38	202 F.B.	K.6931 K.9682 K.9683 K.9684		Libyan coast: Tobruk, Bardia, Derna	Photographs obtained by aircraft re- turning from Mersa Matruh, where 202 Sqdn had been based during the Munich crisis (S.43029/24A 27A, 31A).

Date	Sqdn	A/C	Crew	Areas photographed	Remarks
5.11.38	202 F.B.	K.6931	F/Os Case and Longbottom	Libyan coast: Benghazi	Initiated by H.Q. Med., with compliance of A.M. (S.40886/68A, 69A).
9.12.38	202 F.B.	K.6931	F/Os Harger, MacCallum and Longbottom	Pantellaria and coast of SW. Sicily from Marsala to Terranova	(S.40886/75A, 76A)
18.2.39 and 20.2.39	202 F.B.	K.6931	F/Os. Case and Longbottom	Libyan coast: Tobruk and Bomba	At urgent request of A.M. to locate cer- tain submarines for Admiralty. Photographs taken on flights to and from Alexandria. (S.43029/33A and 35A).
<u>ADDENDUM - GREECE</u>					
31.3.39	202 F.B.	K.9682 K.9685	F/L Mason and F/O Longbottom F/O Harger and F/O Farrer with S/L Oliver (H.Q. Med.)	Greek seaplane bases	Taken on a cruise Malta - Athens - Alexandria - Mersa Matruh - Malta (S.1190)

APPENDIX IV

FRENCH PHOTOGRAPHY OVER GERMANY (1936-1939)

July 17th 1936	SIGMARINGEN (HEUBERG CAMP) - FRIEDRICHSHAFEN	Deuxième Bureau dossiers
July 18th 1936	ROTTWEIL - WALDSHUT	Deuxième Bureau dossiers
Aug. 15th 1936	MUNICH (B.M.W. factory)	Deuxième Bureau dossiers
May 1937	(a) WYLEN - RHEINFELDEN - RIEDMATT - SACKINGEN - LAUFENBURG - KL. LAUFENBURG - ALB - DOGERN - WALDSHUT - KAISERSTUHL - EGLISAU	C.I.U.Lib.ref.No. 7228
	(b) ROTTWEIL - VILLINGEN - SCHWENNINGEN	Deuxième Bureau dossiers
	(c) WARTENBERG - GUTMADINGEN - GEISINGEN - IMMENDINGEN - MOHRINGEN - TUTTLINGEN - SIGMARINGEN (HEUBERG CAMP)	Deuxième Bureau dossiers
	(d) SINGEN - RADOLFSZELL - CONSTANCE - FRIEDRICHSHAFEN - LINDAU	Deuxième Bureau dossiers
September 1937	TRIER - BINGEN - MAINZ - WORMS - MANNHEIM - SPEYER - LANDAU - ZWEIBRÜCKEN - SAARBRÜCKEN - SAARLOUIS	C.I.U.Lib.ref. No. 7223
October 1937	(a) MANNHEIM - GERMESHEIM (b) HAMM - MAINZ (c) MAINZ - FRANKFORT - HANAU (d) HANAU - ASCHAFFENBURG - MILTENBERG - HEILBRONN - ENZWEIHINGEN (e) GELNHAUSEN - BUDINGEN	C.I.U.Lib.ref.No. 7222
May 6th 1938	FREUDENSTADT - TUBINGEN - REUTLINGEN - STUTTGART - PFORZHEIM - KARLSRUHE - BISCHWEILER	C.I.U.Lib.ref. No. 7226
May 12th 1938	LEVERKUSEN - DUSSELDORF - DUISBURG - WESEL - EMMERICH - ESCHWEILER - DÜREN - COLOGNE - LEVERKUSEN	C.I.U.Lib.ref. No. 7227
July 7th 1938	KREFELD - DUISBURG - ESSEN - DORTMUND - HAMM - MÜNSTER - RHEINE - NORDHORN - HENGELOO - BOEKELOO	C.I.U.Lib.ref. No. 7225
September 1938	SAARLAUTERN	Deuxième Bureau dossiers
March 1939	WALDSHUT - FREIBURG (in Breisgau)	Deuxième Bureau dossiers
April 21st 1939	SAARBRÜCKEN - RECKLINGHAUSEN	Deuxième Bureau dossiers
Aug. 6th 1939	RHEYDT - MÜNCHEN GLADBACH	Deuxième Bureau dossiers

APPENDIX V

R.H.NIVEN'S FLYING LOG: 15TH FEB. 1939 - OUTBREAK OF WAR

1939 Date	Aircraft	Pilots	Journey	Remarks
15/2	Lockheed 124 (G - AFKR)	(M.BURCHAM (R.H.NIVEN	SOUTHAMPTON	Local
16/2	"	"	SOUTHAMPTON - HESTON	
16/2	"	R.H.NIVEN	HESTON	Local
17,18,19 22,23, & 26/2	"	(F.S.COTTON (R.H.NIVEN	HESTON	Local
28/2	"	"		Wireless installation and air test
1/3	"	"	HESTON - LE BOURGET	
2/3	"	"	LE BOURGET - HESTON	
4/3	"	"	HESTON	Local
5/3	"	"	HESTON - YEOVIL - HONNINGTON - HESTON	
7/3	"	"	HESTON - LE BOURGET	
9/3	"	"	LE BOURGET - HESTON	
14/3	"	"	HESTON	Local
17/3	"	"	HESTON - LE BOURGET	
18/3	"	"	LE BOURGET - BUC - LE BOURGET	
19/3	"	"	LE BOURGET	Local
20/3	"	"	LE BOURGET - BUC	
22/3	"	"	BUC - LE BOURGET - HESTON	
24/3	"	"	HESTON - YEOVIL - HESTON	
25/3	"	"	HESTON - BUC - TOUSSUS LE NOBLE	
25,27 & 28/3	"	"	TOUSSUS LE NOBLE	Local
28/3	"	(M.VILLET (R.H.NIVEN	TOUSSUS LE NOBLE	Local
30/3	"	(F.S.COTTON (R.H.NIVEN	TOUSSUS - NANCY	4 hrs.05 mins.
30/3	"	"	NANCY - TOUSSUS	
31/3	"	"	TOUSSUS	Local

1939 Date	Aircraft	Pilots	Journey	Remarks
1/4	Lockheed 12A (G - AFKR)	(F.S. COTTON R.H. NIVEN)	TOUSSUS	5 hrs. 15 mins.
1/4	"	"	TOUSSUS - LE BOURGET - WHITE WALTHAM	
2/4	"	"	WHITE WALTHAM - HESTON	
5/4	"	"	HESTON - LE BOURGET - HESTON	
7/4	"	"		6 hrs. 35 mins.
8/4	"	"	HESTON - LE TOUQUET - TOUSSUS	
9/4	"	"	TOUSSUS	4 hrs. 50 mins.
10/4	"	"	TOUSSUS - LE TOUQUET - HESTON	
13/4	Beechcraft (G - AESJ)	R.H. NIVEN	HESTON	Local
15/4	"	"	HESTON - LE TOUQUET - TOUSSUS	
18/4	Lockheed 12A (G - AFKR)	"	TOUSSUS - ORANGE - BASTIA	
20/4	"	"	BASTIA - TUNIS	
21/4	"	"	TUNIS	Local
22/4	"	"	TUNIS	Local
25/4	"	"	TUNIS	5 hrs. 40 mins.
27/4	"	"	TUNIS - BASTIA - TOUSSUS	
27/4	Beechcraft (G - AESJ)	R.H. NIVEN	TOUSSUS	Local
28/4	"	"	TOUSSUS - LE TOUQUET - HESTON	
3/5	"	"	HESTON	Local
5/5	"	"	HESTON - WHITE WALTHAM HESTON	
11/5	Lockheed 12A (G - AFKL)	"	SOUTHAMPTON	Local
11/5	"	"	SOUTHAMPTON - HESTON	

1939 Date	Aircraft	Pilots	Journey	Remarks
12, 13 and 14/5	Beechcraft (G - AESJ)	R.H. NIVEN	HESTON	Local
16/5	"	"	HESTON - SOUTHAMPTON - HESTON	
20/5	"	"	HESTON - SOUTHAMPTON	
20/5	Lockheed 12A (G - AFPH)	"	SOUTHAMPTON - BUC	
22/5	Beechcraft (G - AESJ)	"	HESTON - LE BOURGET - HESTON	
23/5	"	"	HESTON - CROYDON - SOUTHAMPTON - HESTON	
25/5	"	"	HESTON - LE BOURGET - HESTON	
31/5	"	"	HESTON - SOUTHAMPTON - HESTON - CARDIFF - SOUTHAMPTON	
2/6	"	"	SOUTHAMPTON - LE BOURGET TOUSSUS	
3/6	"	"	TOUSSUS - BUC - HESTON SOUTHAMPTON - HESTON	
5/6	"	"	HESTON - SOUTHAMPTON - HESTON	
6/6	"	"	HESTON - SOUTHAMPTON	
14/6	Lockheed 12A (G - AFPL)	(F.S. COTTON (R.H. NIVEN	HESTON - MALTA	
15/6	"	"	MALTA	3 hrs. 10 mins. (N. 1 hr.)
16/6	"	"	MALTA - CAIRO	7 hrs. 30 mins. (N. 3 hrs.)
19/6	"	"	CAIRO - KAMARAN - ADEN	
20/6	"	"	ADEN	6 hrs. (N. 2½ hrs.)
20/6	"	"	ADEN	2 hrs. 15 mins.
21/6	"	"	ADEN - KAMARAN	
22/6	"	"	KAMARAN - ATBARA - CAIRO	
24/6	"	"	CAIRO - MALTA	
25/6	"	"	MALTA - LYON	

1939 Date	Aircraft	Pilots	Journey	Remarks
2/7	Beechcraft (G - AESJ)	R.H.NIVEN	HESTON - LE BOURGET - HESTON - LE BOURGET	
3/7	"	"	LE BOURGET - HESTON	
5/7	"	"	HESTON - LE BOURGET	
8/7	Lockheed 12A (G - AFTL)	(F.S.COTTON (R.H.NIVEN	LE BOURGET - HESTON - BIRMINGHAM - HESTON	
12/7	"	"	HESTON - BRUSSELS- HESTON	
14 & 15/7	D.H.90 (G - AFDJ)	R.H.NIVEN	HESTON	Local
15/7	Lockheed 12A (G - AFTL)	(F.S.COTTON (R.H.NIVEN	HESTON	Local
16/7	"	"	HESTON - RAMSGATE	
17/7	Beechcraft (G - AESJ)	R.H.NIVEN	HESTON	Local
18/7	D.H.90 (G - AFDJ)	"	HESTON	Local
20/7	"	"	HESTON - LE BOURGET - HESTON	
22/7	Beechcraft (G - AESJ)	"	HESTON - DIJON - GENEVA	
23/7	"	"	GENEVA - DEAUVILLE	
24/7	"	"	DEAUVILLE - HESTON	
26/7	Lockheed 12A (G - AFTL)	(F.S.COTTON (R.H.NIVEN	HESTON - TEMPLEHOF	3 hrs. 50 mins. (N.1 hr.)
27/7	"	"	TEMPLEHOF - HESTON	3 hrs. 55 mins. (N.1 hr.)
28/7	Beechcraft (G - AESJ)	R.H.NIVEN	HESTON	Local
28/7	"	"	HESTON - BRUSSELS	
28/7	Lockheed 12A (G - AFTL)	(F.S.COTTON (R.H.NIVEN	BRUSSELS - FRANKFORT	
31/7	"	"	FRANKFORT - BRUSSELS	
31/7	Beechcraft (G - AESJ)	R.H.NIVEN	BRUSSELS - GENEVA	
1/8	"	"	GENEVA - LE BOURGET - DIEPPE - LE TOUQUET - HESTON	
2/8	"	"	HESTON - FORD - HESTON	

1939 Date	Aircraft	Pilots	Journey	Remarks
5/8	Lockheed 12A (G - AFTL)	(F.S.COTTON R.H.NIVEN	HESTON - LEMPNE - HESTON	
6/8	Beechcraft	R.H.NIVEN	HESTON - LE TOUQUET - LA FAYETTE - LYON	
7/8	"	"	LYON - DINARD	
8/8	"	"	DINARD - LE TOUQUET - HESTON	
13/8	Lockheed (G - AFTL)	(F.S.COTTON R.H.NIVEN	HESTON - 'ENDURANCE'	6 hrs. 10 mins. (N.2 hrs.)
13/8	"	"	HESTON - LE TOUQUET - HESTON	
17/8	"	"	HESTON - BERLIN	3 hrs. 40 mins. (N.1 hr.)
19/8	"	"	BERLIN - HESTON	3 hrs. 25 mins. (N.1 hr. 30 mins.)
19/8	"	R.H.NIVEN	HESTON - WHITE WALTHAM - HESTON	
22/8	"	(F.S.COTTON R.H.NIVEN	HESTON - BERLIN	3 hrs. 30 mins. (N.1 hr. 15 mins.)
24/8	"	"	BERLIN - HESTON	3 hrs. 55 mins. (N.2 hrs.)
26/8	"	"	HESTON - PARIS - DINARD - HESTON	
27/8	"	"		6 hrs. 15 mins. (N.3 hrs.)
28/8	Beechcraft (G - AESJ)	R.H.NIVEN		6 hrs.
29/8	Lockheed (G - AFTL)	(F.S.COTTON R.H.NIVEN		7 hrs.

APPENDIX VI.

PRINCIPAL MOVEMENTS OF S.I.S. AIRCRAFT (FEB-AUG. 1939) FROM R.H. NIVEN'S FLYING WING.

1939

15th Feb.	The original <u>Lockheed XIIA (G-AFKR)</u> taken on a local flight from Southampton.
Feb/March	During the rest of February and throughout March the Lockheed was worked in by a number of local flights, including brief trips to Le Bourget and Buc.
25th March	The Lockheed was flown to Toussus-le-Noble via Buc.
✱ 30th March	The first operational use of the Lockheed was the flight of 4 hrs. 05 mins. from Toussus, ending up at Nancy.
✱ 1st April	A second flight - 5 hrs. 15 mins. in duration - was made from Toussus on April 1st, the Lockheed returning to White Waltham via Le Bourget.
✱ 7th April	A flight of 6 hrs. 35 mins., presumably from Heston.
✱ 9th April	Another of 4 hrs. 50 mins. from Toussus.
13th April	A <u>Beechcraft (G-AESJ)</u> flown locally from Heston by Niven.
15th April	Flown to Toussus, also by Niven.
✱ 18th/27th April	The Lockheed XIIA (G-AFKR) carried out Tunisian reconnaissance and returned to Toussus. Handed to French
28th April	Niven flew the <u>Beechcraft</u> back to Heston.
11th May	Second <u>Lockheed (G-AFTL)</u> flown from Southampton to Heston.
20th May	A third <u>Lockheed (G-AFPH)</u> flown from Southampton to Buc. Handed to French?
✱ 14th/25th June	The second <u>Lockheed (G-AFTL)</u> carried out Mediterranean - Red Sea sorties.
14th July	<u>D.H.90 (G-AFVJ)</u> taken on local flight from Heston.
✱ 26th/27th July	<u>Lockheed (G-AFTL)</u> - Berlin and return.
✱ 28th/31st July	Lockheed to Frankfurt and back.
✱ 13th Aug.	Lockheed - Heston to 'Endurance' - 6 hrs. 10 mins.
✱ 17th/19th Aug.	Lockheed to Berlin and back.
✱ 22nd/24th Aug.	Lockheed to Berlin and back
✱ 27th Aug.	Lockheed 6 hrs. 15 mins.
✱ 28th Aug.	Beechcraft Wilhemshaven 6 hrs.
✱ 29th Aug.	Lockheed 7 hrs.

APPENDIX VII.

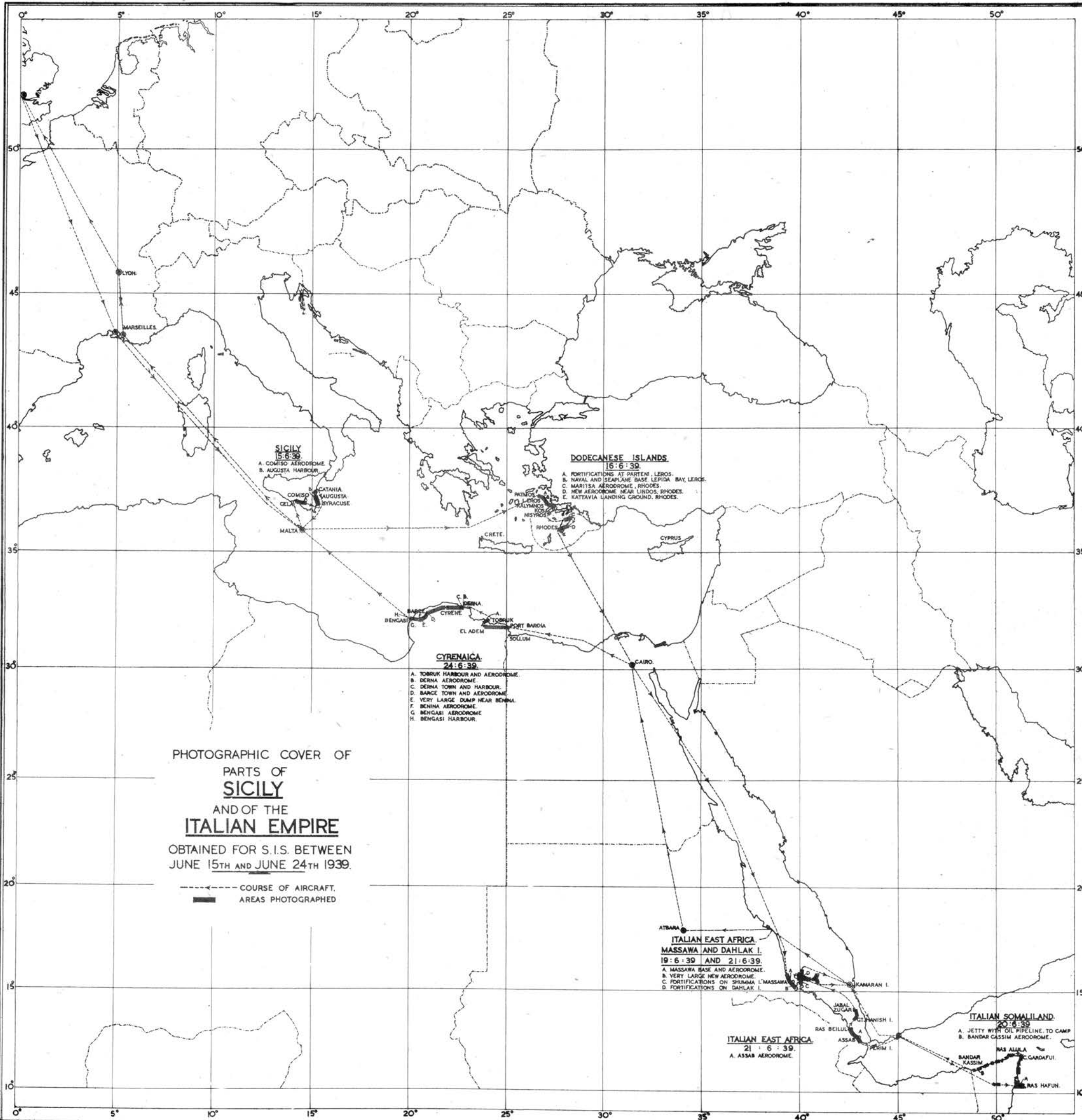
S.I.S. PHOTOGRAPHY OVER GERMANY : PRE-WAR.

March 30th	Lockheed 12A	F.S.COTTON	KREFELD - HAMBORN - GLAD- BACH - autobahn to HAMEL - MUNSTER - Dutch frontier crossed near VREDON - WINTERSWIJK - GROENLOO - GOOR - crossing German frontier east of ELLERICH	C.I.U.Lib.ref. No. 7224
April 1st and 7th	"	"	NANCY - FREIBURG - NEUSTADT - SCHWENNINGEN - SCHAFFHAUSEN	
April 9th	"	"	ETTlingen - DURLACH - HEIDLEBURG - MANNHEIM - LUDWIGSHAFEN - HEIDLEBURG - EBERBACH - HEPPENHEIM - MANNHEIM - NEUSTADT - PIRMASENS - BITSCH	C.I.U.Lib.ref. No. 5764
August 12th/ 13th	Lockheed 12A (G-AFTL)	"	JEVER A/D - WANGEROOG	
August 28th	Beechcraft (G-AESJ)	R.N.NIVEN	WILHELMSHAVEN and SCHILLIG ROADS	
August 29th	Lockheed 12A (G-AFTL)	F.S.COTTON R.H.NIVEN (co-pilot)	ditto	

APPENDIX VIII

MEDITERRANEAN AND EAST AFRICAN SORTIES FOR S.I.S: JUNE, 1939.

Date	Departure base	Areas photographed	Return base
13/6/39	HESTON	(movement)	MALTA
15/6/39	MALTA	Eastern Sicily: COMISO A/D AUGUSTA port	MALTA
16/6/39	MALTA	Dodecanese: Leros: fortifications at PARTENI Naval and S.P.B. base at LEPIDA BAY Rhodes: MARITSA A/D New A/D nr. LINDOS KATTAVIA A/D.	
19/6/39	CAIRO	Italian E. Africa: MASSAWA port and A/Ds	KAMARAN
20/6/39	KAMARAN	(movement)	ADEN
	ADEN	Somaliland: RAS HAFUN, oil pipe line from jetty to camp BANDAR KASSIM A/D	ADEN
	ADEN	ASSAB HANISH and JABAL ZUQAR Islands SHUMMA and DAHLAK Islands	KAMARAN
	KAMARAN	(movement)	CAIRO
24/6/39	CAIRO	Cyrenaica: TOBRUK port and A/D DERNA port and A/D BARCE town and A/D BENINA A/D and dump near BENGHAZI port and A/D	MALTA
25/6/39	MALTA	(movement)	TOUSSIEU



APPENDIX IX

POSTINGS OF SPECIALISTS PHOTOGRAPHIC OFFICERS TO STAFFS OF COMMANDS AND GROUPS - 1921 to SEPTEMBER 3rd 1939

METROPOLITAN AIR FORCE

COASTAL AREA

Jan.21 1932:
F/L Ernest Drudge
Feb.26 1934:
S/L F.R.Wynne M.B.E.
Aug.1 1934:
S/L C.Porri

COASTAL COMMAND

Mar.14 1936:
S/L W.E.Purdin
Oct.28 1938:
S/L A.R. Collins

NO.17 TRAINING GROUP (COASTAL)

July 29 1937:
F/O A.E.L.Worster
(Commissioned
photography officer)

WESSEX BOMBING AREA

Jan.26 1933:
F/L J.B.Barrett

CENTRAL AREA

Oct.10 1933:
F/L J.B. Barrett
until Nov.9 1935

WESTERN AREA

Jan.11 1934:
F/L S.J.Smetham

BOMBER COMMAND

July.14 1936:
S/L S.J.Smetham

Dec.25 1936:
F/O. F.C.Crowdy
(Commissioned photo-
graphy officer)
until Dec.1938

TRAINING COMMAND

Nov.13 1937:
S/L R.W.Hill

NO.23 TRAINING GROUP
(TRAINING COMMAND)
April 1937

S/L R.W.Hill
Jan.3 1938:
F/O W.F. Childs
(Commissioned
photography officer)

NO.22 ARMY CO-OPERATION GROUP

July 14 1936:
S/L H.V.Pendavis D.S.O.
Jan.26 1939:
S/L D.G. Keddle

OVERSEAS AIR FORCES

MIDDLE EAST

Nov.29 1921:
F/L C.Porri
Dec.17 1924:
F/O G.Lambourne
Sept.28 1928:
F/L R.W.Hill
Mar.4 1932:
S/L G.Y.Tyrell M.C.
Nov.13 1936:
S/L G.H.Russell D.F.C.
Mar.1 1939:
S/L F.G.Cator

IRAQ

Feb.4 1922:
F/L E.Drudge M.B.E.
Dec.1 1922:
F/O W.Bourne
Feb.23 1923:
F/L M.L.Taylor A.F.C.
Sept.18 1924:
F/L E.H.James M.C.
Feb.27 1925:
H.G.Crowe M.C.
Sept.21 1926:
F/L W.A.C.Morgan M.C.
Jan.29 1929:
S/L C.Porri
Jan.17 1931:
S/L O.W.de Putron
Oct.4 1932:
F/L H.V.Pendavis
Oct.10 1934:
S/L W.A.C.Morgan M.C.
Nov.9 1935:
S/L L.B.Duggan
Oct.5 1937:
S/L J.B.Barrett

FAR EAST

Dec.26 1936:
F/L R.C. Field
Feb.12 1938:
S/L A.Earle
Oct.22 1938:
F/L C.G.R. Lewis

APPENDIX X

SCHEDULE OF PHOTOGRAPHIC RECONNAISSANCE FLIGHTS BY BLENHEIMS OF NO. 2 GROUP, BOMBER COMMAND SEPTEMBER 1939 - JANUARY 1940

Note: Information from:
Daily Narrative Bomber Operations (II H/35)
Reconnaissance Flights (II H/74)
Bomber Command Form 540 (Appendix A)
C.I.U. Library

Date	Squad:	Number of Aircraft	Task	Results
1939				
Sept. 3rd	139	1	Location of German Naval Force	Photos WILHEIMSHAVEN - SCHILLIG RDS (20,000')
Sept. 5th	139	1	ditto	U/S (weather)
Sept. 16th	139	1	Verification of report of large concentrations of enemy a/c	Camera froze, but successful infra-red phot. SYLT (22,000')
Sept. 19th	139	2	To ascertain normality of road and rail movement in N.W. Germany	Only partial success, due to weather. Phot. DRIERWALDE A/F.
Sept. 20th	139	2	ditto	Chased and attacked by enemy a/c. Results inconclusive due to cloud. Phot. MEPPEN (autobahn) and DIEPHOLZ A/F (20,000'); also WILDESCHAUSEN (16,000').
Sept. 21st		2	ditto	50 low oblique phot. showed no unusual movement
Sept. 25th	107	3	ditto*	One a/c attacked and hit, but both returned. Phot. BIELEFELD (7,000'); SOLDE, MARSBURG, MUNSTER, GUTERSLOH, RHEDA, SCHWERT, ISELOHN, FREIENOHLE (22,000').
Sept. 27th	82	5	Specified airfields in N.W. and W. Germany	N.W. Germany: 17 out of 18 airfields phot. W. Germany: 5 out of 10 airfields phot. A.A. fire over Rhineland
Sept. 28th	107	2	ditto	Both a/c lost.
Oct. 1st		3	Airfields in N.W. Germany	One a/c lost. One returned home when attacked by 3 Me.109s, its guns having frozen. The third obtained phot. of airfields - HOYA, CELLE, ESCHADE, ROTTENBURG. A.A. fire encountered from two destroyers in SCHILLIG ROADS and also from 8 miles east of HOYA.

* Also of RUHR balloon barrage between KAMEN and HOLTEN.

Date	Squad:	Number of Aircraft	Task	Result
Oct. 13th		2	Objectives in RUHR	One a/c lost. The other returned with good photos, having been twice attacked by Me.109s one near WUPPERTAL and one near COBLENTZ, and fired at by A.A. near TRIER and in the Rhine Valley near COLOGNE and COBLENTZ.
Oct. 30th	139	6	Airfields and Sea-plane bases in N.W. Germany; also shipping in estuaries	One a/c lost. One sortie U/S. Four a/c brought back photos, all taken between 3/4,000', including HARBURG.
Nov. 11th	114	3	HELIGOLAND to detect possible naval concentration.	Two a/c lost. Third failed to sight HELIGOLAND. Phot. two small ships.
Nov. 17th		4	HELIGOLAND and WILHEIMSHAVEN to check possible naval concentrations	Thres a/c secured phot. WILHEIMSHAVEN (20,000'). One a/o phot. HELIGOLAND (20,000').
Nov. 25th	107	4	N.W. German ports: BRUNNSBÜTTEL WILHEIMSHAVEN, CUXHAVEN and HELIGOLAND.	No photos. of BRUNNSBÜTTEL or WILHEIMSHAVEN. CUXHAVEN phot. failed, apart from one showing two trawlers. Three phot. HELIGOLAND
Dec. 24th	82	2	WILHEIMSHAVEN	U/S (weather)
Dec. 27th	107	2	WILHEIMSHAVEN	One a/c lost. One phot. WILHEIMSHAVEN - failures due to iceing of camera; also successful phot. five trawlers towing paravanes.
Dec. 31st	{ 21	1	BORKUM, NORDERNEY	Photos. U/S.
	{ 82	1	SYLT	Recce. abandoned, due to lack of cloud cover.
1940				
Jan. 2nd		1	WILHEIMSHAVEN	Phot. WILHEIMSHAVEN

APPENDIX XI

STRATEGICAL PHOTOGRAPHIC RECONNAISSANCE BY DAY, UNDERTAKEN BY AIR COMPONENT, FRANCE, TO END OF JANUARY, 1940

NO. 70 WING (Bomber Reconnaissance Blenheims), AIR COMPONENT

	Date	No. of sorties	Results
NO. 18 SQUADRON	Nov. 6th	2	1 successful 1 result not recorded
	7th	3	3 results not recorded
	16th	1	1 successful (c.50 photos.)
	23rd	1	1 u/s (camera failure)
	Nov. -	1	1 successful (c.25 photos.)
	Jan. 3rd	2	1 lost (P.O.W.) 1 successful (85 photos.)
	Total sorties	10	{ 4 successful 4 results not recorded 2 u/s
	Losses	1 2 — 3	on photographic sorties on incidental flights (Nov.9th (crew safe); Dec.27th (fatal)).
NO.57 SQUADRON	Nov. 6th	3	1 lost (crew killed) 1 successful: 6 photos Siegfried Line 1 successful: 4 photos Siegfried Line
	7th	3	1 lost (P.O.W.) 2 u/s
	16th	1	1 lost (P.O.W.)
	Dec. 3rd	1	1 u/s (cameras froze)
	21st	1	1 successful: 120 photos Siegfried Line
	22nd	1	1 successful: 50 photos Siegfried Line
	Jan.10th	2	1 successful: 125 photos, N.W. Germany 1 successful: 46 photos, N.W. Germany
	Total sorties	12	{ 6 successful: 451 photos. 6 u/s
	Losses	3 2 — 5	on photographic sorties on incidental flights (Nov.16th and 23rd; both fatal)
	<u>SUMMARY</u>		
	Total sorties:	22	{ 10 successful 4 results not recorded 8 u/s
	Total losses:	8	4 on sorties (3 P.O.W.; 1 fatal) 4 on incidental flights (3 fatal).

August, 1939.

PHOTOGRAPHIC RECONNAISSANCE OF ENEMY TERRITORY IN WAR
(MEMORANDUM BY F/O. M.V. LONGBOTTOM)GENERAL:

Air reconnaissance of enemy territory in war may be broadly divided into two types; reconnaissance of the immediate vicinity of the front lines of the opposing forces, and reconnaissance of all other parts of the enemy's territory behind the lines. Near the front lines reconnaissance will probably be made possible by the maintenance of local air superiority. Enemy A.A. guns may be temporarily partly put out of action by gunfire or bombing, and the remainder risked for short periods, or they may be avoided by keeping at a distance from them, and taking oblique photographs with long focus lenses from considerable heights. From behind the enemy lines both strategical and tactical information will be required about important areas, which may extend to any distance into the enemy territory, and will include accurate information on the results of night bombing raids, which obviously cannot be obtained by the taking of photographs from the raiding aircraft, as would be done in day raids.

Reconnaissance aircraft endeavouring to obtain this information run all the risks that raiding bomber aircraft run. It is not possible to have air superiority over enemy territory. The A.A. guns cannot be silenced by bombardment. Important areas, which are the ones over which it will be necessary to fly, will probably be defended by elaborate fixed defences, in addition to the mobile ones. The reconnaissance aircraft will be over enemy territory for a considerable time - certainly long enough for the defensive fighter organisation to be brought into operation, and even if they get to their objectives they may still be intercepted and destroyed on the return journey. Furthermore, heavy bombers are well armed, and move in large numbers in formation, giving good protection against fighter attack, which would not be an economical method of reconnaissance. Also, bombers which have got to their target and dropped their bombs have still achieved their main object even if they are shot down on the return trip, whilst the reconnaissance aircraft must get back with his information in order to achieve his object at all, as to use his radio would only be to increase his own chances of interception and destruction, and in any case his most valuable information would be in the form of photographs, which are the only really reliable and worth-while form of reconnaissance in this type of work.

Clearly, therefore, this type of reconnaissance must be done in such a manner as to avoid the enemy fighters and A.A. defences as completely as possible. The best method of doing this appears to be the use of a single small machine, relying solely on its speed, climb, and ceiling to avoid destruction. A machine such as a single seater fighter could fly high enough to be well above balloon barrages and A.A. fire, and could rely on sheer speed and height to get away from the enemy fighters. It would have no use for its armament or radio, and these could be removed, to provide extra available weight for more fuel, in order to get the necessary range, which a fighter does not normally have. As most fighters have a very good take off, due to their great reserve of engine power, they could be considerably overloaded, for this purpose, with further fuel, giving even greater range.

In clear weather the aircraft would fly at a great height all the time it was over enemy territory, and would be too high to be heard or seen with the unaided ear or eye. If detected by sound locators it would still be out of range of the guns, and with its great speed and advantage of height it could almost certainly elude fighters coming up to intercept

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it from the ground, particularly as it would be a very small machine, painted in the manner which would reduce its visibility against the sky as much as possible. In cloudy weather it would fly in or above the cloud, if possible only emerging below for long enough to take the photographs required, intermittently, not giving the waiting gunners below time to open effective fire, and certainly not giving fighters any opening or opportunity to approach it.

Equipment

Aircraft:

The fastest of the fighters in service at present is the 'Spitfire' and as speed is one of the most important characteristics it will be assumed that the Spitfire will be used.

The weights for the Spitfire I, with Merlin II engine, and V.P. airscrew are as follows:-

Tare weight	4598 lbs.
Service load	658 "
84 gals. fuel	630 "
Oil	49 "
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Total	5935 lbs

About 450 lbs of the Service load (in the form of guns, ammunition etc.) can be dispensed with. The weight to be added consists of extra tanks, fuel and cameras, and will be approximately as below:-

Tare weight (including extra tanks)	4650 lbs.
Service load (pilot, cameras, etc.)	268 "
Oil	60 "
240 gals. fuel	1880 "
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Total:	6858 lbs.

This represents an increase of 923 lbs. (about 15%) over the all-up weight as a fighter.

With the 240 gals. of fuel, allowing 20 gals. for warming, take-off, and extra used on climb, the range is 1500 miles (1200 miles safe) at 300 mph., or 1800 miles (1400 miles safe) at 250 mph.

Allowing one hour flying at full throttle (367 mph) the range is reduced to 1270 miles (1000 miles safe) if the rest of trip is flown at 300 mph., or to 1450 miles (1150 miles safe) if the rest of the trip is flown at 250 mph.

With two hours flying at 320 mph., the range is reduced to 1380 miles (1100 miles safe) doing the rest at 300 mph., or to 1520 miles (1200 miles safe) doing the rest at 250 mph.

Starting with 6858 lbs. all-up weight the service ceiling should be about 30000 ft., so the aircraft could climb to, say, 25000 ft. over friendly territory, and then gradually climb to about 30000 ft. over a considerable period. After about two hours flying including take-off and climb, about 100 gals., i.e. 800 lbs., of fuel would have been used, and the service ceiling should be about 34000 ft., so that it should be easy to maintain 30000 ft. for the rest of the trip. During the later stages of the trip, if necessary, the machine could climb to over 35000 ft.

NOTE: These figures are for 15000 ft. (except the top speed of 367, which is for 18500 ft.) but are all for the Spitfire with Merlin II engine. In practice it is proposed that the Merlin XX with the two speed supercharger, or the Merlin RM2M with 100 octane fuel and two speed supercharger should be used, either of which would give a better performance at a greater height, and a very considerably increased ceiling. Also, the machine itself could probably be cleaned up slightly, as the special high speed Spitfire has been. However, the figures given above are the only ones available now, so they will be used for the present, on the assumption that they could be improved in practice.

As a good deal of flying may be done over the sea, it would be an advantage if parts of the aircraft, such as sections of the wings, could be made watertight, and jettison valves fitted on the tanks, which could be used for extra bouyancy, in the event of a forced landing in the sea.

Equipment

Cameras, etc:

Owing to limitations of space and weight available the standard R.A.F. F24 camera cannot conveniently be used.

Because of the great height from which the photographs will normally be taken it is necessary to use lenses of quite long focal length in order to get the resultant prints on a scale which will be sufficiently large to be useful. Generally speaking, the scale of the print should not be smaller than about 3 inches to one mile, or $1/21120$. To get the scale of print from 30000' with the F24 camera it would be necessary to use 8" lenses, and in order to cover a sufficiently wide band on the ground it would be necessary to use three cameras - one vertical, and the other two inclined to either side, with a slight overlap with the centre one. Obviously, three F24 cameras, with the necessary motors and controls, would be far too heavy and would take up too much space in a very small machine such as the Spitfire, and would probably entail cutting too large a hole in the bottom of the stressed skin fuselage.

It is suggested therefore, that 3 Leitz Leica 250 cameras be used. These cameras hold a length of 35 mm. cine film long enough for 250 exposures, size 24 mm. by 36 mm. As the lenses are computed and made for a circle of confusion of $1/800$ inch, the negatives can be enlarged 8 times without visible loss of definition, as opposed to the maximum of $2\frac{1}{2}$ times for the F24 negatives. If the 5 cm. F 2 lenses were used, from 30000 ft., the scale of the 8 times enlarged print would be $1/22500$ for the centre camera. The two other cameras would be inclined $33\frac{1}{2}$ degrees from the vertical to either side, giving 6 degrees overlap with the centre camera, and the same scale as the centre one on the inside edges of the print, decreasing slightly outwards from this edge (as they would be steep oblique views). The three cameras would cover a band 15 miles wide from 30000 ft. They would all be driven from one gear box, on a similar principle to the F 24 gear box, and one F24 motor, controlled by a Type 35 automatic electrical control. The Type 35 control would be set in a suitable position near the pilot, and the cameras, gear box, and motor in the position in the bottom of the fuselage selected as being the best from the point of view of space, accessibility, and convenience for cutting a hole in the fuselage for the lenses. This hole would be covered by a sliding panel controlled by the pilot, and would only be opened when the photographs were being taken, in order to exclude dirt, oil, etc. from the lenses as far as possible. It would only have to be a small hole, and would be unlikely to require much stiffening around it.

With a 60% fore and after overlap the 250 exposures would cover a band of 15 miles wide and 280 miles long from 30000 ft., and would run for 55 minutes continuously at 300 mph. From 20000 ft. the 250 exposures would

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cover a band 10 miles wide and 190 miles long, running for 38 minutes continuously at 300 mph. This would be ample for the requirements of a single flight, so that no reloading of the cameras would be required - an essential point, as they would be inaccessible to the pilot.

The large aperture of F 2 would permit the use of a medium speed pan film (about 27 Scheiner) with a very fine grain, and red filters, such as the Ilford Tri-colour Red filter, known in the R.A.F. as the Type 5 filter. This filter should give ample haze penetration from 30000 ft. or more. A very good lens hood would be essential, as there would be at times a considerable amount of strong extraneous light from below, particularly when there was any cloud lower than the aircraft.

The films would be developed with the usual cine apparatus, in a good very fine grain developer, preferably a paraphenylenediamine developer, with a hardening stop bath, and an acid hardening fixer. Before any prints were taken off the film should be treated with some form of scratch proofing. 8 times enlargements could be made with a proper 35 mm enlarger at least as quickly as contact prints with a standard F 24 contact printer from a F 24 film.

Camouflage

As all armament is being removed, and, to avoid detection or interception, the machine is relying on its speed, climb, and ceiling, and on its small size, every effort should be made to make it as difficult to see as possible. It is assumed that the question of it being seen from above will not arise, as it would always be above its opponents, except when it is necessary to fly lower because of cloud, when escape in the clouds will be possible.

Probably the best camouflage would be to paint the entire machine a very pale blue, with a dull surface, to avoid reflections. An alternative would be parts in the pale blue, and parts in a pale cream, with dull surface, or part pale blue and part pale green.

There must be no bright metal parts at all, so that the only part of the aircraft from which there could be a reflection would be the wind-shield and the Perspex cockpit covering.

Experiments could be made with the machine painted various colours, and flying at a height such that it was just visible from the ground, to determine the best colour scheme. During the experiments the machine should also be observed from another machine in the air, from about 5000 ft. lower, and from various distances.

Experiments might be made with a redesigned exhaust system on the engine, with a view to reducing the engine noise.

Tactics

The aircraft will normally leave on its flight from the nearest suitable aerodrome to the objective. The fuel taken on will be such that it will give a safe margin, allowing for periods of full throttle flying, and some zig-zagging, but no more, so that the weight will always be kept as low as possible, to give the best possible climb and ceiling.

In clear weather the aircraft should climb to at least 25000 ft. before approaching enemy territory, and preferably 30000 ft. In any case, 30000 ft. should be reached as soon as possible, and once reached should be held. In the later stages of the trip it will probably be possible to fly considerably higher, and at all times the greatest height consistent with a good high cruising speed should be used.

At these heights, there should be no danger from any A.A. fire at all. The Germans claim that their 8.8 cm. gun is effective up to about 25000 ft. This gun is the normal German heavy A.A. armament, and has been well tried in the Spanish war, where it proved quite effective. Batteries of them will be found near all important objectives. But at 25000 ft. the effectiveness of any A.A. gun against a small aircraft flying at speeds in the region of 300 mph. is doubtful. It would be invisible to the naked eye, and, owing to the varying winds over the great difference in height, sound locators would tend to be inaccurate, as also would height finders, and the shell fuzes. The length of time between the aircraft being detected or coming into range of the guns and passing out of range again would be very small indeed. No one gun would be able to fire more than three shots during that time. The German 10.5 cm. gun, used for fixed A.A. defences around important areas, and perhaps as mobile guns in some cases, would probably reach higher than the 8.8 cm. gun, but would, of course, be subject to the same inaccuracies at great heights. In general, 25000 ft. should be out of effective A.A. fire for an aircraft flying at speeds near or above 300 mph., and provide no real danger for such a machine. 30000 ft. should be out of range, and even if the 10.5 cm. guns could actually reach that height, the chance of being hit would be negligible.

The German experiments at kite and balloon barrage are not believed to have resulted as yet in anything over 160000 ft., so they would not constitute any danger on a clear day when it was possible to fly high.

Over enemy territory a slightly zig-zag course should be flown, with fairly long legs, to confuse anyone who might be endeavouring to plot the track, and to make interception more difficult. The return trip should not normally be made by the same route as was used to get to the objective.

The German policy for fighter aircraft is believed to be to keep them on the ground until a warning is received of the approach of hostile aircraft, and not to operate fighter patrols.

Even if fighter patrols were up, they would not be as high as 30000 ft., but would be at a more suitable height to intercept bomber aircraft, such as about 20000 ft., and a small, suitably painted, high speed aircraft, about 10000 ft., higher, would have to pass very close to be noticed. If noticed, he could not be caught unless the enemy fighters had at least as good a ceiling and a considerably higher speed, as they would have to climb while pursuing, thus reducing their speed. Even a fighter at the same height would have to have a reasonable margin of speed to catch up in level flight, and if his ceiling was not so good as the reconnaissance machine he could be avoided by climbing.

If the machine was detected by sound locators or other method, and an attempt made to plot his track and intercept him, it would be necessary, for the interception to have any chance of success, for his height to be computed fairly accurately, for his track to be accurately known, and also his speed, all of which are unlikely, particularly as he would be zig-zagging on a large scale. Also, the fighters would have to have climbed to at least the same height as the reconnaissance machine by the time they were due to intercept, and would even then have to be considerably faster than their quarry.

Of the German fighters at present known to be in service, even the fastest of them, the Messerschmidt 109, series E.1., could not catch the modified Spitfire. The only German fighter which is probably faster than it, would be the Messerschmidt 112 U, which is a new machine, probably not yet in service. But the Spitfire, cleaned up, without armament, and with the Rolls Royce RM2M engine with two speed supercharger and 100 octane fuel, could probably equal or better the speed of the Me 112 U, particularly at great heights, and would almost certainly have a better ceiling.

Reconnaissance of an area such as the Ruhr would be a comparatively simple matter, as the distance travelled over enemy territory would be small. In the case of places such as Bremen, Hamburg, and Kiel, the machine could fly from somewhere in Norfolk, keeping over the sea to just off the coast near these places, and would then have only a short distance to go over enemy territory. The same applies to Heligoland and the adjacent islands.

For a distant objective, such as Berlin, the machine would fly over the sea to a point just south of Heligoland, and then turn towards Berlin. The total distance would be considerably greater than going in a more or less straight line, but it would give the minimum time over hostile territory, and whilst over the sea the machine could be flown at its most economical speed and height, climbing to about 30000 ft. before crossing the coast line.

When there is cloud in the region of the objective the tactics employed will have to be arranged to suit the particular type and amount of cloud. In the case of high cloud, above about 18000 ft., i.e. cirrus, cirro-stratus, cirro-cumulus, high alto-stratus, and high alto-cumulus, if it is below about 30000 ft., the aircraft should fly mainly above it whilst over enemy territory, only descending below when necessary for navigational purposes and to take photographs, and then only for the shortest possible time. In the case of cloud below 18000 ft., if it is less than about $\frac{4}{10}$, the photographs can probably be taken without descending below them, in which case the tactics will be as given above. If it is more than about $\frac{4}{10}$ it will be necessary to descend below them to get the photographs. This entails danger of running into balloon or kite barrages over important areas. For such areas it will have to be decided at the time whether the importance of the information required warrants taking the risks of probable barrages. If it does, the machine will have to endeavour to get through the barrages, if they exist. In this case, and in the case where the machine is forced to go low in regions where there are unlikely to be barrages, every possible advantage should be taken of the cloud as a means of concealment. For a large part of the trip it should be possible to fly over the cloud, which will be an advantage, as thick clouds tend to blanket the sound locators.

If chased by fighters above the cloud the machine can retire into the cloud, keeping on its course, and flying near the top of the cloud layer, to get the maximum amount of cloud between it and the sound locators. When descending below the cloud for navigational purposes an area should be selected, if possible, which is likely to be free from A.A. guns. When descent below the clouds has to be made below about 25000 ft. in an area which is likely to be defended, as will probably be the case when the photographs are being taken, it should be done at a very high speed, and if A.A. fire is opened an irregular zig-zag course should be steered.

There will obviously be conditions of low cloud, such as low stratus and nimbo-stratus, under which it would be impracticable to attempt the reconnaissance at all, but these conditions would be unlikely to last for any very long period without a break. In general, it will hardly be worth while from the photographic point of view below about 5000 ft.

Owing to the large amount of cloud flying which might be done, it would probably be well worth while to fit the machine with some form of de-icing equipment.

One of the problems to be considered is that of navigation. In such a small machine the facilities for accurate navigation are few. The first essential is that the pilot should be a qualified navigator. He should have had ample practice at high altitude navigation in a small fast machine, and he should be able to fly accurately by instruments for long periods.

It would obviously be a great advantage if the pilot knew the country over which he had to fly. Therefore, initially at any rate, the pilots should be taken from those who had been doing certain photographic reconnaissances of foreign territory in peace time.

Accurate forecasts of the upper winds would be a most important factor.

In clear weather, or when there was only high cloud, the navigation should be quite straightforward. In cases where there was medium or low cloud, the navigation would have to be done entirely by the met. forecasts of the upper winds, and from such checks on track and ground speed as could be obtained either through gaps in the clouds if they were not 10/10, or by descending below them for short periods. The pilots should be given ample opportunity to practice this type of navigation, keeping the descents below cloud down to the minimum.

Possible Future Developments

Aircraft:

There is a new fighter, of which the prototype has been made, which would be an improvement on the Spitfire. This is the Westland "Whirlwind", with two Rolls Royce Peregrine engines, which has a top speed between 370 mph. The weights as a fighter are as follows:-

Tare weight	6776 lbs.
Service load	952 lbs.
140 gals. fuel	1092 lbs.
Oil	85 lbs.
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	8905 lbs.

Of this, about 650 lbs. of the service load, in the form of guns, ammunition, etc., could be dispensed with. It is suggested that the weights should then be made up as follows:-

Tare wt. (with extra tanks)	6850 lbs.
Service load (including pilot, cameras, etc.)	360 lbs.
Oil	100 lbs.
408 gals. fuel	3182 lbs.
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	10492 lbs.

This is an increase of 1587 lbs., i.e. about 17½%, over the weight as a fighter.

Allowing 30 gals of fuel for warming, take-off etc., the range would be 1800 miles (1400 miles safe) at 300 mph., or 2150 miles (1700 miles safe) at 250 mph.

With one hour at full throttle (say 380 mph.), the range would be reduced to 1480 miles (1200 miles safe) doing the rest of the trip at 300 mph., or to 1700 miles (1400 miles safe), doing the rest of the trip at 250 mph.

With more powerful engines, and two speed superchargers, the performance of this aircraft could probably be considerably improved.

Except for the added safety given when flying over the sea, it is very doubtful whether two engines are any advantage for this type of work. If one engine were to fail whilst over enemy territory the greatly reduced speed and ceiling, combined with the absence of armament, would make the machine an easy

prey for the hostile fighters and A.A. guns. The ideal seems to be a single engined machine, of the single seater fighter type, with a two speed super-charger engine of about 1700 to 1800 max. B.H.P. It would have a top speed of 450 mph., a ceiling of 40000 ft., and a range of 1500 miles safe at 350 mph. If a machine were to be designed and built specially for this work it should be quite possible to get this performance, if a suitable engine were available.

Future Developments

Cameras.

Although the use of the Leica 250 cameras may be expected to give excellent results, it is not the ideal arrangement. Considerable research is needed to find the best apparatus for the work, and the best compromise between scale and area covered. A suitable arrangement might be to use three cameras, with film $2\frac{1}{2}$ inches square, and 4 inch lenses. It might be possible to combine these in one unit. From 30000 ft. they would cover a band 12 miles wide, and, if the lenses could be made with a circle of confusion of about $\frac{1}{800}$ inch, the resultant 8 times enlargements, which would be possible, would have a scale of about $\frac{1}{11200}$, which is about $5\frac{1}{2}$ inches to one mile. The $2\frac{1}{2}$ inch film could be used in lengths up to, say, 200 exposures or 250 exposures, which would be ample for all the requirements of a single flight.

There are also further improvements which might be made, such as the taking of both panchromatic film and infra-red simultaneously, or possibly colour and pan or infra-red together.

(Sgd) M.F. LONGBOTTOM. F/O.

August, 1939.

APPENDIX XIII

REPORT OF HESTON FLIGHT RECONNAISSANCE. 12/10/39

SECRET

HESTON FLIGHT

Reconnaissance of Ostend and
Zeebrugge, 12/10/39

At 1600 hours on 12/10/39 the aircraft was about 4 miles off Ostend at a height of 18,000 feet. Photographs were taken with a 20 inch camera, and the mouth of the harbour was carefully examined with binoculars. No sign of boom defences was seen.

The aircraft flew straight along the coast to Zeebrugge, which was reached at 1610 hours. Photographs were taken, and examination with binoculars revealed no sign of boom defences.

About 8 miles off Flushing the aircraft turned back, a few photographs being taken of Flushing whilst turning.

The return was made at 18,000 ft. at about 3 miles from the coast at Zeebrugge, closing to about 1 mile off the coast at Ostend. Further photographs were taken, and visual observation checked the previous impression that there were no boom defences.

There was considerable cloud, extending up to about 16,000 feet, and advantage was taken of this to conceal the aircraft from the ground, as far as possible.

The machine was not fired on, and no other aircraft were seen.

Wing Commander.
O.C. Heston Flight.

APPENDIX XIV

S/2041/1A

MEMORANDUM BY F.S. COTTON. 21/9/39.

HESTON FLIGHT

SECRET

Future Requirements for Photographic Aircraft

1st Stage: Long Range:

1. Aircraft must be small, to reduce visibility, and well camouflaged against sky.
2. Top speed of at least 370 m.p.h. attained at a height of 18,000 to 20,000 feet.
3. Range of at least 1,200 miles safe at a cruising speed of 300 m.p.h., including half an hour at full throttle.
4. Service ceiling of 30,000 feet climbing straight up from full load take-off, rising to 35,000 feet with decrease of load through fuel consumption.
5. At least one 5 inch F.24 camera with automatic electrical control.
6. No armament. Reliance is placed on speed, climb, ceiling, and invisibility of aircraft, to escape attack.

Short Range:

As above, except that range of safe 500 to 600 miles only is required, for photography immediately behind front lines.

2nd Stage: Long Range:

1. Aircraft must be small, to reduce visibility, and well camouflaged against sky, and may be single or two seater.
2. Pilot's visibility towards the ground, immediately downwards, and ahead, must be good.
3. Top speed in the region of 450 m.p.h., attained at a height of about 25,000 feet, but engine must have a two speed supercharger, so that high speed is also available lower down.
4. Range of 1,500 miles safe at 300 m.p.h., including half an hour at full throttle.
5. Service ceiling of at least 34,000 feet, climbing straight up from full load take-off.
6. At least 2 F.24 cameras, with automatic electrical control.
7. No armament. Reliance is placed on speed, climb, ceiling, and invisibility of aircraft, to escape attack.

/ Short Range:

Short Range:

As above, but range need only be 500 to 600 miles safe, for photography immediately behind front lines, and general short range work.

In principle, the machine should always be slightly faster than the fastest fighters in use. This should always be possible, as the machine may always be a simplified and cleaned-up form of the fighters. The use of turbo-superchargers should make possible the desired performance.

(Sgd) F. SIDNEY COTTON.

21/10/39.

APPENDIX XV

SPECIAL SURVEY FLIGHT, FRANCE: Nov. 5th 1939 - Jan. 10th 1940

SCHEDULE OF SUCCESSFUL SORTIES




Note: Cameras of F.L. 5" used in each case

Spitfire N. 3071, Mark I, Type A

Date	Sortie ref:	Pilot	Base	Principal points covered	Flying time	Flying height
22.11.39	HAA/000	F/L LONGBOTTOM	COULOMBIERS (refuelling at BAR LE DUC)	ELSENBOREN-EUPEN- SPA	1 hr. 40 mins	33,000'
21.12.39	HAA/001	F/L NIVEN	NANCY	TRABEN-TRARBACH- TRIER-SAARBRUCKEN SAARLAUTERN	1 hr. 25 mins	34,000'
21.12.39	HAA/002	F/L LONGBOTTOM	"	TRIER	1 hr. 15 mins	31 to 32,000'
22.12.39	HAA/003	F/L LONGBOTTOM	"	AACHEN-PRUM	1 hr. 30 mins	32,000'
22.12.39	HAA/004	F/L NIVEN	"	SAAREGUMMINES- SAARBRUCKEN	1 hr. 10 mins	32,000'
29.12.39	HAA/005	F/L LONGBOTTOM	"	AACHEN-COLOGNE- JULICH	1 hr. 50 mins	34,000'
1. 1.40	HAA/006	F/L NIVEN	"	KAISERSLAUTERN	1 hr. 20 mins	32,000'
2. 1.40	HAA/007	F/L LONGBOTTOM	"	AACHEN (E. out- skirts) - DUSSELDORF- VIERSEN	1 hr. 45 mins	34,000'
2. 1.40	HAA/008	F/L NIVEN	"	KAISERSLAUTERN- MAINZ-WIESBADEN- BAD KREUZNACH	1 hr. 35 mins	32 to 33,000'
10. 1.40	HAA/009	F/L LONGBOTTOM	"	" RÖTGEN-DIEKIRCH	1 hr. 30 mins	34,000'

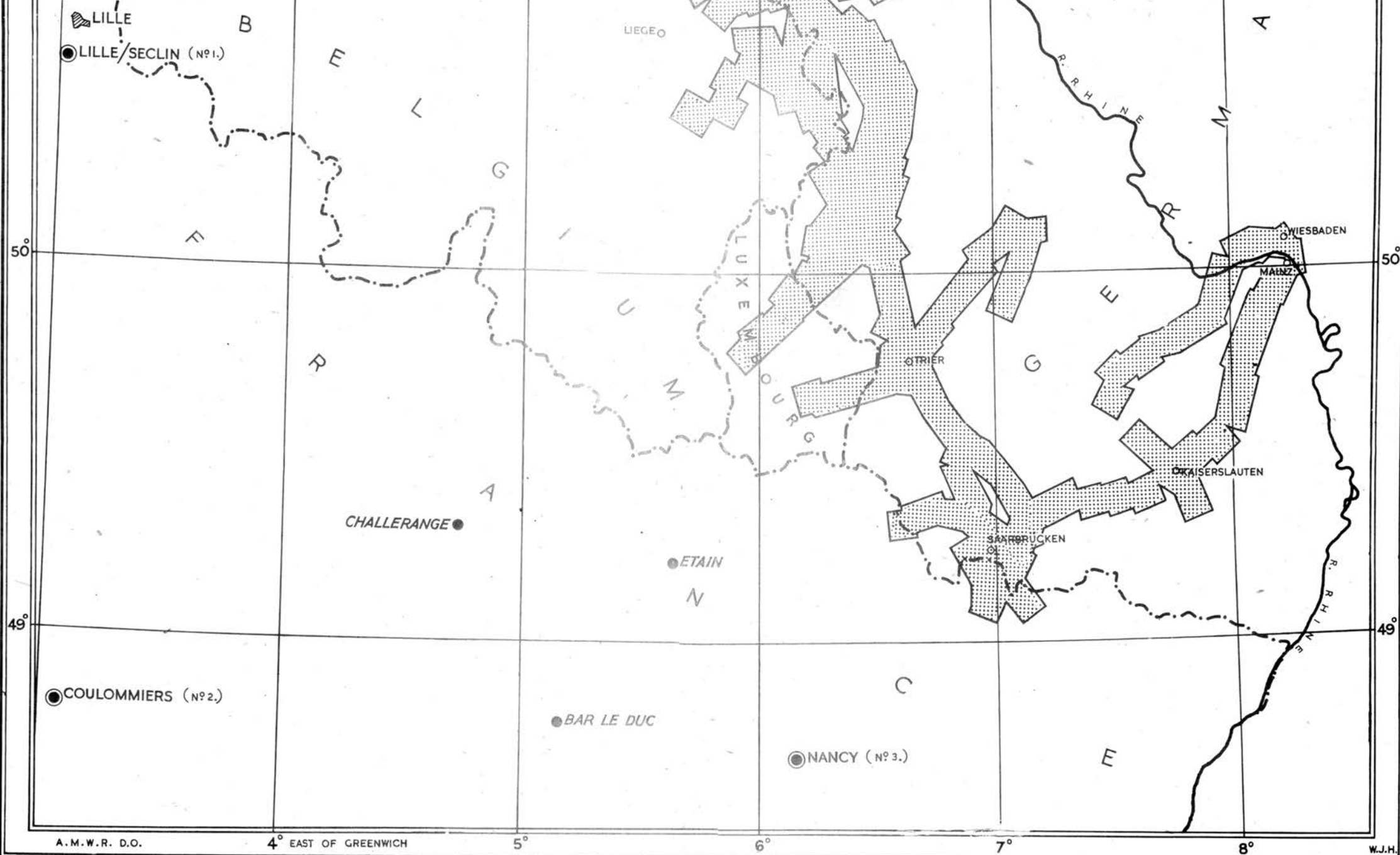
THE SPECIAL SURVEY FLIGHT, FRANCE

NOVEMBER 5TH, 1939 — JANUARY 11TH, 1940

-  TOTAL AREA PHOTOGRAPHED BY SPITFIRE N.3071.
-  SUCCESSIVE BASES (NUMBERS 1, 2 AND 3).
-  FORWARD FUELLING BASES FOR NUMBERS 1 AND 2.

SCALE

0 5 10 20 30 40 50 60 70 MILES



A.M.W.R. D.O.

4° EAST OF GREENWICH

5°

6°

7°

8°

W.J.H.

APPENDIX XVI.

HIGH ALTITUDE FLYING: CARE OF THE BODY

(Report submitted by Flight Lieutenant R.H. Niven of the Special Survey Flight, France, to the Officer Commanding, No.2 Camouflage Unit, Heston. Dated 25.12.39).

Besides the general features which are well known, such as good reflexes and good physical condition, the following features are also recommended.

Eat a small breakfast in the morning, followed if possible by a good bowel movement, this being necessary to allow as much food as possible to pass out of the stomach. If the flight is to be made after lunch it is advised that one should not have any lunch whatever except possibly a bar of chocolate and do not drink very much of any liquid.

At great heights it has been found that the stomach is inclined to distend or at least to give the impression that it is distended and although not in any way dangerous, it is very uncomfortable and causes considerable wind.

Gaseous drinks are also very much inclined to give one the same feeling as too much food or liquid.

It has been noticed that after an hour or so at great heights that when you come down you are subject to dull aches in the head behind the ears and when you have been down for an hour or more a feeling of drowsiness creeps over you and you are unable to shake it off all day, this is more apparent when you have been flying over 32,000 feet for some time.

APPENDIX XVII

CONDENSATION TRIALS AT HIGH ALTITUDE

(Report submitted by F/Lt. M. V. Longbottom of the Special Survey Flight, France, to the Officer Commanding, No. 2 Camouflage Unit, Heston. Dated 25.12.39.)

It has been found that, at high altitude over about 8000 metres (27,000'), under certain conditions, aircraft in flight leave behind them a dense white trail of condensation. In its most marked form this condensation, starting from the engine exhausts, forms a dense white trail behind the aircraft, which rapidly spreads to a band many times the width of the aircraft, stretching across the sky like a long wisp of well marked cirrus cloud. From the ground this trail appears to come to a point, sharply defined, at the exact position of the aircraft, so that, although the machine itself may not be visible, every movement it makes --- every turn and zig-zag --- is easily visible to the naked eye of an observer on the ground, and may be very accurately plotted, enabling accurate A.A. fire to be opened. Although the machine itself may not be visible, the A.A. gunners' problem is thus rather more simple than if it were clearly visible. The accuracy of A.A. fire possible under these circumstances may be judged from the fact that, on 21.12.39, whilst the Spitfire of this Unit was in the vicinity of Waxweiler (to the N.N.W. of Trier) at a height of about 9700 metres (32,000') and was leaving a very pronounced condensation trail, of some 20 to 30 shots fired at it, the average error was about a $\frac{1}{4}$ mile to $\frac{1}{2}$ mile in direction, and about 200 feet in height, but some shots were much nearer, one being almost exact for height, and about 50 yards ahead of the machine. (This shot was certainly accidental, as the machine had commenced to zig-zag at the time).

In addition, of course, it is very easy for enemy fighter aircraft to make an interception, even though the attacked aircraft itself is not visible to them, as they know it is exactly at the end of the trail of condensation and they can follow every movement it makes.

Up to now, on the occasions when the condensation has been experienced, it has only been above about 8000 metres (27,000'), so that if one descends to about this altitude it may be avoided. However, in the case of the aircraft of this Unit, it is highly undesirable to make a descent to that height over enemy territory, owing to the chances of encountering enemy fighters. These could almost certainly be outdistanced if seen in time, but in a small single seater one might not always see an enemy making a cunning approach to attack at a height where his performance has not been badly impaired by the falling off of power, climb, speed, etc.

An examination of enemy air activity reports in the vicinity of the Front between Strasbourg and Luxembourg and over France near the Front, shows the following facts about the heights at which enemy aircraft fly:-

As regards enemy fighters, on the 21st and 22nd of December, two cloudless days over the whole area, they were reported largely at heights in the vicinity of 4000 metres (13,000') and 7000 metres (23,500'), but some were reported at heights up to 8000 metres (27,000').

On the same two days, enemy reconnaissance aircraft, in particular Do.17's, were frequently reported at heights of 7500 metres and 8000 metres and one was reported at 9000 metres (30,000').

A.A. fire has been encountered up to 10,000 metres (33,000'), but when the condensation trail has been visible.

The Spitfire of this Unit has been flown at heights in the region of 10,000 metres (33,000') on several occasions, and on one occasion at 10,800 metres (35,500') without the formation of the condensation trail,

/although

although, particularly when climbing, at heights over about 8000 metres, there nearly always appears to be wisps of condensation passing down the sides of the fuselage from the exhausts.

The dates on which flights have been made over Western Germany at heights over 9000 metres (30,000') without formation of condensation trails were the 20th and 22nd of November, and the 7th of December. There have been three days on which the trails have been particularly noticeable, namely, the 20th, 21st and 22nd of December. These occasions will now be examined in detail.

In the afternoon of the 20th December, the Spitfire of this Unit was flying at 9000 metres in the area approximately Metz - Trier - Saarbrücken. At this height a pronounced condensation trail was left. On closing the throttle considerably and descending, the trail ceased at about 8700 metres (29,000').

In the morning of the 21st the machine was flying in the area approx. Metz - Trier - Saarbrücken, at a height of about 9000 metres (30,000'). A dense trail was left, which ceased at about 8300 metres on closing the throttle partly and descending.

In the afternoon of the 21st the machine was flying to the north of Trier. A dense condensation trail was left, and the enemy A.A. opened fire. On descending partly throttled back the trail almost ceased at about 8500 metres. On the climb the trail had begun to form at about 8200 metres (27,500').

About midday on the 22nd the machine flew north from the Luxembourg frontier near Sierck to Aachen, and returned to just west of Sierck at about 9700 metres (32,000'). Slight wisps of condensation appeared to be passing along the sides of the fuselage from the exhausts, but, on several occasions, a complete turn of the machine revealed no sign of condensation trail.

However, in the afternoon of the same day, the machine was at 9300 metres (31,000') in the vicinity of Saarbrücken, and was leaving a pronounced trail of condensation. A.A. fire was opened. On descending the trail ceased at about 8700 metres (29,000').

On the afternoon of the 21st two aircraft appeared over Nancy in formation. The aircraft themselves were not visible to the naked eye, but the two trails left no doubt as to their exact position. They circled for some minutes at a great height, and every turn and manoeuvre was clearly visible from the ground. The trails persisted for between one and two hours, strongly resembling lines of cirrus clouds.

The French Met. Officer at Essey aerodrome was consulted as to the possible reasons for the phenomenon. He advanced the opinion that the upper air, above about 8000 metres, was very humid, and that, owing to this and to the very low temperatures at those heights, the passage of an aircraft, with the rapidly expanding gases from the exhausts, caused sudden condensations to form in its wake*.....

* The rather lengthy meteorological explanation which occupies the rest of this report is omitted. It may be found in A.C.A.S.(G) folder 70G/2.

APPENDIX XVIII

Directorate of Intelligence

War Instruction No.5.

(S.1926)

Photographic Reconnaissance

BC/S/20443/72B

1. It has been observed that when photographic reconnaissances have been carried out, the resulting photographs are often of such a small scale that in many cases they have negligible interpretation value.

2. It appears that this is due to the fact that the instructions contained in A.P.1633 paragraph 17, and A.P.1176 chapter XV, are not being adhered to and possibly to the lack of some guidance to indicate the most suitable scale for certain subjects.

3. It is realised that a variety of factors may affect the taking of photographs to a certain scale, and it may be necessary to effect a compromise, but as far as is possible the instructions contained in the abovementioned Air Publications are to be adhered to and the scale of photographs required broadly stated as large, medium or small and in the case of the last mentioned, it is most desirable that they should not be smaller than 1/25,000. When it is known that weather conditions over the objective may make it impossible to decide the height at which photographs should be taken before the reconnaissance starts, then Unit Commanders when making detailed orders should bear in mind that when more than one camera is carried, it will be better to fit lenses of varying focal length in order to ensure securing something of value.

4. As a guide, a list of subjects is given below showing the most suitable scale for interpretation purposes at which the photographs should be taken:-

Large Scale

1/6,000 to 1/10,000	Battery positions, M.G. posts, air lines, cable trenches and all small tactical detail.
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Medium Scale

1/10,000 to 1/14,000	Road and rail movement detail of aerodromes and location of aircraft at dispersal points in woods etc. Small industrial works. Location of transformer stations and the like. Detailed layout of industrial works, ports, shipping, identity of ships. Assessment of damage to targets. Location of ammunition and supply dumps.
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Small Scale

1/14,000 to 1/20,000	New road and rail construction. General layout of aerodromes and detection of landing grounds. Location of large industrial works. Location of ammunition depots and stores.
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* Under reasonably good weather conditions this scale could be reduced to small scale.

5. Regarding the figures given above for large scale, it is pointed out that there are limits to the usefulness of this scale as, with a ground speed of 200 m.p.h. a 60% overlap cannot be obtained at scales larger than 1/9,000 although individual photographs can be taken at 1/3,000.

(Sgd) K.C. BUSS.

Air Commodore
Director of Intelligence

6/12/39.

APPENDIX XII.

DIRECTORATE OF INTELLIGENCE

WAR INSTRUCTION NO. 8.

(Note:- This instruction cancels W.I. No. 5
previously issued which should be destroyed)

Distribution and Interpretation of Air Photographs.

It is essential that the results of photographic reconnaissances should reach those concerned as quickly as possible, but at the same time, if the maximum value is to be obtained from them it is also necessary that as far as possible they should have been interpreted except those to the War Office, G.H.Q. and Admiralty.

The following instructions are based upon these two considerations.

1. The origin of the request for a photographic reconnaissance will usually determine by whom the results are to be handled.

The possible sources from which a demand may come and the type of information required is broadly as follows:-

by Air Ministry

(a) D. of I. (A.I.3)

(i) Reconnaissances to determine the existence or otherwise of concentrations of aircraft on enemy aerodromes, or to obtain general information regarding known or suspected aerodromes.

(ii) Reconnaissances to obtain intelligence regarding air defences.

(b) D. of I. (A.I.1(b))

Reconnaissances of industrial targets.

(c) D.G.O.

Reconnaissances to obtain naval intelligence for use in connection with air operations against naval objectives.

by War Office

Special reconnaissances, to obtain intelligence regarding enemy military movements.

by G.H.Q.

To obtain intelligence regarding enemy military movements and fortifications.

by Admiralty

Special reconnaissances to obtain Naval Intelligence.

2. Reconnaissances under the above headings will be carried out by Bomber Command, A.A.S.F., Air Component F.F., Coastal Command, and the special

/Photographic

Photographic Flight; they will be in addition to normal reconnaissance and incidental photographic work effected without orders originating outside the Commands.

These formations will keep a library of all photographs taken by them and will retain the negatives except where expressly instructed to the contrary.

3. Photographs, the orders for which originated within the Command, will be interpreted in accordance with Command requirements but one copy of such photographs as may be of interest to Air Ministry Branches will be sent direct to the Branch concerned, together with interpretation report.

4. Tables are attached showing the distribution of photographs according to the origin of the request, and the responsibility for interpretation, but normally distribution and interpretation will always be made in accordance with Appendix I, except when it is definitely stated in Directions from Air Ministry that the reconnaissance is at the request of other Departments.

The distribution is based upon a first production of a maximum of six prints for users only and this number cannot be exceeded without interfering with the speed of production. Any further printing for distribution within Commands will be carried out under Command arrangements, but where further copies are required by Air Ministry branches and Admiralty, requests are to be forwarded direct to D. of I. (A.I.1.h.), who will co-ordinate requests and make a consolidated demand upon the Command concerned and will arrange for the distribution of the photographs.

In the case of the War Office, that Department will demand only upon the Air Ministry for reprints when the photographs have been taken by formations other than A.A.S.F. or Air Component to Field Force. When the photographs have been taken by those formations, then the demands for reprints will be made through G.H.Q.

5. Where the photographs are required by the Admiralty one copy is to be forwarded direct by the quickest possible means.

In the case of the War Office and when that department carries out interpretation on behalf of G.H.Q., the photographs are to be despatched to Air Ministry F.O.7 and marked "For War Office". F.O.7 will be responsible for their onward transmission.

6. The above instructions are for general guidance and do not apply to special directives on the subject of reconnaissance and the distribution of photographs which may be ordered by the Air Staff from time to time.

(Sgd.) K.C. BUSS.

Air Commodore,
Director of Intelligence.

22/12/39.
Air Ministry.

APPENDIX I

DISTRIBUTION OF PHOTOGRAPHS - AIR MINISTRY REQUIREMENTS

Serial	Reconnais- sance required by	Photo- graphs taken by	Copies of photographs to	Interpre- tation by	Copies of interpretation to	Remarks
1.	Air Ministry	Unit of Bomber Command	(1) H.Q. (2) B.Cmd. (3) A.M. F.O.7 (4) A.M. A.I. 3(b) ^{**} (5) French (6) Mission (7) Admiralty ^{**}	B.Cmd.	1. A.M. (F.O.7) 2. A.M. (A.I. 1(b)) + 3. A.M. (A.I. 3(b))	^{**} Only if of landing grounds and aero- dromes and seaplane bases A.I. 3(b) will subsequently pass prints to A.I. 1(h) for detailed interpretation. +If of targets or potential targets. xOnly if photographs are of naval vessels or bases, coast defences and seaplane bases.
2.	Air Ministry	Unit of Coastal Command	(1) H.Q.C.Cmd (2) A.M. D.N.O. (3) Admiralty (4) A.M. A.I. 1(h) (5) H.Q.B.Cmd	Admiralty and A.M. A.I. 1(h)	1. Admiralty 2. A.M. D.N.O. 3. A.M. A.I. 3(b) 4. A.M. A.I. 1(b) ^{**}	^{**} Copy sent by A.I. 1(h) only. Photographs are to be forwarded to Admiralty and Air Ministry D.N.O. by Unit producing by quickest possible means.
3.	Air Ministry to obtain Naval Intelli- gence in connection with air operations	Unit of Bomber Cmd or Coastal Cmd	(1) H.Q. B.Cmd (2) H.Q. C.Cmd (3) A.M. D.N.O. (4) A.M. F.O.7 ^{**} (5) A.M. A.I. 1(h) (6) Admiralty	B.Cmd C.Cmd Air Ministry Admiralty	1. A.M. F.O.7 2. A.M. A.I. 1(b) 3. A.M. A.I. 3(b)	^{**} Will pass to A.I. 3(b) if of aerodromes and seaplane bases. Photographs are to be forwarded to Admiralty and Air Ministry D.N.O. by quickest possible means.

APPENDIX II

DISTRIBUTION OF PHOTOGRAPHS - ADMIRALTY REQUIREMENTS.

Serial	Reconnais- sance required by	Photo- graphs taken by	Copies of photographs to	Interpre- tation by	Copies of interpretation to	Remarks
1.	Admiralty	Unit of B. Command	1.) B. Command 2.) 3. Admiralty 4. A.M. D.N.O.* 5. A.M. A.I. 1(h) 6. C. Command	Admiralty A.M. A.I. 1(h)	1. Admiralty 2. A.M. F.O. 7 3. A.M. A.I. 3(b) 4. A.M. A.I. 1(b)x 5. C. Command 6. B. Command	Photographs are to be forwarded to Admiralty and Air Ministry D.N.O. by quick- est possible means. *Will subsequently pass photographs to A.I. 1(h). +If of naval vessels, naval bases and coast defences. xIf of targets or potential targets.
2.	Admiralty	Unit of C. Command	1. C. Command 2. Admiralty 3. A.M. D.N.O.* 4. A.M. A.I. 1(h) 5. B. Command	Admiralty A.M. A.I. 1(h)	1. Admiralty 2. A.M. F.O. 7 3. A.M. A.I. 3(b) 4. A.M. A.I. 1(b)x 5. C. Command 6. B. Command	Photographs are to be forwarded to Admiralty and D.N.O. by quick- est possible means. *Will subsequently pass photographs to A.I. 1(h). xIf of targets or potential targets.

APPENDIX III.

DISTRIBUTION OF PHOTOGRAPHS - ARMY REQUIREMENTS.

Serial	Reconnais- sance required by	Photo- graphs taken by	Copies of photographs to	Interpre- tation by	Copies of interpretation to	Remarks
1.	G.H.Q.	F.F. Compon- ent or A.A.S.F.	G.H.Q. 2	G.H.Q.	War Office 2 No.2 Military Mission for G.Q.G. 1	When aircraft lands in France.
2.	G.H.Q.	F.F. Compon- ent or A.A.S.F.	War Office 1 No.2 Air Mission 3 ^{II} (Two copies for G.H.Q.) French B Mission 1 B.Command 1	War Office	G.H.Q. 1 No.2 Military Mission for G.Q.G. 1 Air Ministry 1	When aircraft lands in England. *Film together with prints will be return- ed to France as early as possible.
3.	G.H.Q.	Bomber Command	War Office 1 No.2 Air Mission 3 ^{II} (Two copies for G.H.Q.) French B Mission 1 B.Command 1	War Office	G.H.Q. 1 No.2 Military Mission for G.Q.G. 1 Air Ministry 1	If aircraft lands in FRANCE, film and prints will be dealt with as in Serial I. *If aircraft lands in England, films and prints are to be sent o No.2 Air Mission as in 2 above.
4.	War Office	A.M. arrange- ments	War Office 4 (Two copies for G.H.Q.)	War Office	G.H.Q. 1 No.2 Military Mission for G.Q.G. 1 Air Ministry 1	
5.	Air Ministry	A.M. arrange- ments	War Office 1 ^{II}	B.Cmd and/or Air Ministry	War Office 1 ^{II} G.H.Q. 1 No.2 Air Mission for G.Q.G. 1	*Only if photographs contain information of interest to W.O. e.g. fortifications, dumps, move- ments etc. north of a line TRIER- MAINZ.

Directorate of Intelligence

Addendum to War Instruction
No. 8 (S.1926)

(BC/S/20443/106B)

PHOTOGRAPHIC RECONNAISSANCE

Table showing minimum scales at which information may be expected from photographs, as a guide to Station Intelligence Officers in briefing pilots as to flying heights, and in securing that lenses of the proper focal length were used.

Forwarded to H.Q. B.C. from A.I.1(h) on March 8th 1940.

Scale Limit	Can be reported with reasonable degree of certainty.	Becoming visible but with large element of doubt.
1:57,000	(i) Aerodrome and hangars. No other details. (ii) Autobahns and railways.	
1:53,000	Barge traffic.	(i) Rolling stock (ii) "Elephants Teeth" and wire.
1:46,000	(i) Ammunition stores. (ii) Location of landing grounds.	(i) Coastal defence batteries. (ii) Camps and barracks.
1:44,000	Large industrial plants e.g. synthetic oil plants.	(i) Small industrial plants e.g. coke oven batteries. (ii) Train movement.
1:38,000	Bomb stores.	(i) Secondary roads. (ii) Presence of aircraft.
1:35,000	(i) Presence of aircraft. (ii) Secondary roads and tracks. (iii) Train movement in general	(i) Identification of types of larger a/c. (ii) A.A. gun positions. (iii) Rolling stock.
1:31,000	(i) Presence of warships. (ii) Small industrial plants. (iii) Wire in continuous line. (iv) "Elephants Teeth" U/C.	(i) Identity of battle-ships, but not of smaller vessels. (ii) Damage to targets. (iii) Cable trenches.
1:20,000	(i) Camps and barracks. (ii) "Elephants Teeth" finished. (iii) Cable trenches. (iv) Small wire entanglements. (v) A.A. gun positions.	(i) Dumps. (ii) Trenches. (iii) Forts u/c. (iv) Types of bridges.
1:15,000	(i) Trenches. (ii) Forts. (iii) Dumps. (iv) Vehicles in towns and woods. (v) Train movement in detail and rolling stock.	
1: 9,600	(i) Identification of types of A/C. (ii) Road movement in detail. (iii) Damage to targets.	(i) Local of Light A.A. defences. (ii) M.G. posts. (iii) Airlines.
1: 8,000	(i) Light A.A. defences. (ii) M.G. posts. (iii) Airlines. (iv) All small tactical detail.	

INTERPRETATION OF AIR PHOTOGRAPHS SUMMARY. No.1.GERMAN AERODROMES

These notes have been compiled as the result of a photographic study of some forty aerodromes. One cannot help being impressed with the magnitude of the work put into the construction of some of these. No obstacles seem too big to overcome. Woods have been removed, new roads built, railways diverted and branch lines laid, marshes drained, small hills removed and large areas reclaimed from the sea.

	EXAMPLE
<p>1. <u>LANDING GROUNDS.</u> Although efforts have been made to camouflage some of these, they are usually easy to identify. The light railway, which almost invariably supplies them, is conspicuous. At the main aerodromes there is often an elaborate system of service roads circling the aerodrome and in front of the hangars, and at some of the low-lying stations there are wide run-ways from 1,000 to 1,300 yards long.</p> <p>At certain points round the perimeter groups of 5 or 6 objects a few yards apart may be seen. They can best be described as having the appearance of sections of a wall about 8 to 10 feet high. As they are often on good lines of approach, it is thought that they may have something to do with the night landing of aircraft.</p>	<p>BIBLIS</p> <p>GIEBELSTADT ARDORF</p> <p>MUNSTER</p>
<p>2. <u>HANGARS.</u> The number of different types is very noticeable, even to the extent of an aerodrome having 5 hangars and only 2 of them being similar. Their lay-out varies at each station, it is unusual to find any two places the same. The "V" type repair hangar is, however, very general.</p> <p>Hitherto none of the places studied has shown any signs of underground hangars.</p>	<p>JEVER</p>
<p>3. <u>CAMOUFLAGE.</u> At the majority of aerodromes little has been done but work is in progress. Every advantage, though, is taken of neighbouring trees to put hangars and buildings amongst them. The best example seen is of FASSBERG, where the buildings have been most effectively painted with a blurred mottled effect which tones in very well with the surrounding pines. The tarmac and roads have been coloured dark.</p> <p>Another type of camouflage which is quite effective consists of a series of numerous narrow rectangles of various tones. The tarmac was painted in a similar way and blended in well with the hangar. Care is usually taken to retain the line of any road which formerly crossed the site of an aerodrome. These are not well done, they show up white or black and are invariably more pronounced than the surrounding roads.</p>	<p>FASSBERG</p> <p>DETMOLD</p> <p>EUTINGEN</p>
<p>4. <u>BUILDINGS.</u> Barrack blocks are very much of a pattern, symmetrically arranged with shelter trenches near. Incidentally, shelter trenches are to be found all round an aerodrome.</p> <p>M/T sheds are noticeable for their size, sometimes rectangular in lay-out with long sides.</p>	<p>GUTERSLOH</p>
	/The

	EXAMPLE
The light railway, which supplies the larger bomber aerodromes, almost always has its station, with platform and siding, centrally situated behind the hangars. Bomb storages are very conspicuous and connected by light railway which has a loop round the store.	LANGENHAAGEN OLDENBURG
5. <u>FUEL STORAGE</u> . Usually to be found on the far side of an aerodrome and shows on a photograph as a series of rectangular shapes.	JEVER
The round flat tops of what must be fuel tanks are sometimes between the hangars.	MUNSTER
Another detail noticed several times, which is presumed to be a type of fuel storage, shows as 2 round flat-topped objects with a square shaped one in the middle appearing just above the level of a grassy mound.	GUTERSLOH
A favourite method refuelling A/C is the provision of 3 or more groups of 4 points well out into the aerodrome, which obviously allows for this operation to be carried out with the maximum speed. One large tank sunk into the ground near the hangars, has been noted at a number of aerodromes which are being constructed or developed. This is thought to be for oil storage.	GUTERSLOH
6. <u>EINSATZ aerodromes</u> . Frequently given away by the light railway circling the landing field, usually have a few innocent looking buildings scattered around near them. The presence of shelter trenches adjacent to these buildings reveals their purpose.	EUTINGEN
7. <u>AIRCRAFT</u> . Special markings have been observed on two occasions. (a) On some twin-engined a/c, the nose and engine cowlings were painted white. There were white spots on the wing tips and a white band round the fuselage near the tail.	FASSBERG
(b) Some fighter a/c had the tops of the wings painted one light and one dark.	EUTINGEN
Dispersed aircraft have been noted outside the limits of an aerodrome, in an adjacent field and under trees. An interesting feature has been observed at one or two places and that is the provision of wind or blast shields. They appear to be of a semi-permanent nature, possibly made of sandbags and arranged funnel-shaped, the tail of the a/c being at the narrow end and the wing tips just inside at the other. They are estimated to be about 7 feet high. Picketing points have been seen. They show as a series of groups of 3 white dots.	WENZENDORF
The Germans are fond of having their aircraft drawn up in orderly fashion in front of the hangars. Two rows of machines facing each other across the apron in front of the hangar. At one station special run-ways are provided for this purpose, which show oil patches where a/c are regularly parked.	LANGENHAAGEN

	EXAMPLE
The presence of fighters on an aerodrome is sometimes disclosed, where it otherwise might not have been, by the large uncamouflaged three-engined a/c which accompanies them.	MIDLUM
8. <u>ANTI-AIRCRAFT.</u> Aerodrome defence positions are to be found at the majority of stations. There are usually 2 A.A. gun positions but at one a group of 4 was located.	GIEBELSTADT

A.I.1.(h) Air Ministry.

21.10.39.

(S/1818/79A)

APPENDIX XXI

CORRESPONDENCE ON AIRCRAFT OPERATING COMPANY
BETWEEN THE FIRST LORD OF THE ADMIRALTY AND THE
SECRETARY OF STATE FOR AIR, FEBRUARY, 1940

My dear Kingsley,

The interpretation of the photographs of the Ems which we saw yesterday has proved the value of the stereoscopic arrangement possessed by Major Hemming's organization, and it seems to me most desirable that this organization, including the expert personnel, should be taken over by one of the Service Departments without delay. I imagine that the Air Ministry would be the most suitable Department for them to come under, but if for any reason the Air Ministry do not wish to take it over, we should be quite prepared to do so.

Yours sincerely,
(Sgd) WINSTON S. CHURCHILL.

The Right Honourable Sir Kingsley Wood, M.P.

(S/1818/81A)

February 17th, 1940.

My dear Winston,

You wrote to me on the 13th about Major Hemming's organization. The position is that immediately the value of the organization became apparent in connection with the Ems photographs we decided that we must take over control of the apparatus and the personnel necessary to work it. The Deputy Chief of the Air Staff reported in this sense at the meeting of the Deputy Chiefs on the 14th, and we are now going ahead with the necessary arrangements for taking over the organization.

(Sgd) KINGSLEY WOOD.

The Rt. Hon. Winston Churchill, C.H., M.P.
Admiralty.

APPENDIX XXII

LOG OF HUDSON N. 7334 FLYING FROM HESTON

Note: Abstracted from a demi-official letter from W/C F.S. Cotton to A.V-M R.H. Peck on March 8th, 1940, commending the crew for decoration.

Date	Pilot	Crew	Time up	Time down	time in air	Remarks
16.2.40	F/O Slocum	3	1615	1645	30	Test
21.2.40	"	4	1030	1545	5.15	Photo trip
22.2.40	"	4	0920	1145	2.25	" "
23.2.40	"	4	0915	1135	2.20	" "
24.2.40	"	4	1245	1645	4.00	" "
25.2.40	"	4	1050	1310	2.20	" "
27.2.40	"	4	1015	1505	4.50	" "
29.2.40	"	4	0935	1520	5.45	" " (Sortie HNA/002)
2.3.40	"	4	1045	1620	6.05	" "
3.3.40	"	4	1035	1130	1.15	Local
"	"	4	1335	1500	1.25	Shot down
Total					40.30	

APPENDIX XXIII

RECONNAISSANCE FOLLOWING THE HORNUM RAID BY
BOMBER COMMAND, MARCH 19th/20th, 1940.

Items:

- A. Operational Order: Photographic Development Unit. 20/3/40.
- B. Reports from Photographic Interpretation Section
- C. Bomber Command, based on photographs taken on 20/3/40 by No.82 Squadron, 2 Group.
- D. Report on same by A.I.1(h)

A. Operational Order: Photographic Development Unit.

OPERATIONAL ORDER NO.3.

Date: 20.3.40.

From: C.O., P.D.U.

To: O.C. "N" Flight, S.I.O. Photo Officer.

Information: Bomber Command carried out bombing operations on the seaplane base at HORNUM on the Island of SYLT on the night of 19,20/3/40. The Air Ministry requires to know the extent of damage (if any).

Photographs of the whole Island of SYLT including WESTERLAND and HORNUM are urgently required.

Whether tilted camera may be used: cameras as fitted.
Scale required (state whether of contact or final enlarged scale): N/A.

Special Instructions if any:

- (1) Type "C" Spitfire is to be used.
- (2) This is a warning order: but executive order to take off will be issued separately.

Distribution: Standard distribution for "N" series.

(Sgd.) G.W. TUTTLE W/Cdr.
for C.O., P.D.U.

B. Photographic Interpretation Section, Bomber Command,
Report on Photographs taken on 20.3.40.

1. Attached herewith (C), is a report on the photographs taken by Blenheim reconnaissance today to ascertain the extent of the damage caused by the raid on night 19/20 March.
2. The photographs of HORNUM seaplane base are rather distant and blurred obliques. No vertical photographs were taken of HORNUM. In these oblique photographs all hangars and buildings appear to be untouched. Similarly a crane on the water-side, and the Slip-way are undamaged. Nor do the petrol and ammunition dumps some 1,000 yards to the North of the Base appear to have suffered any damage. It is possible that a few bomb bursts may have fallen in the sand dunes in the vicinity. However, without vertical photographs it is impossible to confirm the presence of craters and to say more than that the station seems to be undamaged.
3. Further photographs show strips of the Island from the North end to a point North of HORNUM on the East Coast, and to WESTERLAND on the West Coast. The seaplane base of RANTUM on the East Coast, of which photographs show little more than half appears to be undamaged and the buildings seen are intact. Similarly the aerodrome at WESTERLAND seems untouched, although one small shed, which may be hangar, on the Northern side of the station is no longer present. Its disappearance appears to have been effected by removal rather than by bombing, as the general appearance of the ground and environment is undisturbed. A large number of aircraft dispersed round the main buildings at WESTERLAND are in the normal positions seen on previous photographs. Of these aircraft a number are considered to be fighter aircraft, probably MEs 109.
4. At the Northernmost end of the Island the seaplane base at LIST was only photographed on one very distant oblique. Consequently no details can be seen.
5. It is quite possible that there are a few bomb bursts in the rough ground and dunes, some possibly at HORNUM, some possibly near the town and aerodrome of WESTERLAND. A large number of Flak positions can be seen and rail activity (two trains) is seen on the railway line near WESTERLAND.
6. The conclusion reached from these photographs is that the aerodromes and buildings at WESTERLAND and the seaplane base buildings at HORNUM and RANTUM appear to be undamaged, although there may be some bomb bursts at HORNUM which might be seen from vertical photographs. From various reports there seems to be a slight possibility that the major part of the bombs were dropped at some place other than HORNUM. As the results of bombing - the burning buildings, the bursting of bombs and the crashing of one aircraft - appear to have been reported clearly by Neutral Observers from the small town of HAVNEBY at the South end of the Island of ROM, some 25 miles from HORNUM, it may be that some of the bombs were dropped towards the Northern end of SYLT. Moreover, aircraft appear to have been seen, again by Neutral Observers, over the Northern area.
7. It may therefore be possible that some of the bombs were dropped on the seaplane base at LIST. Owing to the absence of photographs of the latter this can only be assumed from the absence of any real material damage at HORNUM, RANTUM or WESTERLAND.
8. It is of note that during the raid the pilots saw clearly the slip-way and hangars of their target and reported two hangars on fire burning furiously. If this is so it would seem that more damage would be visible at HORNUM. However, as LIST is a considerably larger seaplane base with more hangars, a crane similar to that at HORNUM near a slip-way, it would not be difficult to report a set of circumstances which would fit either LIST or HORNUM. And if, once the mistake had
/been

made by leading aircraft, buildings were seen to be on fire, it is more than likely that the following aircraft would bomb the burning target without more ado.

20.3.44.

C. Report

HEADQUARTERS BOMBER COMMAND

Photographic Raid Report / No.51

PHOTOGRAPHIC INTERPRETATION SECTION

Date: 20.3.40 Operation Order No.A.89.

M.S.I.t.b.a.182

Reference Raid Report No.

Date taken 20.3.40 by 82 Sqdn. 2 Group

DISTS	SERIAL NO.	SQDN. NO. & CAMERA LETTER	POSITION AND OBSERVATIONS	A/C. HEADING	HEIGHT	FOCAL LENGTH
F.O.7/DNO Adm. 2 C.C. 1 Ailb. 1 Gp 1 Sta. 1 CinC 1 G/C Ops. 1 for SASO Int. 1 Ops. la 1 PIS 1	1		Series of Oblique Photographs running from KONIGSHAFEN (North of the Island of Sylt) 53°03'N. 08°24'E. to HORNUM (South end of Island) 54°45'N. 08°18'E.	S	7,000'	14"
	4 - 20	82 T	<u>KONIGSHAFEN to 1 km North of KAMPEN 54°58'N. 08°21'E.</u> Sand dunes Considerable number of A.A. Positions and one possible W/T Station. No signs of Bomb Bursts apparent.			
	21 - 23	82 T	<u>KAMPEN 54°57'N. 08°21'E.</u> No signs of damage or unusual activity. No signs of Bomb Bursts apparent.			
	24 - 27	82 T	<u>WESTERLAND aerodrome 54°54'N. 08°21'E.</u> No damage apparent. Considerable Activity. Approx. 27 M.E. 109's - 2 He. 111's - 1 Ju. 52 and 8 Training A/C. Two new hangars under construction. One old hangar appears to have been removed. Aircraft dispersed in normal positions around North and East edges of ground of aerodrome buildings and along North perimeter of aerodrome.			H.251
	29	82 T	Considerable number of A.A. Positions to the North of Aerodrome.			
	30 - 33	82 T	Sand dunes - Possible A.A. Positions.			

SERIAL NO	SQDN. NO. & CAMERA LETTER	POSITION AND OBSERVATIONS	A/C HEADING	HEIGHT	FOCAL LENGTH
34 - 36	82 T	HORNUM 54°45'N. 08°18'E. All the Hangars, buildings, the Slipways and the Crane appear to be intact. No signs of damage can be seen and photographs seem to compare exactly with those taken earlier. Although slight damage would perhaps pass unnoticed on photographs of such poor clarity it is certain that no considerable damage could have been inflicted as the vast majority of buildings are certainly intact. <u>NOTE:</u> Although no signs of Bomb Bursts are apparent, in view of the dune type of country it is possible that some bombs have been dropped on the sand dunes and on rough ground, as these would be difficult to notice. It can however be said that at Westerland and Hornum no damage is apparent and there are no signs of damage to civil habitation in the area covered.			
1 - 31	82 N	Area covered by KÖNIGSHAFEN 55°03'N. 08°23'E. to Vertical Photographs WESTERLAND 54°55'N. 08°19'E. including - Eastern extremity of KAMPEN - 54°57'N. 08°21'E. BRADERUP 54°56'N. 08°21'E. N.E. corner of WESTERLAND AERODROME. No apparent damage, to any buildings, roads or railways. There is a possible Bomb Burst on the East side of road from BRADERUP to KAMPEN, Approx. 580 yds. North of BRADERUP 54°52'N. 08°21'E. It would be difficult to detect presence of Bomb Bursts on rough ground or among sand dunes in this area. However the ease with which A.A. Battery Positions, some of which are light batteries of small size, can be seen makes it appear that any Bomb Bursts in this area would be visible. Vertical Line Overlap. 55°00'N. 08°21'30"E. 10 Km N.N.E. of WESTERLAND to 54°52'20"N. 08°18'E. 4 Km S. of WESTERLAND	S	7,000'	8"
1 - 14	82 B	55°00'N. 08°21'30"E. to 55°56'N. 08°21'20"E. No Bomb Bursts apparent.	S	7,000'	8"
15	82 B	55°56'N. 08°21'20"E. There may possibly be Bomb Bursts, One beside Road and One on East Side of Road South of Braderup.			

SERIAL NO	SQDN. NO. & CAMERA LETTER	POSITION AND OBSERVATIONS	A/C HEADING	HEIGHT	FOCAL LENGTH	
17-18 26	82 B	<u>WESTERLAND AERODROME.</u> No visible damage. Considerable activity. Approx. 27 Me. 109 Fighters, 2 He.111, 1 Ju.52 and some Training Aircraft are visible, dispersed at the usual dispersal points on this Aerodrome.				H.251
26		<u>WESTERLAND STATION (Railway).</u> A Number of Trains stationary in sidings and station.				
28	82 B	<u>54°53'30"N. 08°18'30"E.</u> Train steaming South on Westerland - Rantum line. <u>Vertical Line Overlap.</u> 29-52. RANTUM SEAPLANE BASE, 54°53'N. 08°19'E. to 54°48'N. 08°17'30"E. 5 Km. NORTH OF HORNUM.				
29 - 40	82 B	<u>RANTUM SEAPLANE BASE.</u> No visible damage to Sea Wall or to buildings in South area of Base.				H.317
14 - 52	82 B	<u>Sand dunes.</u> No Bomb Bursts apparent. Anti-Aircraft and Coastal Defence visible at various points in this area.				
1,2,2A	82 F	<u>52°55'N. 01°50'E.</u> Approx. 30°N.W. of Gt. Yarmouth. Merchant ship, reported to be Italian, under way. Probably of GILDA class, approx. 380 ft. long and 2000-3000 tons.	E	500'	20"	
3	82 F	NIL				
4,5,6	82 F	<u>55°35'N. 08°05'E.</u> (approx) 5 Miles SOUTH OF BLAAVANDS HUK off WEST COAST of DENMARK. Two Merchantmen in company under way. Both are single funnel ships, the nearer of the two having one white band around the funnel 2/3rds of length upwards, and the more distant, two white bands. Probably approx. 1,000 tons. These ships are said to be Patrol Vessels.	N	800'	20"	
8 - 43	82 F	Series of 36 Obliques covering an area on SYLT from - KONIGSHAFEN (55°02'N. 08°24'E.) in the North to HORNUM (54°45'N. 08°18'E.) in the South passing down the centre of the Island through:-		7,000'	20"	
						/SHINDERHEIM

SERIAL NO	SQDN. NO. & CAMERA LETTER	POSITION AND OBSERVATIONS	M/C HEADING	HEIGHT	FOCAL LENGTH	
		<p>SHINDERHEIM (55°00'20"N. 08°22'E.) KAMPEN (54°57'N. 08°20'30"E.) WENNINGSTEDE and BRADERUP (54°56'N. 08°20'E. and 08°21'E.) WESTERLAND AERODROME (54°55'30"N. 08°21'E.) WEST of TINNUM (54°00'N. 08°20'E.) HORNUM SEAPLANE BASE (54°45'N. 08°18'E.)</p> <p>No damage is apparent throughout the whole of this run: the hangars and buildings at WESTERLAND AERODROME and HORNUM SEAPLANE BASE and in addition the slipway, crane rifle range and storage at the latter appear to be intact. The photographs are somewhat indistinct and cover dune country; Bombs may have fallen on the sand dunes where the craters would be difficult to identify. No activity is apparent on road or sea; One train is seen proceeding NORTH towards WENNINGSTEDE. (54°56'N. 08°20'E.)</p> <p><u>AERODROMES</u> WESTERLAND 54°55'30"N. 08°20'E. Fighter and Training aircraft are apparent; all have been fully reported on other runs.</p> <p><u>HORNUM SEAPLANE BASE.</u> 54°45'N. 08°18'E. No aircraft seen.</p> <p><u>W/T STATION - HORNUM.</u> One tall steel lattice tower and at least two smaller ones are apparent at 45°36'30"N. 08°18'E. about 500 yards NORTH of SEAPLANE BASE.</p> <p><u>STORAGE DUMP.</u> One large dump type not identified, probably ammunition is located about 300 yards NORTH EAST of BR'DERUP (54°56'30"N. 08°21'E.); it appears to be connected by light railway to WESTERLAND AERODROME.</p> <p><u>FLAK.</u> A considerable number of batteries can be seen: The positions will be reported in a supplementary report.</p> <p><u>ROADS.</u> Work on the new road running from NORTH to SOUTH of the Island is continuing.</p>				
28 - 33	82 F					
39 - 43						
39 - 43	82 F					
22	82 F					

D. A.I.1(h) Report on Photographs taken on 20.3.40.

SECRET

Report No. N32/5/17

29th March, 1940.

Photographs: A.M. File Nos - 35 to 39
 Unit Nos - 107M. 7 to 11
 Taken - 27.3.40

Locality: HORNUM (SYLT)

The photographs cover the Seaplane Base South of the slipway and show the slipway, crane, harbour, jetty, the southernmost hangar and the living quarters South of the road leading from the slipway.

The small pier running N. to S. at the end of the jetty (shown on photograph taken 23/9/39) has been destroyed, but the jetty itself appears to be in normal use.

No damage or alteration to any part of the Seaplane Base photographed can be seen with the exception of possible very slight damage to the Northern end of the hangar. The Base itself is in full operational order.

A row or what appear to be bomb craters to the West of the quarters show in Photograph No. 11.

One of the houses is now only a shell.

R. I. JONES F/O.

Interpretation Officer,
A.I.1(h), Air Ministry.

Distribution:

A.I.3(b) 1
F.O.7 1
File 1

APPENDIX XXIV

SECRET AIR SURVEY OF BELGIAN TERRITORY FOR THE BRITISH

(a) Schedule of XA sorties flown from LILLE/SECLIN 24.1.40 to 17.3.40

Date	Sortie No:	Pilot	Principal points covered	Aircraft	Duration of flight	Flying height	Cameras
19.1.40	001	F/L R.H.NIVEN	LIEGE - MAASTRICHT - WEERT - TONGRES	N.3071	1 hr. 40 mins.	33,000'	5"
12.2.40	002	F/L L.E.CLARK	TIRLEMONT - HUY	N.3071		30,700'	5"
12.2.40	003	F/O W.MILNE	NAMUR - LOUVAIN - ROOSENDALL	N.3117	2 hrs. 25 mins.	31,500'	5"
13.2.40	004	F/L L.E.CLARK	AERSCHOT - GEMBLoux	N.3071	2 hrs. 45 mins.	32,000'	5"
13.2.40	005	F/L R.H.NIVEN	CHARLEROI - MALINES - LIERRE - ANTWERP (E)	N.3117	2 hrs. 0 mins.	31,000'	5"
1.3.40	007	F/O W.MILNE	NAMUR - TIRLEMONT - LOUVAIN	N.3071	2 hrs. 0 mins.	31,500'	8"
2.3.40	008	F/O W.MILNE	HASSELT - HUY	N.3117	2 hrs. 15 mins.	31,500'	8"
2.3.40	009	F/L L.PIPPET	HANNUT - GEET	N.3071	2 hrs. 05 mins.	31,500'	
3.3.40	010	F/O W.MILNE	TONGRES	N.3117	2 hrs. 05 mins.	31,000'	5"
3.3.40	011	F/L L.PIPPET	BRUSSELS - ANTWERP - CHARLEROI - MONS	N.3071	1 hr. 55 mins.	31,500'	5"
3.3.40	012	F/O W. MILNE	SOIGNIES - ALOST - WETTEREN	N.3117	1 hr. 55 mins.	31,000'	8"
4.3.40	013	F/O W. MILNE	GHEENT - FRAMERIES - LOCKEREN	N.3117	1 hr. 55 mins.	31,500'	5"
4.3.40	014	F/L L.PIPPET		N.3071	1 hr. 25 mins.	31,500'	
8.3.40	015	F/O W.MILNE		N.3071	2 hrs. 0 mins.	31,500'	
15.3.40	016	F/O W.MILNE	ROSEDAEL - POPERINGHE - YPRES - COURTRAI - ROULERS	N.3117	2 hrs. 05 mins.	31,500'	8"
15.3.40	017	F/L L.PIPPET	CRESPIN- ETICHOVE	N.3071	1 hr. 25 mins.	31,500'	
16.3.40	019	F/O W.MILNE	BLANKENBERGHE - BRUGES - COURTRAI - TOURNAI - ST.AMAND	N.3117	2 hrs. 05 mins.	31,500'	5"
25.3.40	020	F/O S.L.RING	MAIDEGEM - ABLEIRE - SNEVEGHEM	N.3117	1 hr. 45 mins.	31,000'	5"

(b) Schedule of Belgian Airfields plotted from XA sorties

	Airfields	Sortie and photo. nos.
1.	AELITRE	XA/020, Nos. 10, 11
2.	ANTOING	XA/019, Nos. 91, 92
3.	ANTWERP/DEURNE	XA/011, Nos. 44, 45
4.	BELCELE	XA/012, Nos. 58, 59
5.	BEVERLOO	XA/008, Nos. 66, 67
6.	BRASSCHAFT	XA/007, Nos. 37, 38
7.	BRUSSELS/EVERE	XA/011, Nos. 32, 33
8.	BRUSTEM	XA/008, Nos. 22, 23
9.	BUVRINNES	XA/012, Nos. 6, 7
10.	CAMBON - CASTEAU	XA/012, Nos. 101, 102
11.	CELLES - ESCANAPLES	XA/019, Nos. 86, 87
12.	CHARLEROI (JUMET - GOSSELES)	XA/005, Nos. 100, 101
13.	COURT - ST. ETIENNE	XA/005, Nos. 40, 41
14.	DENDERLEEUEW	XA/012, Nos. 65, 66
15.	GLABBEK	XA/002, Nos. 71, 72
16.	HASSELT (KLEWIT)	XA/010, Nos. 8, 9
17.	LIEGE (BIERSLT - ANANS)	XA/001, Nos. 66, 67
18.	LONZEE (ARTON)	XA/004, Nos. 88, 89
19.	LOUVAIN	XA/006, Nos. 80, 81
20.	MALDEGHEM	XA/020, Nos. 5, 6
21.	GAMEIGNIES	XA/013, Nos. 86, 87
22.	SOIGNIES	XA/012, Nos. 74, 75
23.	STEENOCKERZEEL (SILVENTHEM)	XA/005, Nos. 83, 84
24.	STERREKEN	XA/012, Nos. 39, 40
25.	TIRLEMONT/GOSSONCOURT	XA/007, Nos. 82, 83
26.	URSEL	
27.	VISSENAKEN	XA/007, Nos. 85, 86
28.	WARCOING	XA/019, Nos. 36, 37
29.	YPRES/VLMERTINGHE	XA/016, No. 20
30.	ZWEVEZELLE	XA/019, Nos. 28, 29

APPENDIX XXV

REPORT ON EASTERN FLIGHT (CAUCASIAN OILFIELDS) WITH SPECIAL LOCKHEED

MOST SECRET

1. This aeroplane left Heston at 0930 hours on 23rd March, 1940, with the following personnel on board:-

Commander Boulby
Squadron Leader Macphail
Flying Officer Burton
L.A.C. Bissett
L.A.C. Dickson
Mr. Norrington, Civilian Marconi radio operator.

A stop was made at Bordeaux, and from there we proceeded to Marseilles, where the aircraft and personnel remained over night, as there was not then sufficient time to make Malta in daylight.

2. On Sunday, 24th March, a take-off was made from Marseilles at 0800 hours G.M.T. Malta was reached after four hours flying and a landing made at the new aerodrome. This aerodrome has concrete runways and approximately 1,000 yards in length in all directions.

3. The following day, Monday, 24th March, the flight was continued to Cairo and a landing made at Helwan, instructions having been received at Malta from Headquarters Middle East, to land at this aerodrome in preference to Heliopolis, the reason being that it would be considerably easier to preserve secrecy at Helwan rather than at the latter aerodrome.

4. Tuesday 26th March. In view of the fact that Helwan was too small to permit of a full load take off, the aircraft was flown over empty to Heliopolis and refuelled there, ready for take-off the following day. The rest of the day was spent at Headquarters, Middle East, getting all available information regarding the proposed sorties. Commander Boulby left the flight at this stage.

5. Wednesday, 27th March. The aircraft left Heliopolis for Habbanyeh at 0800 hours. The Suez Canal was crossed at Kantara and from there a direct course was steered to Rutbah, after which the pipe line was followed until Habbanyeh was reached at 1330 hours, local time, after 4 hours, 30 minutes flying. The aircraft was met by Group Captain Walker and immediately placed in the hangar of S squadron. Although the time of arrival had been chosen to coincide with the airmen's dinner hour, there was a considerable crowd of airmen in the vicinity and great difficulty was experienced in restraining them from taking photographs of the aircraft. An office was put at our disposal in "S" Squadron's hangar. Arrangements were then made for the aircraft to be washed down and cleaned, with a view to touching up the paintwork, which by this time had deteriorated considerably.

6. Thursday, 28th March. The R.A.F. markings were removed from the aircraft. This incidentally caused considerable comment, and it is suggested that for any future flight of this nature, the markings should be obliterated at the landing prior to that from which operations are to be carried out. It had been hoped to carry out a trial flight that afternoon, but considerable leaks in the oxygen system made this impossible.

7. Friday, 29th March. The entire piping of the oxygen system had to be removed, and in most places renewed, as owing to the vibration a large number of joints had become loose. This all took some considerable time, but in spite of that a four hour test flight was carried out at

/heights

heights between 15,000 feet to 20,000 feet and everything was found to be satisfactory. All equipment was stowed on the aircraft, cameras tested and arrangements made for Sortie No. 1 to be carried out the following morning.

8. Saturday, 30th March. The aircraft took off from Habbanyeh at 0730 hours with the following personnel on board:-

Squadron Leader Macphail
Flying Officer Burton
L.A.C. Bissett
L.A.C. Dickson

9. A climb was made steadily to 17,000 feet, when it was found necessary to turn on the oxygen, after which we continued climbing until we reached a height of 20,000 feet. The weather conditions were ideal, being completely cloudless, and visibility unlimited. After the first hour's flying, the country became most mountainous and was mainly covered with snow. For the greater part of the flight the effecting a forced landing with any possibility of success would have been impossible.

10. The coast was struck at Alan and we continued a distance of about 15 miles out to sea and then steered due North for Baku. We arrived over Baku at 11.45 hours and did six runs over the target, endeavouring to get an overlap of the entire district. It was difficult from a photographic angle because in both directions of the run there were no points to steer on, as the area in question was a peninsula and in either direction we were flying out to sea.

11. We were, in all, one hour over the objective and no sign of any other aerial activity or anti-aircraft was observed. L.A.C. Dickson, the photographer, was taking oblique photographs from a 14" hand held over the camera through the emergency panel, which had been removed from the side of the aircraft. Eventually, however, the energy he expended in taking these photographs proved too much for him and he collapsed, partly due to the fact that he had removed his oxygen mask. The temperature inside the cabin was minus 200 degrees C. but in the pilot's cockpit no discomfort was experienced.

12. At 1245 hours we left the objective and flew on a straight course for Habbanyeh, landing there at 1645 hours, after nine hours, fifteen minutes flying. It was found that there was approximately 40 minutes petrol left in the aircraft.

13. In all, two vertical films and one oblique film were taken. L.A.C. Dickson, in my presence developed the oblique film and the first vertical film that night, but as I was not satisfied with the results that he was obtaining, and he did not appear to be at all confident in his own ability, I did not allow him to develop the second vertical film. We finished developing at 0130 hours on Sunday morning and as the results, as far as one could see, appeared to be satisfactory, we flew that afternoon to Cairo, landing at Helwan, and handed the films over to the Intelligence Section, Headquarters, Middle East.

14. Headquarters, Middle East, developed at the Photographic Section, Heliopolis, the remaining film overnight, and re-washed the other two negatives and the first batch of contact prints ready for plotting on Monday morning. The oblique negative was marked badly and slightly underexposed. It was found on plotting the verticals that there was a small gap between the black and white towns, owing to the considerable amount of drift having set in which had not been checked.

15. Tuesday, 2nd April. The A.O.C.-in-C. inspected the completed results and after a conference, it was decided that in view of the fact

/that

that we had not sufficient range to reach Grosni from Habbanyeh, and as it was not politic to use any other landing ground, to abandon this sortie and return to Habbanyeh the following day with a view to carrying out Sortie No. 3 i.e. Batum. It was also decided, in the event of this sortie being successful, to fill in the gaps in the Baku area.

16. Wednesday, 3rd April. The aircraft was flown over to Heliopolis, refuelled and then proceeded on to Habbanyeh.

17. Thursday, 4th April. The day was spent in changing over the oxygen bottles which, it is worth mentioning, is a somewhat lengthy process, owing to the fact that each bottle is inter-connected and a very large number of nuts have to be removed, apart from the fact that the piping system is extraordinarily complicated. Camera magazines were loaded and all cameras checked, the aircraft refuelled and all arrangements made for a start on Sortie No. 3 the following morning.

18. Friday, 5th April. We took off with the same personnel as on the previous flight, climbing steadily until a height of 16,000 feet was reached. We then turned on the oxygen. From Mosul onwards there was nine-tenths to ten-tenths cloud about 3,000 feet below us. This cloud continued all the way to Lake Vangolu, where for about a quarter of an hour it was broken to about two-tenths cloud, after which nine-tenths were experienced until we came to within about thirty miles of the coast, when the cloud broke up completely. The mountains around here appeared to be considerably higher than indicated on the maps and although we were flying at 20,000 feet, there did not appear to be more than 4,000 to 5,000 feet clearance between us and the mountains. Just before reaching the coast, I noticed what appeared to be an observation post on the top of one of the mountains. The coast was crossed just south of the Russo-Turkish border and we then flew directly towards Batum. It had been intended to do four runs over the objective, but half-way through the second run I noticed four bursts of anti-aircraft fire about 4,000 feet below us. These immediately followed by three more bursts about 3,000 feet below us, and immediately after by two more bursts approximately 2,000 feet below us. I considered it advisable not to continue with the photography because I thought there might still be a chance if they had not identified the aircraft and, although we had not obtained all the results desired with the vertical camera, it was thought that we had obtained a fairly good line overlap with the oblique. We therefore headed straight back for Habbanyeh. Clouds were considerably higher on the return journey but were broken to about seven tenths just North of Mosul. At Mosul itself they were about four-tenths at 12,000 feet. We landed at Habbanyeh at 1550 hours.

19. Saturday, 6th April. The day was spent in overhauling the machine and packing up, preparatory to returning to Cairo on Sunday, as in view of our previous experience, it had been decided not to attempt any developing at Habbanyeh. An uneventful flight was made to Cairo and the films were handed over to Intelligence Section, Headquarters Middle East, for developing on Sunday evening.

20. Monday and Tuesday, 8th and 9th April, were spent in plotting the results of the two sorties.

21. I had intended to leave for Malta on Tuesday, 9th April but the A.O.C.-in-C. signalled Air Ministry, D. of I., requesting that I might be allowed to remain at Middle East for a further few days, and my departure was therefore delayed pending an answer to this signal.

22. The answer to the signal arrived on Friday, 21st April too late for me to take off that day. I accordingly left Heliopolis aerodrome on Saturday, 13th April for Malta. Malta was reached without any trouble, beyond a momentary failure of the port engine, due, it is thought to carburation trouble.

23. At Malta the Service markings were restored to the aircraft, and on Sunday, 14th April, a take-off was made for Marseilles. In spite of the fact that a signal had been sent from Malta to the R.A.F. Liaison Officer at Marseilles, giving my estimated time of arrival and requesting routing instructions this officer was not present on my arrival and I was unable to trace him. Consequently, it was not possible for me to proceed to England that day. I accordingly delayed my departure until the following morning, Monday 15th April.

24. Marseilles was left at 0930 hours G.M.T. on Monday, and after four hours flying the weather became so bad that I considered it advisable to make a forced landing at Bernay, approximately 30 miles S.W. of Deauville. As no improvement in the weather took place, and the reports which I received from Heston were of an unfavourable nature, I remained there overnight, returning to Heston the following morning, Tuesday, 16th April.

H.C. MACPHAIL

18.4.40.

Squadron Leader.

APPENDIX XXVI

SUCCESSFUL HMA SORTIES FLOWN FROM HESTON, TO JUNE 18th 1940

Naval reconnaissance at first of N.W. German ports only, but later extended to include those of the Low Countries and of Northern France.

Sortie No.	Date	Pilot	Aircraft	Fuelling base	Principal points covered	Duration of flight	Flying height
001	10.2.40	F/L M.V. LONGBOTTOM	N.3069	DEBDEN	EMDEN - WILHELMSHAVEN	3 hrs. 20 mins.	33,000'
002	29.2.40	F/L S.D. SLOOM	Hudson	HESTON	Obliques of N. & S. Shores of MOUTH OF ELBE including CUXHAVEN and BRUNSBUTTEL		0 to 300' approx
003	1.3.40	F/L M.V. LONGBOTTOM	N.3069	STRADISHALL	HELLIGOLAND	3 hrs. 10 mins.	34,000'
004	2.3.40	F/L E.C. LE MESURIER	N.3069	STRADISHALL	WANGEROOG - BORKUM	2 hrs. 30 mins.	32,000'
005	28.3.40	F/L E.C. LE MESURIER	P.9308	HESTON	CUXHAVEN	3 hrs. 45 mins.	32,000'
006	6.4.40	F/L M.V. LONGBOTTOM	P.9308	STRADISHALL	HORNUM - SYLT	3 hrs. 45 mins.	
007	6.4.40	F/L E.C. LE MESURIER	P.9308	HESTON	RÜSTRINGE (WILHELMSHAVEN)	3 hrs. 15 mins.	28,000'
008	7.4.40	F/L M.V. LONGBOTTOM	P.9308	HORSHAM ST. FAITH	KIEL	3 hrs. 50 mins.	33,000'
009	11.4.40	F/L E.C. LE MESURIER	P.9308	HORSHAM ST. FAITH	BORKUM	3 hrs. 05 mins.	36,000'
010	17.4.40	F/L E.C. LE MESURIER	P.9308	HORSHAM ST. FAITH	BORKUM - SPIEKEROOG	3 hrs. 35 mins.	30,000'
011	1.5.40	F/L E.C. LE MESURIER	P.9308	HESTON	Verticals of HELLIGOLAND	3 hrs. 15 mins.	26,000'
012	3.5.40	F/L M.V. LONGBOTTOM	P.9308	HORSHAM ST. FAITH	BORKUM - NORDERNEY	2 hrs. 45 mins.	33,000'
013	6.5.40	F/O S.L. RING	P.9308	HESTON	BORKUM - JULST - NORDERNEY and west coast of BALTRUM	3 hrs. 30 mins.	34,500'
014	10.5.40	F/O S.G. WISE	P.9394	HESTON	HELDEN - SHERMONDIKOOG	3 hrs. 0 mins.	33,500'
015	11.5.40	F/O S.L. RING	P.9394	HORSHAM ST. FAITH	HAARLEM - IJMUUDEN - ALGEMAR - DEN HELDER TEXEL - VLIELAND	1 hr. 50 mins.	31,500'
016	14.5.40	F/O J.H. COLEMAN	P.9394	HESTON	DEN HELDER - TEXEL - South side of TERSCHELLING	2 hrs. 25 mins.	26/31,000'
017	17.5.40	F/O S.G. WISE	P.9308	HESTON	THE HAGUE - AMSTERDAM - IJMUUDEN	3 hrs. 15 mins.	34,000'
018	17.5.40	F/O J.H. COLEMAN	P.9308	HORSHAM ST. FAITH	TERSCHELLING - BORKUM - NORDERNEY	2 hrs. 30 mins.	33,000'
019	18.5.40	F/L L.D. WILSON	P.9308	HORSHAM ST. FAITH	BREMEN - CUXHAVEN - BRUNSBUTTEL - KOOG - HAMBURG	3 hrs. 35 mins.	34,500'
020	18.5.40	F/O D. SHEEN	N.3116	HESTON	LEEUWARDEN - GRONINGEN - EMDEN	3 hrs. 10 mins.	33,500'
021	18.5.40	F/O S.G. WISE	P.9307	HESTON	ROTTERDAM	2 hrs. 30 mins.	33,500'
022	19.5.40	F/L P. CORBISHLEY	P.9310	HORSHAM ST. FAITH	BREMENHAVEN - WILHELMSHAVEN - RÜSTRINGEN	3 hrs. 0 mins.	35,000'
023	26.5.40	F/L E.C. LE MESURIER	P.9331	HESTON	BRUGES CANAL to ZEEBRUGGE	2 hrs. 0 mins.	3 to 6,000'
024	27.5.40	F/O S.G. WISE	N.3116	HESTON	CALAIS - BOULOGNE - MONTEUIL	2 hrs. 15 mins.	31,000'
025	28.5.40	F/O H.P. BLATCHFORD	P.9307	HESTON	ROTTERDAM	2 hrs. 10 mins.	16,000'
026	31.5.40	F/O H.P. BLATCHFORD	N.3116	HESTON	DEN HELDER - DEKOOG	3 hrs. 0 mins.	34,000'
027	2.6.40	F/O P.F. ILLINGWORTH	P.9331	HESTON	West ROTTERDAM - HOOK OF HOLLAND - THE HAGUE	2 hrs. 20 mins.	33,000'
028	2.6.40	F/O H.P. BLATCHFORD	P.9307	HESTON	IJMUUDEN - HAARLEM	2 hrs. 0 mins.	32,500'
029	3.6.40	F/L P. CORBISHLEY	P.9331	STRADISHALL	WILHELMSHAVEN	3 hrs. 0 mins.	33,000'
030	4.6.40	F/O J.H. NICHOLSON	N.3116	HESTON	BRUGES - I. of WALCHEREN - DEN HELDER	3 hrs. 0 mins.	34,000'
031	5.6.40	F/O P.F. ILLINGWORTH	N.3116	HESTON	ROTTERDAM - THE HAGUE - AMSTERDAM	22hrs. 35 mins.	33,000'
032	5.6.40	F/O S.L. RING	P.9307	STRADISHALL	EMDEN - JEVER	3 hrs. 15 mins.	32,500'
033	5.6.40	F/L P. CORBISHLEY	N.3116	HESTON	CALAIS - DUNKIRK - OSTEND	2 hrs. 0 mins.	31/32,000'
034	6.6.40	F/O J.H. NICHOLSON	N.3116	STRADISHALL	EMDEN - WILHELMSHAVEN - NORDERNEY - BORKUM	3 hrs. 0 mins.	33,500'
035	6.6.40	F/O J.H.L. BLOUNT	N.3116	HESTON	ABBEVILLE - BOULOGNE - CALAIS	2 hrs. 5 mins.	31,600'
036	7.6.40	F/O A. HYDE PARKER	N.3116	HESTON (STRAD on way back owing to petrol shortage)	AMSTERDAM - GUTERSLOH - ISERLOHN - ARNSBERG	3 hrs. 22 mins.	34,000'
037	8.6.40	F/L P. CORBISHLEY	P.9313	HESTON	DEKOOG - TEXEL - TERSCHELLING - AMELAND	2 hrs. 40 mins.	32,000'
038	14.6.40	F/O A. HYDE PARKER	P.9307	HESTON (landed small L/G ALDERNEY)	HAVRE North coast towards Dieppe	2 hrs. 10 mins.	32/34,000'
039	18.6.40	F/O J.H.L. BLOUNT	N.3116	HESTON	HAVRE - DIEPPE - BOULOGNE	2 hrs. 15 mins.	32,000'
040	18.6.40	F/O S.G. WISE	P.9313	STRADISHALL	DEN HELDER - TEXEL	2 hrs. 20 mins.	34,000'
041	18.6.40	F/O P.F. ILLINGWORTH	N.3116	HESTON	HEYST - FLUSHING - THE HAGUE - IJMUUDEN	2 hrs. 25 mins.	32,000'
042	18.6.40	F/O J.H. NICHOLSON	P.9385	HESTON	DUNKIRK - S. of OSTEND - FLUSHING - ANTWERP - GHEENT	1 hr. 30 mins.	30,500'
043	18.6.40	F/O S.L. RING	P.9307	HESTON	BOULOGNE - CALAIS	1 hr. 30 mins.	30,500'

APPENDIX XXVII

SUCCESSFUL HAA SORTIES FLOWN FROM ILSTON
TO JUNE 18TH, 1940

Reconnaissance of the Ruhr, the Low Countries and Northern France.

Sortie No:	Date	Pilot	Aircraft	Principal points covered	Duration of Flight	Flying height
010	2.3.40	F/L. R.H. NIVEN	N.3116	KREFELD - MULHEIM - DUISBURG - HAMBORN - GLADBECK - HOMBERG - BOCHUM	3 hrs. 15 mins.	30,000'
011	3.3.40	F/L. E.C. LE MESURIER	N.3116	KEMPEN - GELDERN - DUISBURG - EMERICH - DEVENTER	3 hrs. 20 mins.	
022	18.5.40	F/O. S.L. RING	P.9308	ROTTERDAM - KREFELD - GLADBECK - GELSENKIRCHEN	2 hrs. 45 mins.	33,000'
023	19.5.40	P/O. J.H. NICHOLSON	P.9313	MUNSTER - HILVERSUM - AMERSFOORT	3 hrs. 10 mins.	36,000'
024	19.5.40	F/L. J.A. KENT	P.9331	FLUSHING - ROTTERDAM - THE HAGUE	3 hrs. 15 mins.	33,200'
025	19.5.40	F/O. H.P. BLATCHFORD	N.3116	HOOK OF HOLLAND - HAAMSTEDE	2 hrs. 15 mins.	30,000'
026	20.5.40	F/L. J.A. KENT	P.9310	FOURMIE - FUMY	2 hrs. 10 mins.	33,000'
027	20.5.40	F/L. E.C. LE MESURIER	P.9307	ROTTERDAM - HAAMSTEDE	2 hrs. 30 mins.	32,000'
028	25.5.40	F/O. P.F. ILLINGWORTH	N.3116	BOULOGNE - ABBEVILLE - AMIENS	2 hrs. 20 mins.	32,000'
029	25.5.40	F/O. H.P. BLATCHFORD	P.9307	GRAVELINES - ST. OMER - CARVIN	2 hrs. 20 mins.	31,000'
030	27.5.40	F/O. A.L. TAYLOR	N.3116	NIEUPORT - DUNKIRK - GUINES	2 hrs. 0 mins.	32,500'
031	31.5.40	F/O. S.G. WISE	P.9331	GRAVELINES - BERGUES - FURNES - NIEUPORT	1 hr. 55 mins.	30,000'
032	31.5.40	F/O. S.L. RING	P.9307	S.E. from BOULOGNE - East of Ft. MAHON	1 hr. 40 mins.	15,000'
033	2.6.40	F/O. H.P. BLATCHFORD	N.3116	COAST NORTH OF FT. MARDICK	2 hrs. 05 mins.	31,000'
034	2.6.40	F/O. S.G. WISE	P.9331	ARRAS - HESDIN - MONTREUIL	1 hr. 45 mins.	33,000'
035	3.6.40	F/O. S.L. RING	P.9307	ARRAS - CAMBRAI - ST. QUENTIN - GUISE	2 hrs. 0 mins.	31,500'
036	3.6.40	P/O. J.H. NICHOLSON	N.3116	ABBEVILLE - AMIENS - DOULLEN - LE TORQUET	2 hrs. 05 mins.	34,000'
037	3.6.40	F/O. P.F. ILLINGWORTH	P.9307	AUDENARDE - GHENT	2 hrs. 30 mins.	33,000'
038	4.6.40	F/O. H.P. BLATCHFORD	P.9307	MARLES - ARRAS - DESVRES - RIBEMONT	2 hrs. 15 mins.	33,000'
039	4.6.40	F/L. P. CORBISHLEY	N.3116	R. WAAL from NIMMEGEN	1 hr. 50 mins.	31/32,000'
042	6.6.40	F/O. S.G. WISE	P.9313	S. side of R. SOMME to AMIENS (landed at MEAUX)	2 hrs. 15 mins.	36,000'
043	6.6.40	F/O. A.L. TAYLOR	P.9385	From S.E. to N.W. of LUMBRES	1 hr. 10 mins.	31,000'
045	7.6.40	F/O. H.P. BLATCHFORD	P.9313	AMSTERDAM - RHEINE	1 hr. 30 mins.	34,000'
046	8.6.40	F/O. S.L. RING	P.9313	IJMUIDEN - ARNHEM - COESTFELD	3 hrs. 15 mins.	30,000'
047	9.6.40	P/O. J.H. NICHOLSON	P.9313	VERNON - ANDELYS - LOUVIERS - ELBEUF	2 hrs. 40 mins.	34,000'
048	14.6.40	F/O. A.L. TAYLOR	P.9453	SCHELLINGWOUDE - MUNSTER - RHEINE	1 hr. 40 mins.	5,000'
049	18.6.40	F/O. A.L. TAYLOR	P.9385		3 hrs. 0 mins.	30,000'

APPENDIX XXVIII

HXF SORTIES BY 'B' FLIGHT (212 SQUADRON) NANCY. (Split 8" Cameras)

Sortie	Date	Pilot	A/c	Task	Areas photographed	Flying height	Duration	Serial number of flight
HXF/001	20/4	F/O TAYLOR	N/3071	XF2	TRIER - GEROLSTEIN	34,500'	1 hr. 55 mins	B.15
/002	20/4	F/O TAYLOR	N/3071	XF2	SAARBURG	33,000'	1 hr. 45 mins	B.16
/005	21/4	F/O MILNE	N/3116	XF1	LAKE CONSTANCE - RHINE		3 hrs. 0 mins	B.17
/004	21/4	F/O TAYLOR	N/3116	XF4	NURNBURG - BAMBERG - WURZBURG	33,000'	2 hrs. 45 mins	B.18
/003	22/4	F/O TAYLOR	N/3116	XF1	MERANO	33,000'	2 hrs. 45 mins	B.19
/006	23/4	F/L CLARK	N/3116	XF1	MERANO	33,000'	2 hrs. 50 mins	B.20
/007	7/5	F/L CLARK	N/3116	XF1	BOLZANO - MERANO	33,000'	3 hrs. 05 mins	B.21

DEMANDS BY THE FRENCH

XF1 Brenner Pass and surrounding area
 XF2 Bridges on rivers in area bounded by Moselle, Luxemburg frontier and line
 Prum - Daun - Whittlich
 XF4 River Danube from Frankfurt to Bratislava

APPENDIX XXIX.

212 SQUADRON: SCHEDULE OF SUCCESSFUL SORTIES (OTHER THAN 'X')
APRIL TO JUNE, 1940.

Sortie No.	Date	Pilot	Aircraft	Principal points covered	Duration of flight	Flying height
				<u>FROM LITTE/SECLIN</u>		
HAA/013	7.4.40.	F/O W. MILNE	N.3116	MAINZ - COBLENZ - COLOGNE		33,500'
				<u>FROM NANCY</u>		
HAA/014	7.4.40.	F/O A.L. TAYLOR	N.3071	SPEYER - MANNHEIM - WORMS	1 hr. 50 mins.	32,000'
HAA/015	7.4.40.	F/L L.E. CLARK	N.3071	SPEYER - MANNHEIM	1 hr. 50 mins.	35,500'
HAA/016	19.4.40.	F/L L.E. CLARK	N.3071	VIERNHHEIM	1 hr. 45 mins.	33,000'
HAA/017	19.4.40.	F/O W. MILNE	N.3116	KARLSRUHE and course of RHINE	1 hr. 45 mins.	33,000'
				<u>FROM MEAUX AND VOISIN **</u>		
FAA/002	19.4.40.	F/O C. CRAXTON	P.9313	AACHEN	2 hrs. 0 mins.	32,000'
FAA/003	21.4.40.	F/L DAISH	P.9307	LINNICH - N.W. of AACHEN	2 hrs. 10 mins.	32,000'
FAA/004	21.4.40.	F/O C. CRAXTON	P.9307	MAESSEYCK - MORS	2 hrs. 0 mins.	30,000'
FAA/005	3.5.40.	F/O C. CRAXTON	P.9313	DUREN - DUISBURG - WESSEL	2 hrs. 30 mins.	32,000'
FAA/006	10.5.40.	F/O A.J. BLACKWELL	P.9331	Area S. of LIEGE - MEZIERES	2 hrs. 0 mins.	
FAA/007	10.5.40.	F/L L.D. WILSON	P.9396	MEZIERES - DINAN - NAMUR - LIEGE - MAASTRICHT - ANTWERP	2 hrs. 15 mins.	33,000'
FAA/008	10.5.40.	F/O A.L. TAYLOR	P.9310	MEZIERES - BASTOGNE - R. OURTHE to LIEGE - canal to MAASTRICHT - HERENTHALS - VILVORDE	2 hrs. 05 mins.	35,000'
	(12.5.40.)	F/O A. HYDE PARKER	P.9331	HUY	1 hr. 40 mins.	33,005'
FAA/009-	(12.5.40.)	F/O C. CRAXTON	P.9313	Area W. of MEZIERES	2 hrs. 0 mins.	
013	(13.5.40.)	F/O G.P. CHRISTIE	P.9396	Canal MAASTRICHT to HERENTHALS	-	34/35,000'
	(13.5.40.)	F/L L.D. WILSON	P.9313	-	2 hrs. 25 mins.	
	(14.5.40.)	F/O G.P. CHRISTIE	P.9396	NAMUR - MEUSE to LIEGE - MAASTRICHT	-	32,000'
HAA/018	14.5.40.	F/O A.L. TAYLOR	P.9331	AACHEN - EINDHOVEN - HELMOND	2 hrs. 35 mins.	33,500'
HAA/019	14.5.40.	F/O J.H. NICHOLSON	P.9396	MAESSEYCK	2 hrs. 35 mins.	32,000'
FAA/014	14.5.40.	F/L L.D. WILSON	P.9331	MUNCHEN - GLADBACH - KREFELD - CLEVE	2 hrs. 35 mins.	34,000'
FAA/015	15.5.40.	F/L DAISH	N.3116	MEZIERES - FUMAY - GIVET - DINANT - NAMUR	2 hrs. 20 mins.	33,000'
HAA/020	16.5.40.	F/O A.L. TAYLOR	P.9313	LIEGE - DUSSELDORF - MULLHEIM	2 hrs. 30 mins.	32,000'

APPENDIX XXIX (Continued)

Sortie No.	Date	Pilot	Aircraft	Principle points covered	Duration of flight	Flying height
HAA/021	16.5.40.	F/O G.P. CHRISTIE	P.9313	RUHR (landed HESTON)	3 hrs.20 mins.	32,000'
FAA/016	19.5.40.	F/O A.J. BLACKWELL		ARLON - AISNE E. of SOISSONS (landed MEAUX)	2 hrs. 0 mins.	30,000'
FAA/017	19.5.40	F/O G.P. CHRISTIE	P.9396	CAMBRAI - LE CATEAU - GIVET - DINANT - NAMUR	2 hrs.10 mins.	29,000'
FAA/019	20.5.40	F/O A.J. BLACKWELL	P.9393	GUISE - AVESNES (landed MEAUX)	2 hrs.15 mins.	
FAA/018	21.5.40	F/O G.P. CHRISTIE	P.9313	CHAUNY - RIBEMONT - GUISE (landed COULOMMIERS)	1 hr. 30 mins.	30,000'
FAA/020	24.5.40	F/L L.D. WILSON	P.9313	OUVIER - THUIN - RENNEVILLE (landed MEAUX)	1 hr. 40 mins.	33,500'
FAA/021	24.5.40	F/O G.P. CHRISTIE	P.9313	FOURMIES - CHIMAY	1 hr. 45 mins.	4to10,000'
FAA/022	25.5.40	F/L L.E. CLARK	P.9313	HUY - LA ROCHE - MERTELARKE	2 hrs.05 mins.	14to27,000'
FAA/024	27.5.40	F/O G.P. CHRISTIE	P.9313	LE TOUQUET and COMST N. and S.	1 hr. 50 mins.	2to12,000'
FAA/023	29.5.40	F/O C. CRAXTON	P.9313	HAM	1 hr. 50 mins.	34,000'
FAA/025	31.5.40	F/O A.L. TAYLOR	P.9396	SEDAN - MEZIERES - FUMAY	1 hr. 45 mins.	28,000'
FAA/026	2.6.40	F/L L.D. WILSON	P.9313	MONTHEMER - NOUZONVILLE	1 hr. 20 mins.	34,000'
FAA/027	2.6.40	F/O P.E. BARNES	P.9396	LE CATEAU	1 hr. 25 mins.	32,000'
FAA/026A	3.6.40	F/O A.L. TAYLOR	P.9396	DOULI - DENLIN - AVESNES - VALENCIENNES - FOURMIES - SECLIN CONDE- FUMAY.	2 hrs. 0 mins.	33,500'
FAA/028	3.6.40	F/L J.A. KENT	P.9313	RUMIGNY	1 hr. 10 mins.	31,000'
FAA/029	3.6.40	F/L L.D. WILSON	P.9313	DOULLENS - N. of LAON	2 hrs.10 mins.	34,000'
FAA/030	4.6.40	F/O A.HYDE PARKER	P.9313	CHARLEVILLE - FUMAY - NAMUR	2 hrs. 0 mins.	34,500'
FAA/031	4.6.40	F/L J.A. KENT	P.9331	MONTHEMER - FOURMIES	1 hr. 55 mins.	26to32,000'
FAA/032	4.6.40	F/O G.P. CHRISTIE	P.9331	SEDAN - NEUFCHATEAU - BASTOGNE	2 hrs.05 mins.	32,000'
HAA/041	4.6.40	F/O A.L. TAYLOR	P.9313	BAD KREUZNACH - BINGEN - DIEBRICH - LUDWIGSHAVEN - SPEYER	2 hrs.50 mins.	33,500'
HAA/040	5.6.40	F/O A.L. TAYLOR	P.9385	FOURMIES - DINANT - CHIMAY	2 hrs. 0 mins.	33,000'
FAA/033	5.6.40	F/L L.D. WILSON	P.9313	THUIN - BUVINNE	1 hr. 30 mins.	28to32,000'
FAA/034	5.6.40	F/O G.P. CHRISTIE	P.9331	GUISE - CHARLEROI - LOUVAIN - LIEGE	2 hrs.20 mins.	32,000'
FAA/035	7.6.40	F/L L.D. WILSON	P.9331	LIEGE - CHARLEROI - HAUTMONT	1 hr. 50 mins.	32,000'
FAA/036	8.6.40	F/O A.L. TAYLOR	N.3116	ROERMOND - MENLO - LIEGE - MAASTRICHT R.MEUSE - GUISE - MAUBEUGE	2 hrs.15 mins.	32,000'
FAA/037	8.6.40	F/O C. CRAXTON	N.3116	N. and N.E. of SOISSONS	2 hrs.15 mins.	

APPENDIX XXIX (Continued)

Sortie No.	Date	Pilot	Aircraft	Principle points covered	Duration of flight	Flying height
FAA/038	10.6.40	F/L J.A. KENT	N.3116	<u>FROM ORLEANS/BRICY</u>	2 hrs.10 mins.	30,000'
FAA/039	11.6.40	F/O A.L. TAYLOR	N.3116	ST.GERMAIN - VERNON - ELBOEUF VERNON	1 hr. 30 mins.	5,500'

APPENDIX XXX

I X F A SORTIES

Reconnaissance of Italy as far south as Naples and of Sardinia from bases in the South of France and Corsica, mainly prior to the entry of Italy into the war (10/6/40)

Sortie No:	Date	Pilot	Aircraft	Departure from	Principal points covered	Duration of flight	Flying height	Cameras
001	12.5.40	F/L M.V. LONGBOTTOM	P.9310	LE LUC	GENOA - SAVONA - IMPERIA - BORDIGHERA	1 hr. 30 mins.	30,000'	Split 8"
002	12.5.40	F/L E.C. LE MESURIER	P.9310	LE LUC	LIVORNO - PISA	1 hr. 55 mins.	28,000'	Split 8"
003	13.5.40	F/L M.V. LONGBOTTOM	P.9310	LE LUC	ITALIAN frontier from MENTONE to LARCHES	1 hr. 15 mins.	29,000'	Split 8"
004	13.5.40	F/L E.C. LE MESURIER	P.9310	LE LUC	ITALIAN frontier from MENTONE to LARCHES	1 hr. 30 mins.	29,000'	Split 8"
005	13.5.40	F/L M.V. LONGBOTTOM	P.9310	LE LUC	TURIN - MODANE railway	1 hr. 50 mins.	27,000'	Split 8"
006	14.5.40	F/L E.C. LE MESURIER	P.9308	LE LUC (landed CORSICA)	MILAN - CATANO	2 hrs. 40 mins.	30,000'	Split 8"
007	14.5.40	F/L M.V. LONGBOTTOM	P.9308	BASTIA	BARI	3 hrs. 0 mins.	30,000'	Split 8", Eagle 20"
008	28.5.40	F/L E.C. LE MESURIER	P.9385	LE LUC	SPEZIA	1 hr. 50 mins.	29,000'	Split 8", Eagle 20"
009	31.5.40	F/O D. SHEEN	P.9385	LE LUC	CUNEO - TURIN	1 hr. 45 mins.	30,000'	Split 8", Eagle 20"
010	31.5.40	F/L E.C. LE MESURIER	P.9385	LE LUC	CUNEO - RIVOLI	29 to 30,000'	30,000'	Split 8", Eagle 20"
011	1.6.40	F/O D. SHEEN	P.9385	LE LUC	TURIN - VERCELLI - NOVARA		30,000'	Split 8", Eagle 20"
012	3.6.40	F/L E.C. LE MESURIER	P.9310	LE LUC	MENTONE - POZZOLO - SPEZIA	2 hrs. 10 mins.	30,000'	Split 8"
013	3.6.40	F/O D. SHEEN	P.9310	LE LUC	MENTONE	2 hrs. 0 mins.	30,000'	Split 8"
014	3.6.40	F/L E.C. LE MESURIER	P.9310	LE LUC	PIEMONTE	1 hr. 25 mins.	30,000'	Split 8"
015	4.6.40	F/O D. SHEEN	P.9310	LE LUC	STRAMBINO - MILAN - MONDOVI - BERGAMO	2 hrs. 35 mins.	30,000'	Split 8"
016	4.6.40	F/L E.C. LE MESURIER	P.9310	LE LUC	AOSTA - VALLEY OF AIP	1 hr. 40 mins.	30,000'	Split 8"
017	5.6.40	F/O D. SHEEN	P.9310	LE LUC	LEGHORN - FLORENCE	1 hr. 30 mins.	30,000'	Split 8"
018	6.6.40	F/L E.C. LE MESURIER	P.9310	LE LUC	TERRANOVA - RIZZICONI - MADALUNA	3 hrs. 0 mins.	29,000'	Split 8"
019	8.6.40	F/O D. SHEEN	P.9310	AJACCIO	POSEIDA - NAPLES - FORMIA	2 hrs. 30 mins.	30,000'	Split 8"
020	8.6.40	F/L E.C. LE MESURIER	P.9310	AJACCIO	CAGLIARI	1 hr. 40 mins.	29,000'	Split 8"
021	10.6.40	F/O G.P. CHRISTIE	P.9385	AJACCIO	FORMIA - NAPLES	2 hrs. 35 mins.	29,500'	Split 8", Eagle 20"
022	11.6.40	F/O D. SHEEN	P.9310	AJACCIO (landed LE LUC)	ALGHERO - CAGLIARI - TERRANOVA	2 hrs. 20 mins.	30,000'	Split 8"
023	11.6.40	F/L E.C. LE MESURIER	P.9385	AJACCIO (landed LE LUC)	CUNEO - LEGHORN	2 hrs. 30 mins.	30,000'	Split 8", Eagle 20"
024	11.6.40	F/O G.P. CHRISTIE	P.9310	LE LUC	MILAN - TURIN - CLOVR	1 hr. 50 mins.	30,000'	Split 8"
025	12.6.40	F/O D. SHEEN	P.9385	LE LUC (landed HYERES)	SPEZIA	2 hrs. 0 mins.	6,000'	Split 8", Eagle 20"
026	13.6.40	F/O G.P. CHRISTIE	P.9385	LE LUC (landed HYERES)	GENOA - SAVONA	1 hr. 50 mins.	15,000'	Split 8", Eagle 20"
027	15.6.40	F/O D. SHEEN	P.9385	LE LUC (landed HYERES)	SPEZIA - PISA - GENOVA	1 hr. 40 mins.	27,000'	Split 8", Eagle 20"

APPENDIX XXXI

Officer Commanding,
P.D.U.,
Heston.

First Priority

Admiralty want:

Photographs of the Rhine from a point just above Karlsruhe down to Maintz, or as far down to that point as possible.

Mines have been dropped into tributaries above Karlsruhe, which it is hoped will have

- (i) Damaged a boom at Karlsruhe, and
- (ii) Done damage to river shipping between Karlsruhe and Maintz.

Admiralty state that the last run done of this objective by P.D.U. (? about three weeks ago):

- (i) Missed the actual line of the river,
- (ii) Photographs were not very clear,
- (iii) Were of a scale too small to reveal damage.

NOTE: 5th Sea Lord very pleased with Genoa job. It seems possible that had the Rhine photographs been of equal sharpness and clearness, they would have afforded the information he wants.

Concerning the Genoa job now laid on, 5th Sea Lord is most anxious that rush copies of prints should reach Naval Officer Commanding at Hyeres at the earliest possible moment.

Photographs subjected to Wild machine can follow later.

It is therefore requested that photographs be developed and printed either in France or in England, according to whichever secures most rapid initial delivery.

(Signed) H.L. COOPER.

Wing Commander.

A.I.8.
26th May, 1940.

APPENDIX XXXII

ACTIVITIES OF P.D.U. AND P.R.U. : JUNE 19TH - OCTOBER 31st, 1940

SPITFIRES

	HESTON			ST. EVAL			WICK			TOTAL P.R.U.		
	Flying Days	Sorties	Successes	Flying Days	Sorties	Successes	Flying Days	Sorties	Successes	Flying Days	Sorties	Successes
June 19th/30th	11	31	24							11	31	24
July	29	77	57	23	36	26	14	18	9	66	131	92
August	29	109	93	19	25	23	13	20	13	61	154	129
September	30	121	98	28	39	27	12	12	7	70	172	132
October	24	88	61	27	60	33	13	14	8	64	162	102
TOTALS	<u>123</u> 135	426	333	<u>97</u> 123	160	109	<u>52</u> 123	64	37	<u>272</u> 481	650	479

HUDSONS

	HESTON		ST. EVAL		WICK		TOTAL P.R.U.	
	Sorties	Successes	Sorties	Successes	Sorties	Successes	Sorties	Successes
June 19th/30th					(1 1)	(LEUCHARS 1)	1	1
July	1		2	2			3	2
August	3		5	2	1		9	2
September	5	2	5	3	1	1	11	6
October			7	2			7	2
TOTALS	9	2	19	9	3	WICK AND LEUCHARS 2	31	13

Total sorties by Spitfires and Hudsons: 681, of which 492 were successful.

APPENDIX XXXIII

Table showing proportions of successful sorties flown by Spitfires of P.D.U. and P.R.U. at different altitudes between mid-June and October, 1940

	<u>Low</u> <u>Altitude:</u> 50-10,000'	<u>Medium</u> <u>Altitude:</u> 10,000-21,000' (mainly 16,000-21,000')	<u>High</u> <u>Altitude:</u> 27,000-35,000' but mainly from 28,000-32,000'	Total
June 19th - 30th	-	1 (4%)	23 (96%)	24
July	4 (4%)	1 (1%)	87 (95%)	92
August	10 (8%)	1 (1%)	118 (91%)	129
September	20 (15%)	5 (4%)	107 (81%)	132
October	15 (15%)	2 (2%)	85 (83%)	102
Total	49 (10%)	10 (2%)	420 (88%)	479

APPENDIX XXXIV

(Information from Form 540)

Air-raid damage to P.R.U. and P.I.U: August-October, 1940

P.R.U.. HESTON

August 26th 00.20 hrs. H.E. bombs of small calibre dropped behind the Cranford billets, breaking window glass.

September 12th Two A.A. shells hit the aerodrome, one passing through the meteorological office and bursting in the officers' mess, the other hitting the main hangar and damaging an aircraft.

17th 00.45 hrs. One enemy aircraft dropped a stick of 9 bombs - seven H.E. and two petrol - across the aerodrome. The largest fell on tarmac outside the main hangar, which was slightly damaged.

18th 21.30 hrs. An enemy aircraft dropped between 50/100 incendiary bombs on the eastern half of the airfield. "The incendiary bombs were extinguished by airmen with blankets and A.R.P. workers with spades. At one time there was a serious danger of the grass fires spreading to dispersed aircraft".

19th 22.48 hrs. "Enemy aircraft appeared to circle the aerodrome above the clouds, then made off in a westerly direction. Approximately 5 mins. later an explosion took place on the tarmac outside the main hangar. This was caused by a magnetic mine dropped by parachute". Although no casualties were sustained, the main hangar was demolished by blast from the mine which fell only 15 yards away, and damage was caused to five Spitfires, a Wellington, a Hudson and ten other aircraft. The damage was inspected by the A.O.C.-in-C. Coastal Command (September 20th), the Duke of Kent (September 23rd) and H.M. the King (September 24th).

25th 23.25 hrs. A large H.E. bomb dropped immediately outside the N.W. corner of the aerodrome caused slight damage to a Tiger-Moth aircraft.

* According to a minute addressed to the C.A.S. by the Director of Naval Operations, Air Ministry, on September 24th, 1940, only four operational Spitfires were damaged and all were estimated to be serviceable again in a week's time.

D. of Ops.(N.C.) folder N. 59 (AHB IIR/36/59(1)/31).

P.R.U. HESTON (CONTD.)

October	12th	00.30 hrs.	An H.E. bomb fell on a building outside the aerodrome, occupied by the Photographic Section.
	14th	20.30 hrs.	Four H.E. and two d/a bombs were dropped in the field south of the aerodrome; the wooden huts occupied by the Photographic Intelligence and Map Sections were pierced and strained.
		21.30 hrs.	Two petrol bombs were dropped within the western boundary of the aerodrome, but did no damage.
	16th	03.30 hrs.	Two incendiary bombs fell on the aerodrome. No damage.
		19.45 hrs.	Three H.E., one delayed action and a number of incendiaries landed on the aerodrome. The Photographic and Equipment Sections were badly damaged and one Spitfire was severely damaged.
	17th	19.40 hrs.	Eight bombs were dropped by an enemy aircraft, five landing on the aerodrome. A Hudson aircraft was damaged.
	27th	02.35 hrs.	One heavy H.E. bomb landed on the aerodrome, but caused no damage.
	29th	03.00 hrs.	One of a stick of three H.E. bombs fell at the eastern end of the hangar buildings, causing a crater 60' wide and 30' deep. Some M/T and other apparatus was destroyed and gas and water mains were damaged.

P.R.U. ST. EVAL

August	21st	c. 14.00 hrs.	Two hangars damaged by bombs.
	22nd	(dusk)	Incendiary and delayed action bombs dropped. Four of the d/a bombs hit a hangar, one damaging the airscrew and wing of a Hudson aircraft.
	23rd	(night)	Further bombing, but no damage.
October	3rd	07.00 hrs.	Aerodrome bombed and machine-gunned. Hangar destroyed, but no damage to P.R.U. aircraft.
	9th	20.00 hrs.	Single enemy aircraft dropped bombs on Officers' mess and tennis court. No damage to P.R.U. aircraft.
	12th	08.30 hrs.	Stick of bombs dropped across bomb dump. Barrack block partially demolished.

/P.I.U.

P.I.U. WEMBLEY

October 2nd 00.15 hrs. P.I.U. Wembley attacked by a single enemy aircraft. Two or three oil bombs dropped. Interpretation School hut destroyed. One Station Policeman killed while standing outside dug-out and two other aircraftsmen treated for shock.

17th 19.40 hrs. Two H.E. bombs fell, one of which did "severe damage to Paduoc House in almost every department".

APPENDIX XXXV.

U-BOAT PROGRAMME AS REVEALED BY AIR-PHOTOGRAPHY

(a) Numbers of U-Boats under construction^m

Date	C.I.U. Reports Numbers	U-Boats on ships.	U-Boats fitting out	Total	Remarks
March 1941.	R.D. 39	106	12	118	Including yards as far east as Stettin.
April 1941.	R.D. 57	120	24	144	Increase due in part to better photographs of Hamburg.
Sept. 1941	A. 40	158	53	211	
June 1942	A.132	204	61	265	Including Danzig (21 on slips; 8 fitting out) for the first time
Sept. 1942	S. 4	188	62	250	
March 1943	S.22	206	54	260	
June 1943	S.39	210	64	274	
Aug. 1943	S.51	213	64	277	
Sept. 1943	S.58	209	60	269	
Mid-Feb. '44	S.70	141	approx 60	201	
End-Feb. 1944	S.74	107 + New programme: 1 prefabricated 1 small	56 + New programme: nil.	163 + New programme 2	
May 1944	S.91	64 + New programme: 10 prefabricated 7 small	41 + New programme: 3 prefabricated 1 small.	105 + New programme: 21	

^m Note: Where numbers quoted in the original reports have been modified in subsequent reports, the latter have been followed.

(b) Numbers of U-Boats completed

Old programme:	Prior to Sept. 1941.	Sept. 1941- Sept. 1942.	Sept. 1942- Sept. 1943.	Sept. 1943- Feb. 1944.	March 1944- May 1944.	May 1944- Sept. 1944.	Sept. 1943- Sept. 1944.	Totals
1600 ton 290' (Minelayer and supply)	-	5	2	1	1			
1600 ton 216' (Supply: Broad-beamed)	-	8	6	-	-			
1200 ton	1	10	15	9	4			
740/50 ton	31	51	51	22	12			
500 ton	115	169	198	90	41			
250/300 ton (Training)	10	-	-	-	-			
Total (Old programme)	157	243	272	122	58			
New programme: Prefabricated 240'	-	-	-	-	-			
Small (97')	-	-	-	-	1 (?)			
Total (New programme)	-	-	-	-	1 (?)			

PHOTOGRAPHIC RECONNAISSANCE

(WINTER 1940)

